ELECTRONICS & INSTRUMENTATION ENGINEERING

SCHEME OF INSTRUCTION

AND

SYLLABUS

B. Tech.

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous, ISO 9001:2008 Certified Institution)
(Approved by AICTE, Accredited by NAAC with 'A' Grade, Affiliated to JNTUK, Kakinada)
(Sponsored by Siddhartha Academy of General & Technical Education)
Kanuru, Vijayawada
Andhra Pradesh - 520007, INDIA.

Velagapudi Ramakrishna Siddhartha Engineering College
Department of Electronics & Instrumentation Engg.
Scheme of Instruction and Examination – VR14

First Year – 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	14CH1102	Engineering Chemistry	3	1		3	30	70	100
3	14CS1103	Introduction to Computing	2			2	30	70	100
4	14CE1104	Basics of Civil Engineering	2			2	30	70	100
5	14HS1105	Professional Ethics	2			2	30	70	100
6	14ME1106	Basics of Mechanical Engineering	2			2	30	70	100
7	14ME1107	Mechanics for Engineers	4	1		4	30	70	100
8	14CH1151	Engineering Chemistry Lab			3	2	30	70	100
9	14CS1152	Basic Computing Lab			3	2	30	70	100
10	14ME1153	Workshop Practice			3	2	30	70	100
		Total	**19**	**3**	**9**	**25**	**300**	**700**	**1000**

First Year – 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	14PH1202	Engineering Physics	3	1		3	30	70	100
4	14CS1203	Programming in C	3	1		3	30	70	100
3	14HS1204	Technical English and Communication Skills	2		2	2	30	70	100
5	14EE1205	Basics of Electrical Engineering	2			2	30	70	100
6	14EC1206	Basics of Electronics Engineering	2			2	30	70	100
7	14ME1207	Engineering Graphics	2		6	5	30	70	100
8	14PH1251	Engineering Physics lab			3	2	30	70	100
9	14CS1252	C Programming Lab			3	2	30	70	100
		Total	**18**	**3**	**14**	**25**	**270**	**630**	**900**

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

Velagapudi Ramakrishna Siddhartha Engineering College
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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	14EI3302	Electronic Devices and Circuits	4			4	30	70	100
3	14EI3303	Network Theory	3	1		3	30	70	100
4	14HS1304	Environmental Studies	3			3	30	70	100
5	14EI3305	Sensors and Transducers	4			4	30	70	100
6	14EI3306	Digital Circuits and Systems	4	1		4	30	70	100
7	14EI3351	Electronic Devices and Digital Electronics Lab			3	2	30	70	100
8	14EI3352	Transducers Lab			3	2	30	70	100
		Total	**22**	**3**	**6**	**26**	**240**	**560**	**800**

Semester IV

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EI3401	Electrical and Electronic Measurements	4	1		4	30	70	100
2	14EI3402	Analog Electronic Circuits	3	1		3	30	70	100
3	14EI3403	Industrial Instrumentation	4			4	30	70	100
4	14EI3404	Signals and Systems	3	1		3	30	70	100
5	14EI3405	Electrical Technology	3	1		3	30	70	100
6	14EI3406	Computer Organization	3			3	30	70	100
7	14EI3451	Measurements Lab			3	2	30	70	100
8	14EI3452	Electrical Engineering Lab			3	2	30	70	100
9	14HS1453	Communication Skills Lab			2	2	30	70	100
		Total	**20**	**4**	**8**	**26**	**270**	**630**	**900**

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

Velagapudi Ramakrishna Siddhartha Engineering College
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Semester V

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	T
1	14EI3501	Control Systems	3	1		3	30	70	100
2	14EI3502	Integrated Circuits and Applications	3	1		3	30	70	100
3	14EI3503	Microcontrollers and Applications	3	1		3	30	70	100
4	14EI3504	Digital Signal Processing	3	1		3	30	70	100
5	14EI2505	Institutional Elective	4			4	30	70	100
	14EI2505/1	Basics of Instrumentation Engineering	4			4	30	70	100
	14EI2505/2	Biomedical Instrumentation	4			4	30	70	100
	14EI2505/3	Process Control Instrumentation	4			4	30	70	100
	14EI2505/4	Basics of Industrial Automation	4			4	30	70	100
6	14EI5506	Independent Learning (Moocs)	3			3	30	70	100
	14EI5506/1	Industrial Safety and Environmental Management	3			3	30	70	100
	14EI5506/2	Analog Signal Conditioning in Instrumentation	3			3	30	70	100
7	14EI3507	Analytical Instrumentation	3			3	30	70	100
8	14EI3551	Integrated Circuits Lab			3	2	30	70	100
9	14EI3552	Microcontrollers Lab			3	2	30	70	100
		Total	**22**	**4**	**6**	**26**	**270**	**630**	**900**

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

Velagapudi Ramakrishna Siddhartha Engineering College
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Semester VI

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	T
1	14EI3601	Virtual Instrumentation	4			4	30	70	100
2	14EI3602	Industrial Electronics	3	1		3	30	70	100
3	14EI3603	Industrial Communication Networks	4			4	30	70	100
4	14HS1604	Engineering Economics and Finance	3			3	30	70	100
5	14EI3605	Process Control	4			3	30	70	100
6	14EI3651	Virtual Instrumentation Lab			3	2	30	70	100
7	14EI3652	Process Control Lab			3	2	30	70	100
8	14EI3653	Term Paper		2		2	30	70	100
		Total	**18**	**3**	**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
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Scheme of Instruction and Examination – VR14
Semester VII

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	T
1	14EI3701	Robotics & Control	3			3	30	70	100
2	14EI3702	Computer Control of Processes	3			3	30	70	100
3	14EI3703	Industrial Automation	4			4	30	70	100
4	14EI3704	Embedded Systems	3			3	30	70	100
5	14EI4705	Program Elective – I	4			4	30	70	100
	14EI4705/1	Advanced Digital System Design							
	14EI4705/2	Fiber Optic Sensors							
	14EI4705/3	Process Modeling and Simulation							
	14EI4705/4	Digital Image Processing							
6	14EI4706	Program Elective – II	4			4	30	70	100
	14EI4706/1	Electromagnetic Interference and Electromagnetic Compatibility							
	14EI4706/2	Measurement and Control in Food Processing							
	14EI4706/3	Wireless Sensor Networks							
	14EI4706/4	Internetworking							
7	14EI3751	Programmable Logic Controllers Lab			3	2	30	70	100
8	14EI3752	Embedded Systems Lab			3	2	30	70	100
9	14EI6753-1 14EI6753-2	Internship/ Industry offered Course	2			2			100
10	14EI5754	Mini Project		1	2	2	30	70	100
		Total	**23**	**1**	**8**	**29**	**270**	**630**	**1000**

L – Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester-end Evaluation, T – Total Marks*** Two credits are added in 7th semester.

Velagapudi Ramakrishna Siddhartha Engineering College
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Semester VIII

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	T
1	14EI3801	Bio-Medical Instrumentation	4			4	30	70	100
2	14EI4802	Program Elective – III	3			2	30	70	100
	14EI4802/1	Nanotechnology							
	14EI4802/2	Power Plant Instrumentation							
	14EI4802/3	Intelligent Systems and Control							
	14EI4802/4	ARM System on Chip							
3	14EI4803	Program Elective – IV	3			2	30	70	100
	14EI4803/1	VLSI Design							
	14EI4803/2	Instrumentation and Control in Paper Industries							
	14EI4803/3	Optimal and Non Linear Control Systems							
	14EI4803/4	Internet of Things							
4	14EI3851	Advanced Instrumentation Lab			3	2	30	70	100
5	14EI5852	Major Project	2	4	12	10	30	70	100
		Total	**12**	**4**	**15**	**20**	**150**	**350**	**500**

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

First year
(I Semester)

14MA1101 – Linear Algebra and Differential Equations

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 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 concept of Rank of Matrix, Nature of solution of system of linear equations (consistent or inconsistent) and able to find eigen values and eigen vectors, able to find inverse of a matrix and able to reduce a quadratic form to canonical form.											
	CO2	Able to solve the linear differential equations by using appropriate methods.											
	CO3	Able to form Partial Differential equations and solve Partial Differential equations.											
	CO4	Understand the concept of Laplace Transforms and able to apply to solve Differential Equations, Integral Equations by Transform method.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(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	H											
	CO3	H											
	CO4	H	L										
Course Content	**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 Orde**r**:** Formation of a Differential Equation, Solution of a Differential Equation, Linear Equations, Bernoulli's Equation, Exact Differential Equations, Equations Reducible to Exact Equations, Orthogonal Trajectories, Newton's Law of Cooling, Rate of Decay of Radio-Active Materials. **Linear Differential Equations of Higher Order**: Definitions, Operator D, Rules for Finding the Complimentary Function, Inverse Operator, Rules for finding Particular Integral, Working Procedure to Solve the Equation. **UNIT - III** 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, ivision 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" XXXXIInd ed., Khanna Publishers, 2012. **Reference books:** [1] Kreyszig, "Advanced Engineering Mathematics" VIIIth ed., JohnWiley & Sons. [2] Peter V.O.Neil, "Advanced Engineering Mathematics" Thomson. [3] R.K.Jain & S.R.K.Iyengar, "Advanced Engineering Mathematics", IIIrd ed. Narosa Publishers. [4] N.P.Bali & Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications (P) Limited. [5] B.V.Ramana, "A Text Book of Mathematics" Tata MC Graw Hill.
E-resources and other digital material	http://www.nptel.iitm.ac.in

14CH1102 – Engineering Chemistry

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	Analyze various water treatment methods and boiler troubles.											
	CO2	Apply the knowledge of different phases in materials, working principle of electrodes and batteries and their application in chemical and other engineering areas.											
	CO3	Evaluate corrosion processes as well as protection methods and apply the principles of UV-visible spectroscopy in chemical analysis.											
	CO4	Apply the knowledge of nature of polymeric materials for their application in technological fields and of fuels for their conservation.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		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		H										
	CO4	L											

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 conditioning 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, and 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, LixC/LiCoO2 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, numerical (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, thermoplastics and thermosettings - conducting polymers - examples, classification intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped, p-doped and n-doped polyacetylenes – applications of conducting polymers, Fibre reinforced plastics (FRP) - composition and applications. **Fuel Technology:** Fuels - classification, calorific value, coal – proximate analysis and ultimate analysis, Petroleum - refining, concept of knocking, octane number and cetane number, flue gas analysis by Orsat's apparatus and numericals based on combustion.
Text books and Reference books	**Text book:** [1] P.C. Jain, "Engineering Chemistry" XVth ed. Dhanpat Rai Publishing Company (P) Limited. **Reference books:** [1] S.S. Dara, "A Text Book of Engineering Chemistry", Xth ed., S. Chand & Company Limited. [2]Shashi Chawla, " A Text Book of Engineering Chemistry", Dhanpat Rai & Company Pvt. Ltd. [3]Sunita Rattan, "A Textbook of Engineering Chemistry", Ist ed. S.K. Kataria & Sons, 2012. [4]B.S. Bahl, G. D. Tuli & Arun Bahl, "Essentials of Physical Chemistry", S. Chand and Company Limited. [5] Y.Anjaneyulu, K. Chandrasekhar & Valli Manickam, "Text book of Analytical Chemistry", Pharma Book Syndicate. [6]O. G. Palanna, "Engineering Chemistry", Tata McGraw Hill Education Pvt.Ltd.
E-resources and other digital material	[1] http://www.cip.ukcentre.com/steam.htm [2] http://corrosion-doctors.org/Modi;es/mod-basics.htm [3] http://chemwiki.ucdavis.edu/Analytical Chemistry.htm [4] http://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/uvvisabl.htm [5] http://www.prenhall.com/settle/chapters/ch15.pdf

14CS1103 – Introduction to Computing

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	-	**Continuous Evaluation:**	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	Analysis input and output devices, different types of memories.											
	CO3	Classify different functions of operating system and the types of operating systems.											
	CO4	Understand types of networks and most common ways of transmitting data via networks and internet.											
	CO5	Know the basics of computerized data bases and data base management system.											
	CO6	Identify the ways in which a program can work towards a solution by using some processes and tools.											
	CO7	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											
	CO2	L											
	CO3					L							
	CO4	L											
	CO5					L							
	CO6		H										
	CO7		H										
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 machine, 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, and 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 networks. **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, Hardware/ Software interaction, Code, machine code, programming languages, Compilers and interpreters, planning a computer program, How programs solve problems, Purpose of flowcharts and algorithms, flow chart symbols, drawing flow charts, developing algorithms.
Text books and Reference books	**Text books** [1] Peter Norton, "Introduction to Computers", VIth ed., Tata McGraw Hill. [2] Reema Thareja, "Computer Fundamentals and C Programming".
E-resources and other digital material	[1] Prof.S. Raman, "Lecture Series on Computer Organization", Department of Computer Science and Engineering, IIT Madras. https://www.youtube.com/watch?v=leWKvuZVUE8 [2] Prof.A. Pal, "Lecture Series on Data Communication" Department of Computer Science Engineering, IIT Kharagpur. https://www.youtube.com/watch?v=sG6WGvzmVaw

14CE1104 – Basics of Civil Engineering

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2- 0 - 0
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	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 masonry's, sub-structure and super structure of a building.											
	CO3	Attain basic knowledge on principles of supervising, various types of surveying and various types of transportation systems.											
	CO4	Attain basic knowledge on water supply, sewage.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		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	L											
	CO3	L											
	CO4	L											
Course Content	**UNIT – I** **Building Materials:** Introduction - Civil Engineering - Materials: Bricks – composition - classifications - properties -uses. Stone - classification of rocks – quarrying - dressing - properties -uses. Timber - properties -uses -ply wood. Cement - grades -types - properties -uses. Steel - types - mild steel - medium steel – hard steel - properties - uses - market forms. Concrete - grade designation – properties - uses. **UNIT - II** **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.												

Text books and Reference books	**Text books** [1] Raju .K.V.B, Ravichandran .P.T, ”Basics of Civil Engineering”, Ayyappa Publications, 2012. [2] Rangwala .S.C, “Engineering Materials”, Charotar Publishing House, 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.
E-resources and other digital material	[1] ncees.org/exmas/fe-exma/ [2] www.aboutcivil.com/

14HS1105 – Professional Ethics

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2- 0 - 0
Prerequisites:	-	**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	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								L				
	CO2								L				
	CO3								H				
	CO4			L									

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 - occupational 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).
Text books and Reference books	**Text books** [1] Mike Martin & Roland Schinzinger," Ethics in Engineering", McGraw Hill, 1996. [2] Govindarajan. M, Natarajan S, & Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, 2004. **Reference books** [1] Baum, R.J. & Flores, A., "Ethical Problems in Engineering", Center for the study of the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute, Troy, 1978. [2] Beabout, G.R., Wennemann, D.J.,"Applied Professional Ethics A Developmental Approach for Use with Case Studies", University Press of America Lanham, 1994.
E-resources and other digital material	--

14ME1106 – Basics of Mechanical 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	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											
	CO2	L											
	CO3							L					
	CO4		L										
	CO5	L											

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	**Text books** [1] T S Rajan, "Basic Mechanical engineering", IIIrd ed ,New Age International Ltd, 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", IVth ed, ,Tata McGraw-Hill publishing Company Ltd, 2003. [2] R.K. Rajput, "Manufacturing Process", Firewall media, 2007. [3] P.K.Nag "Power Plant Engineering", Tata McGraw-Hill Publishing Company Ltd, 2011.
E-resources and other digital material	[1] www.engliblogger.com/mechanical/mechan [2] www.indiastudychannel.com/resources

14ME1107 – Mechanics for Engineers

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 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	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		L										
	CO2	L											
	CO3		L										
	CO4		H										
	CO5	L											
	CO6		L										
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, Coefficient 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, Equations of Dynamic Equilibrium: D'Alembert's Principle. Work and Energy Principle, Conservation of energy principle, Impulse and Momentum principle, Impact-Direct central Impact.												

	UNIT - IV **Kinematics Of Curvilinear Motion** - Introduction, rectangular Components of velocity & 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 Reference books	**Text books** [1] A.K.Tayal "Engineering Mechanics Statics and dynamics", XIIIth ed, Umesh Publication, 2006.(For numerical Problems using S.I.Systemv of Units). [2] S.Timoshenko, D.H.Young, J.V.Rao & Sukumar Pati, "Engineering Mechanics" Vth ed, Mc Graw Hill Education (India) Pvt Ltd,2013. (For Concepts and symbolic Problems using S.I.System of Units). **Reference books** [1] Beer & Johnston, "Vector Mechanics for Engineers Statics and Dynamics" IIIrd ed, Tata McGraw Hill Publishing Company, 2010. [2] SS Bhavikatti & KG Rajasekharappa, "Engineering Mechanics" IVth ed, New Age International Private Limited, 2012. [3] K.Vijaya Kumar Reddy and J Suresh Kumar, "Singer's Engineering Mechanics Statics and Dynamics" IIIrd ed, BS Publications, 2010. [4] Andrew pytel & Jaan Kiwsalaas, "Engineering Mechanics: Statics and Dynamics" IIIrd edition, Cengage Learning, 2013.
E-resources and other digital material	[1]http://openlibrary.org/books/OL22136590M/Basic engineering mechanics [2] http://en.wikibooks.org/wiki/Engineering Mechanics [3] http://nptel.iitm.ac.in/video.php?courseId=1048 [4] http://imechanica.org/node/1551 [5] http://emweb.unl.edu/ [6] http://ebooks-freedownload.com/2009/11/engineering-mechanics-statics-12 .html [7] http://www.ebookee.com/Engineering-Mechanics-Statics 37859.html

14CH1151 – Engineering Chemistry Lab

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

	Upon successful completion of the course, the student will be able to:												
Course outcomes	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			L	H								
	CO2				H								
	CO3				L								
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 AgNO3 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 K2Cr2O7 solution b. Estimation of Mohr's salt 7. Determination of Mohr's salt - Permanganometry a. Standardization of KMnO4 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", IInd ed., Dhanpat Rai Publishing Company. [2] Sunita Rattan, "Experiments in Applied Chemistry, IInd ed., S. K. Kataria & Sons. [3] V. Alexeyev, "Quantitative Analysis", MIR Publishers.
E-resources and other digital material	**--**

14CS1152 – Basic Computing Lab

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

	Upon successful completion of the course, the student will be able to:												
Course outcomes	CO1	Design & develop basic software's (Application and System software)											
	CO2	Attain basic knowledge on hardware (I/O devices, Mother board, processor etc...)											
	CO3	Understand and Apply MS Office 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	PO k	PO l
	CO1				H								
	CO2				H								
	CO3				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:

a. Create a presentation using themes.

b. Save, edit, print and import images/videos to a presentation.

c. Adding animation to a presentation.

4. MS Access:

a. Create simple table in MS Access for results processing.

b. Create a query table for the results processing table.

c.. Create a form to update/modify the results processing table.

d.. Create a report to print the result sheet and marks card for the result.

CYCLE - II: Hardware Experiments

1. Identification of System Layout: Front panel indicators & switches and Front side & rear side connectors. Familiarize the computersystem Layout: Marking positions of SMPS, Motherboard, FDD,HDD, CD, DVD and add on cards. Install Hard Disk. Configure CMOS-Setup. Partition and Format Hard Disk.

2. Install and Configure a DVD Writer or a Blu-ray Disc writer.

3. Install windows operating system and check if all the device (graphics, sound, network etc.) drivers are installed.

	4. Install Linux operating system and check the working of all devices (graphics, sound, network etc.) in the computer. 5. Assemble a Pentium IV or Pentium Dual Core Pentium Core2 Duo system with necessary peripherals and check the working condition of the PC. 6. PC system layout: Draw a Computer system layout and Mark the positions of SMPS, Mother Board, FDD, HDD, and CD-Drive/DVDDrive 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 appropriate 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 command. 3. Creating a shared folder in the computer and connecting to that folder using Universal Naming Convention (UNC) format. (Ex: computer name share name) 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.
Text books and Reference books	**---**
E-resources and other digital material	[1] Numerical Methods and Programing by Prof.P.B.Sunil Kumar, Department of Physics, IIT Madras https://www.youtube.com/watch?v=zjyR9e- N1D4&list=PLC5DC6AD60D798FB7 [2] Introduction to Coding Concepts Instructor: Mitchell Peabody View the complete course: http://ocw.mit.edu/6-00SCS11

14ME1143 – Workshop Practice

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Lab	**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	The Basics of tools and equipment used in Carpentry, Tin Smithy, Welding and House Wiring.											
	CO2	The production of simple models in the above four trades.											
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				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:
a. One side inclined cylindrical pipe
b. Hexagonal pipe inclined one side
c. Square Box without lid
d. Taper Tray
e. Funnel
4. House wiring:
a. To connect one lamp with one switch.
b. To connect two lamps with one switch.
c. To connect a fluorescent tube.
d. Stair case wiring.
e. Go down wiring.

Text books and Reference books	**Reference Books** [1] Kannaiah P. & Narayana K. C., ”Manual on Work Shop Practice”, Scitech Publications.
E-resources and other digital material	---

First year
(II Semester)

14MA1201 – Calculus

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 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	Recollect the concepts of Limit, continuity, differentiability and able to apply them to verify mean value theorems.											
	CO2	Able to find successive derivatives and apply them to expand functions as Taylor and Maclaurin's series. Discriminate curvature & radius of curvatures and find Radius of curvature.											
	CO3	Understand the concepts asymptotes, trace out the curves and find the extreme values of functions.											
	CO4	Discriminates sequence and series, understand the concept of convergence of series.											
	CO5	Understand concept of double & triple integrals and apply them to evaluate areas and volumes.											
	CO6	Recollect the concepts of scalar and vector, apply the concepts of calculus to vectors and appreciate the established relations between line and surface, surface and volume integrals.											
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	L											
	CO3	L											
	CO4		H										
	CO5		H										
	CO6		L										
Course Content	**UNIT - I** **Differential Calculus:** Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Taylors Theorem, Maclaurins Series, 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, Physical Interpretation of Divergence, Del Applied Twice to Point Functions, Del Applied to Products of Point Functions, Integration of Vectors, Line Integral, Surface Integrals, Green's Theorem in The Plane (without Proof), Stokes's Theorem (without proof), Volume Integral, Gauss Divergence Theorem (without proof), Irrotational Fields.
Text books and Reference books	**Textbooks** [1] B.S.Grewal, "Higher Engineering Mathematics" XXXXIInd ed., Khanna Publishers, 2012. **Reference Books** [1] Krezig, "Advanced Engineering Mathematics" VIIIth ed., John Wiley & Sons. [2] Peter V.O.Neil, "Advanced Engineering Mathematics" Thomson. [3] R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics" IIIrd ed., 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	http://www.nptel.iitm.ac.in

14PH1202 – Engineering Physics

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	-	**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 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	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L											
	CO2	H											
	CO3		H										
	CO4	H											
Course Content	**UNIT - I** **Quantum Mechanics:** Dual nature of light, Matter waves and Debroglie's hypothesis, G.P.Thomson experiment, Heisenberg's uncertainty principle and its applications (Non existence of electron in nucleus, Finite width of spectral lines), Classical and quantum aspects of particle, One dimensional time independent Schr¨odinger's wave equation, physical significance of wave function, Particle in a box (One dimension). Statistical Mechanics:Phase space, Differences between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics (qualitative), Fermi-Dirac probability function, Fermi energy level. **UNIT - II** **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 equationpenetration 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 nanotubes: Arc discharge, Laser ablation, Properties of carbon nano tubes, Applications of CNT's & Nanotechnology.
Text books and Reference books	**Textbooks** [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

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 ctokens & input-output statements to solve simple problems											
	CO2	Able to compare and differentiate various looping & branching constructs and apply the best looping structure for a given problem											
	CO3	Interpret and implement the need of arrays and structure/union to store homogeneous and heterogeneous groups of data											
	CO4	Understand pointers and implement the programs to directly access memory locations											
	CO5	Identify the necessity of modularity in programming and design various function types											
	CO6	Contrast the need of using files in programming and implement file Operations											
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					L							
	CO3	L											
	CO4					H							
	CO5					H							
	CO6					L							
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, and 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, Lvalue and Rvalue. **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 (Type def), 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	**Text books** [1] Behrouz A. Forouzan & Richard F. Gilberg , "Computer Science A Structured Programming Approach using C" , IIIrd ed., CENGAGE Learning. **Reference Books** [1] Balagurusamy, "Programming in ANSI" C4 ed.,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, "DataStructures Using C", PHI/Pearson education.
E-resources and other digital material	--

14HS1204 – Technical English and Communication Skills

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 2
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	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**		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		
	CO3								L		L		L
	CO4											H	
	CO5									H	H		
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** 1. Communicative Facet- Speech acts- Extending Invitation, Reciprocation, Acceptance, Concurrence and Disagreeing without being disagreeable. 2. 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	**Text books** [1] TM Farhathullah, "Communication Skills for Technical Students", Orient Longman, 2002 [2] Krishna, "English Language Communication Skills", Duvvuri Publications, 2008 [3] B.S.Sarma, "Structural Patterns & Usage in English", IVth ed., Poosha Series, 2008. [4] Eclectic Learning materials offered by the Department **Reference Books** [1] Randolph Quirk, "Use of English" Longman, 2004. [2] Thomson A.J & Martinet A.V, "Practical English Grammar" Oxford University Press,2001 [3] Thomas Eliot Berry, "Common Errors in English" TMH, 2001 [4] John Langan, "College Writing Skills", McGraw Hill, 2004. [5]Selinkar, " English for Academic and Technical Purposes" Larry et al.,Newbury House Publishers, 1981. [6] Martin Cutts, "Oxford guide to Plain English" Oxford University Press, 2004. [7] J.Sethi & P.V. Dhamija, "A course in Phonetics and spoken English" PHI, 2006.
E-resources and other digital material	---

14EE1205 – 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 electric circuit fundamentals											
	CO2	Understand the basic concepts of Electromagnetism.											
	CO3	Analyze the basic concepts of electric machines											
	CO4	Understand measuring instruments & utilization concepts.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		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											
	CO4	L											
Course Content	**UNIT –I** **DC circuits**: Definitions of work, power, energy and torque; Ohms law; Kirchhoff's laws; Series-parallel resistive circuits; Star-delta transformation. **AC circuits:** Generation of sinusoidal signal ; RMS, Average values, Form factor, Peak factor. **UNIT –II** Magnetic effect of an electric current; cross and dot conventions; concept of m.m.f., flux, flux density, reluctance, permeability and field strength; Self and Mutual inductances; Fleming's left hand rule; Faradays laws of electromagnetic induction, statically and dynamically induced e.m.f. **UNIT – III** **D.C. Machines:** classification of dc machines; Principle of motor and generator; back emf; Torque of a dc machine; Load characteristics of shunt, series motors **AC Machines:** Classification of ac machines; Production of rotating field; Constructional features – principle of operation; Torque-slip characteristics. **UNIT – IV** **Measuring Instruments:** Classification of instruments; Principle of operation of moving-coil and moving-iron instruments; – Dynamometer –type watt meter **Utilization:** Principles of resistance and induction heating – principles of electrical traction – speed time characteristics.												
Text books and Reference books	**Textbooks** [1] I.J.Nagrath and Kothari, "Theory and Problems of Basic Electrical Engineering ", Prentice-Hall of India Pvt Ltd.												

	Reference Books [1] Dr. K. Uma Rao, Dr. A. Jayalakshmi, "Basic Electric Engineering", Pearson Publications. [2] T.K. Nagasarkar and M.S. Sukhja, "Basic Electric Engineering", oxford University press.
E-resources and other digital material	---

14EC1206 – Basics of Electronics Engineering

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

	Upon successful completion of the course, the student will be able to:												
Course outcomes	CO1	Fundamentals of electronic components, devices, transducers.											
	CO2	Principles of digital electronics.											
	CO3	Principles of various 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	H											
	CO2		L										
	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, phototransistor, solar cell, photo couplers). **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, SendurChelvi.K.P, Rangaswamy.T.R, "Engineering Basics: Electrical, Electronics and omputer Engineering", IIIrd ed., New Age International, 2007.												

	(b) Somanathan Nair.B, Deepa.S.R, ”Basic Electronics”, I.K. International Pvt. Ltd., 2009. **Reference Books** (a) Thomas L. Floyd, ”Electronic Devices”, Pearson Education, IXth ed, 2011. (b) Rajput.R.K, ”Basic Electrical and Electronics Engineering”, Laxmi Publications, Ist ed., 2007.
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 – Engineering Graphics

Course Category:	Institutional Core	**Credits:**	5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	2 - 0- 6
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	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	L											
	CO2	L											
	CO3	L											
	CO4	L											
	CO5	L											
	CO6	L											

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 books	**Textbooks** [1] N.D. Bhatt & V.M. Panchal, "Elementary Engineering Drawing",XXXXIXth ed., Charotar Publishing House, Anand. 2006. [2] AK Sarkar, DM Kulkarni, AP Rastogi, "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", IInd ed., Scitech publications(India) Pvt. Ltd., fifth reprint 2006. [2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD" New Age International.
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

14PH1251 – Engineering Physics lab

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

	Upon successful completion of the course, the student will be able to:												
Course outcomes	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				L								
	CO2	L			L								
	CO3			L									
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 function. 4. Torsional Pendulum-Rigidity modulus calculation. 5. Variation of magnetic field along the axis of a current carrying circular coil. 6. Compound pendulum-Measurement of 'g'. 7. LCR circuit-Resonance. 8. Solar cell -Determination of Fill Factor. 9. Hall effect -Study of B & I Variation. 10. Fibre Optics-Numerical aperture calculation. 11. Newton's Rings-Radius of curvature of plano convex lens. 12. Diffraction grating-Measurement of wavelength. 13. Lissajous figures- calibration of an audio oscillator. 14. B-H curves- determination of hysteresis loss. 15. Figure of merit of a galvanometer.												
Text books and Reference books	**Textbooks** [1] Indu Prakash&Rama Krishna, "A text book of practical physics", XXVth ed., Kitab Mahal Publishers, Allahabad, 2003. [2] J.C.Mohanty&D.K.Mishra, "University Practical Physics", Ist ed., Kalyani Publishers, 1990. [3] D.P.Khandelwal, "A laboratory manual of Physics" Ist ed.,Vani educational books , 1991.												

	[4] Dr.Y.Aparna & Dr.K.Venkateswara Rao, "Laboratory manual of engineering physics",Ist ed., VGS Publications,2010.
E-resources and other digital material	**---**

14CS1252 – C Programming Lab

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Lab	**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 basic Structure of the C-PROGRAMMING, declaration and usage of variables											
	CO2	Develop an algorithm for solving a problem											
	CO3	Exercise conditional and iterative statements to inscribe C programs											
	CO4	Exercise user defined functions to solve real time problems											
	CO5	Inscribe C programs using Pointers to access arrays, strings and functions											
	CO6	Inscribe C programs using pointers and allocate memory using dynamic memory management functions											
	CO7	Exercise user defined data types including structures and unions to solve problems											
	CO8	Exercise files concept to show input and output of files in C											
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		L		L								
	CO3					L							
	CO4			L									
	CO5				H								
	CO6				L								
	CO7		H										
	CO8					L							
Course Content	**CYCLE - I:Programming constructs and control structures** 1. Introduction to C programming : a. Use of Turbo C IDE b. The Structure of a C Program c. Writing C Programs d. Building an Executable Version of a C Program 2. Data Types and Variables: a. 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
Text books and Reference books	
E-resources and other digital material	[1] Prof.P.B.Sunil Kumar, "Numerical Methods and Programing", IIT Madras https://www.youtube.com/watch?v=zjyR9e-N1D4& list=PLC5DC6AD60D798FB7 [2] Mitchell Peabody "Introduction to Coding Concepts" View the complete course: http://ocw.mit.edu/6-00SCS11

Second year
(III Semester)

14MA1301 – Complex Analysis and Numerical Methods

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1- 0
Prerequisites:	Linear Algebra and Differential Equations, Calculus	**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	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											
	CO1		H										
	CO1		H										
	CO1		H										
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 -Inversion 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 3/8th rule. **Numerical Solutions of Differential Equations**: Taylor's series method Picard's method, Euler's method, Runge - Kutta method of 4th order, Boundary value problems, Solution of Laplace's and Poisson's equations by iteration.
Text books and Reference books	**Text Book**: [1] B.S.Grewal "Higher Engineering Mathematics" XXXXIInd ed, Khanna Publishers, 2012. **Reference Books**: [1] Krezig "Advanced Engineering Mathematics", VIIIth ed, John Wiley & Sons, 2007. [2] R.K.Jain and S.R.K.Iyengar "Advanced Engineering Mathematics", IIIrd ed, Narosa publishers. [3] N.P.Bali and Manish Goyal "A Text book of Engineering Mathematics", Ist ed, Lakshmi publications (P) limited, 2011. [4] H.K.Das and Er. Rajnish Verma, "Higher Engineering Mathematics", Ist ed, S.Chand, 2011. [5] S. S. Sastry "Introductory Methods of Numerical Analysis" , PHI , 2005
E-resources and other digital material	---

14EI3302 – Electronic Devices and Circuits

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Engineering Physics, Basics of Electronics Engineering	**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 and design basic diode circuits related to various applications.
CO2	Analyze and design different transistor biasing circuits, stabilization and compensation circuits.
CO3	Analyze the behavior of BJT and FET at low frequencies.
CO4	Analyze the behavior of BJT and FET at high frequencies.

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	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	L							
CO2	H	H		H								
CO3		H		H	H							
CO4		H		H	H							

Course Content

UNIT- I

Diode Applications: Diode approximations, Series Diode configurations with DC inputs, Parallel and Series – Parallel configurations with DC inputs, Clippers, Clampers.

Rectifiers: Diode as a rectifier, Half wave, Full wave - Centre-tapped, Bridge rectifiers without filter and with filters - Inductor filter, Capacitor filter, L section, Multiple L section and π - section filters. Zener regulator

Special Semiconductor Devices: Tunnel Diode, Varactor diode, MOSFET, UJT, SCR

UNIT- II

Transistor & FET Biasing: Introduction**,** Operating point, Biasing circuits - Fixed bias, Collector to base bias, Self bias; Stability factors, Bias compensation circuits - Diode compensation for V_{BE} and I_{CO}, Thermistor and Sensistor compensation; Thermal runaway and thermal stability, JFET biasing circuits - Fixed bias, Voltage divider bias.

UNIT- III

Transistor Amplifiers at Low frequencies

BJT Amplifiers: Hybrid parameter model of transistor, Determination of h parameters from characteristics, Measurement of h parameters, Analysis of transistor amplifier using h parameter model, Simplified CE hybrid model, Simplified calculations for CC & CB configurations.

FET Amplifiers: FET small signal model, Analysis of FET amplifiers at low frequencies - CS/CD/CG configurations.

	UNIT- IV **Transistor Amplifiers at High frequencies** **BJT Amplifiers:** BJT at high frequencies, Hybrid PI model, CE short circuit current gain without load, CE short circuit current gain with resistive load, Single stage CE transistor amplifier response, Emitter follower at high frequencies, Gain bandwidth product. **FET Amplifiers:** FET amplifier at high frequencies – CS/CD amplifiers
Text books and Reference books	**Text Books:** [1] Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", VIIIth ed, PHI. 2003**.** [Unit I except Rectifiers] [2] Jacob Millman, Christos C Halkias & Satyabrata JIT, "Millman's Electronic Devices and Circuits", IInd ed.TMH, 2008 . [Unit I Rectifiers, Unit II to Unit IV] **Reference Books:** [1] Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems",Ist ed., TMH, 2008. [2] G k Mithal "Electronic Devices and Circuits" Khanna Publishers [3] S Salivahana "Electronic Devices and Circuits" II^{ed} ed, TMH. [4] David A Bell "Electronic Devices and Circuits" IVth ed, PHI,2003
E-resources and other digital material	http://nptel.iitm.ac.in/courses.php?branch=Ece

14EI3303 – Network Theory

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Calculus, Basics of Electrical Engineering	**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	Determine the basic parameters in DC circuits.											
	CO2	Analyze DC electrical circuit using-mesh analysis, Nodal analysis and network theorems.											
	CO3	Analyze AC electrical circuit using-mesh analysis, Nodal analysis and network theorems.											
	CO4	Analyze resonance and DC transient behavior of RLC circuits and calculate the parameters of two port network.											
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		H		L								
	CO3		H		L								
	CO4		H										
Course Content	**UNIT – I** **Introduction of Circuit Elements:** Circuit concepts, Active and Passive circuit elements; Ideal, Practical and Dependent sources and their V-I characteristics, Source transformation, Mesh and Nodal analysis having independent and dependent sources with problems. Star Delta transformations and problems. Energy stored in Inductors and Capacitors, **UNIT - II** **Network Theorems:** Voltage and Current division; V-I characteristics of passive elements and their series / parallel combination; Application of theorems to DC circuits. Superposition theorem, Thevenin's and Norton's theorems, Reciprocity, Maximum power transfer theorems. **UNIT - III** **Sinusoidal Steady State Analysis:** 'j' notation and concept of phasor, Phasor notation of Voltage, Current and Circuit elements in single phase and three phase circuits, Mesh and Nodal analysis of obtaining steady state response of R,L,C circuits with problems. Application of network theorems such as Superposition theorem, Thevenin's and Norton's theorems, Maximum power transfer theorems to AC circuits. Computation of active power, Power factor. **UNIT - IV** **Resonance and Transients:** Series and Parallel resonance, Selectivity, Bandwidth and Q factor, Series and Parallel RLC circuits. Transient analysis of RL, RC, RLC circuits with DC using												

	Laplace transforms. **Two-port networks:** Calculation of Z, Y and h parameters and their conversions.
Text books and Reference books	**Text Books:** [1]A Sudhakar and SP Shyam Mohan, "Circuits and Networks: Analysis and Synthesis", IInd ed, TMH, 2002. **Reference Books:** [1] Fraklin F.Kuo, "Network Analysis and Synthesis", IInd ed, John Wiley & Sons, 2003 [2] William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", VIth ed, TMH, 2002.
E-resources and other digital material	---

14HS1304 – Environmental Studies

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Engineering Physics, Engineering Chemistry	**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	Explain 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						H	H					
CO4		L	H								H	

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. Biogeographical 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. **Disaster 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] Erach Bharucha, "Text book for ENVIRONMENTAL STUDIES', for under graduate courses of all branches of higher education" University Grants Commission.

	Reference Book: [1] AnjaneyuluY “Introduction to Environmental Sciences”, B S Publications PVT Ltd
E-resources and other digital material	---

14EI3305 – Sensors and Transducers

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Basics of Electronics Engineering, Engineering Physics	**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 various performance characteristics of instrument and the quality of measurement.
CO2	Identify the type of transducer based on the transduction principles.
CO3	Select the relevant transducer for measurement of displacement, velocity and acceleration to meet the requirements of industrial applications.
CO4	Identify the additional attributes in advanced sensors.

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								
CO2	H	L										
CO3		H		H								
CO4	L											

Course Content

UNIT- I

Instrument Characteristics: Block diagram of generalized instrument system, Static characteristics - Desirable & Undesirable characteristics; Dynamic characteristics - Transfer function, Dynamic response of Zero order, First order and Second order instruments to step input.

Estimation of Static Errors and Reliability: Definition of parameters, Combination of limiting error, Statistical treatment, Error estimates from the normal distribution, Curve fitting method and Reliability principles.

UNIT- II

Transduction Principles:

Passive Transducer Principles: Variable resistance - Change in length, Area and Piezo resistive effect; Variable inductance - Change in self inductance, Change in mutual inductance, Variable reluctance, Eddy currents, Magnetostrictive effect, Electromagnetic effect; Variable capacitance - Change in area, Distance and dielectric**;**

Active Transducer Principles: Thermoelectric, Piezoelectric, Pyroelectric, Photovoltaic & Electrochemical effects.

UNIT- III

Displacement Measurement: Introduction, Pneumatic transducers – Flapper Nozzle transducer; Electrical transducers - resistive, inductive and capacitive; Fiber optic transducers, Magnetostrictive transducer, Digital displacement transducer.

Velocity, Acceleration & Vibration Measurement: Electromagnetic tachometer, Digital

	Methods- Photo electric and toothed rotor variable reluctance tachometers, Stroboscope; Principles of accelerometers, Types of accelerometers - LVDT, Strain guage and piezo electric accelerometers; Vibrometers. **UNIT- IV** **Developments in Sensor Technology:** Introduction, Semi conductor sensors, Smart sensors, Micro Sensors, IR radiation Sensors, Ultrasonic Sensors, Fiber optic sensors, Chemical sensors and Bio Sensors.
Text books and Reference books	**Text Book:** [1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrd ed, PHI, 2009. (UNIT I) [2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechnanical Measuremnets & Instrumentation", XIIth ed, Dhanapat Rai & Co., 2012. (UNIT II & III) [3] D.V.S.Murty, "Transducers & Instrumentation", II^{ed}, PHI. (UNIT IV) **Reference Books:** [1] Raman Pallas-Arney & John G.Webster, "Sensors & Signal Conditioning", II nd ed., J. Wiley,2012. [2] D.Patranabis, "Sensors and Transducers" II nd ed., PHI, 2013.
E-resources and other digital material	[1] http://nptel.ac.in/courses/112103174/4 [2] http://nptel.ac.in/courses/112103174/3

14EI3306 – Digital Circuits and Systems

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4- 1- 0
Prerequisites:	Basics of Electronics Engineering	**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	Perform binary arithmetic operations and correct single bit errors.
CO2	Simplify logical functions using K-map method and Tabulation method.
CO3	Design various combinational logic circuits and realize using logic gates.
CO4	Design and realize various sequential logic circuits using flip flops.
CO5	Explain the characteristics of different logic families.

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	H	L		L	H							
CO4	H	L		L	H							
CO5	H			L	H							

Course Content

UNIT- I

Binary Arithmetic and Codes: Binary Addition, Subtraction, Multiplication, Division. Sign-magnitude representation, 1's & 2's complement representations, 2's complement arithmetic - Addition/Subtraction; Codes - Excess-3 code, Gray code, Octal code, Hexadecimal code; Error detecting and correcting codes (single bit error).

Minimization of Switching Functions: Simplification of logical functions using Karnaugh map method (two, three and four variable), Don't-Care conditions, Quine-McCluskey minimization technique (Two, Three and Four variable).

UNIT- II

Combinational Logic Design: Half-Adder, Full-Adder, Half - Subtractor, Full - Subtractor, BCD to 7 segment decoder, Design of a Binary to Gray and Gray to Binary code converters.

Combinational Logic Design Using MSI Circuits: Multiplexer, Combinational logic design using multiplexers, Demultiplexers / Decoders and their use in combinational logic design, Adder with Look Ahead Carry, Decimal to BCD and Octal to Binary Encoders.

UNIT- III

Flip-Flops: Clocked S-R flip-flop, Preset and Clear, J-K flip-flop, Race around condition, Master slave J-K flip-flop, D flip-flop, T flip-flop, Excitation table of flip-flop and flip-flop conversions.

Sequential Logic Design: Shift register, Bi-directional shift register, Applications of shift resisters, Ring counter, Twisted- Ring counter, Sequence generator. Asynchronous counters -

	UP/DOWN counters, Modulus of the counter, Design of Synchronous counters. **UNIT- IV** **Logic Families:** Characteristics of digital IC's, Direct-coupled transistor logic, Resistor-transistor logic, Diode - Transistor logic, Transistor-Transistor logic, Schottky TTL, Emitter-coupled logic, MOS Inverter, MOSFET NAND and NOR Gates, CMOS Inverter, CMOS NAND and NOR gates.
Text books and Reference books	**Text Book** [1] R P Jain "Modern Digital Electronic", IVth ed., TMH. **Reference Books** [1] A.Anand Kumar, "Fundamentals of Digital Circuits", PHI 2006. [2] M.Morris Mano, "Digital Logic and Computer Design", PHI,2003.
E-resources and other digital material	---

14EI3351 - Electronic Devices and Digital Electronics Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 3- 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 and design basic diode circuits related to various applications.											
	CO2	Understand the working of BJT,FET and its application as an amplifier experimentally and infer their salient parameters											
	CO3	Realize the basic gates using discrete components and universal gates experimentally.											
	CO4	Design and test various combinational & sequential logic circuits experimentally.											
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								
	CO3	H	L		L								
	CO4	H	L		L								
Course Content	**List of Experiments** **A. Electronic Devices Module:** 1. Characteristics of PN Junction diode and Zener diode. 2. Analysis of half wave & full wave rectifiers with and without filter. 3. Characteristics of transistor in common base configuration. 4. Characteristics of transistor in common emitter configuration. 5. Design of transistor self-bias circuit. 6. Drain and transfer characteristics of junction field effect transistor **B. Digital Electronics Module:** 1. Realization of logic gates using discrete components and universal gates. 2. Adders/ Subtractor using IC 7483 3. Verification of Flip-Flops using gates 4. Design of synchronous and asynchronous counters using flip flops and IC 74163 5. UP/DOWN counters using IC 74193 6. Design of MUX and DEMUX **C. P-Spice Module:** 1. Verification of half-wave rectifier operation with and without filter. 2. Verification of full-wave rectifier operation with and without filter. 3. Frequency response of CE amplifier. 4. Frequency response of CS Amplifier 5. Verification of logic gates using discrete components. **6.** Verification of Flip-flops												

Text books and Reference books	**---**
E-resources and other digital material	**---**

14EI3352 – TRANSDUCERS LAB

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 3- 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 the various performance characteristics of first and second order systems.											
	CO2	Analyze the characteristics of displacement, velocity and acceleration transducers to meet the requirements of industrial applications.											
	CO3	Compare the characteristics of different temperature transducers.											
	CO4	Analyze the characteristics of level, flow, pressure and humidity measurement transducers.											
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							
	CO2				H								
	CO3				H								
	CO4				H								
Course Content	**List of Experiments** 1. Temperature measurement using RTD and Thermistor 2. Temperature measurement using Thermocouple and IC temperature sensor 3. Characteristics of LDR, Photodiode and Phototransistor 4. Measurement of magnetic flux density using Hall transducer 5. Humidity measurement using Dry wet Hygrometer 6. Dynamic characteristics of first order and second order systems 7. Study of various pressure measuring devices 8. Speed measurement using Magnetic pick-up, Photoelectric pick-up & Stroboscope 9. Torque measurement using Strain gauge load cells with Digital indicator 10. Characteristics of level transmitter 11. Calibration of pressure gauges using Dead weight tester. 12. Fiber optic transducers for measurement of temperature and pressure 13. Flow measurement using ultrasonic flow meter 14. Data loggers for temperature measurement 15. MEMS Accelerometer/Gyroscope												
Text books and Reference books	**---**												

E-resources and other digital material	---

Second year
(IV Semester)

14EI3401 – Electrical and Electronic Measurements

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1- 0
Prerequisites:	Circuit analysis	**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	Select suitable Electromechanical indicating instruments for measurement of voltage, current, Resistance, Power, energy and power factor.											
	CO2	Select suitable analog and digital voltmeters, bridges and Q-Meters for measurement of A.C. & D.C. Voltages, Resistance, Inductance and Capacitance.											
	CO3	Explain the constructional details and working principles of various Oscilloscopes for measurement of electrical parameters.											
	CO4	Explain the principles of working of various signal generators, wave analyzers and Frequency Counters.											
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								
	CO3	H			H								
	CO4	H			H								
Course Content	**UNIT – I** **Electromechanical Indicating Instruments**: Suspension Galvanometer; Torque and deflection of the Galvanometer-Steady state deflection, Dynamic behavior, Damping mechanisms; Permanent Magnet Moving Coil mechanism-D'Arsonval movement, Temperature compensation. **Electrical Measurements**: DC ammeters-shunt resistor, Ayrton shunt, Multirange ammeters, The Ayrton shunt , DC voltmeters- multiplier resistor, Multirange voltmeter,Voltmeter sensitivity- ohms per volt rating, loading effect, Series type ohmmeter, Shunt type ohmmeter, Calibration of dc instrument, Alternating current indicating instruments-Electrodynamometer, Rectifier type instruments, Typical multimeter circuits; Thermo Instruments, Electrodynamometers in power measurements, Watt hour meter, Power Factor meters. **UNIT – II** **Bridges:** Wheatstone's bridge (Measurement of Resistance), Kelvin's bridge, Practical Kelvin's double bridge, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, Wagner's ground connection. **Electronic Instruments**: AC Voltmeter using rectifiers, True RMS voltmeter, Digital voltmeters - Ramp technique, Dual slope integrating type DVM, Staircase ramp DVM, Successive approximation type DVM, Q Meter- Impedance measurement using Q Meter.												

	UNIT – III **Oscilloscopes**: Block diagram of oscilloscope, Vertical amplifier, Horizontal deflecting system, Delay line in triggered sweep, Typical CRT connections, High frequency CRT, Dual beam CRO, Dual trace oscilloscope (basic block diagram), Sampling oscilloscope, Storage oscilloscope, Probes for CRO – Direct probes, Passive voltage probe, Active probes, Attenuators - Uncompensated attenuators , Simple compensated attenuator. **UNIT – IV** **Signal Generators:** Basic standard sine wave generator, Standard signal generator, Function generator, Laboratory square wave and pulse generator. **Wave Analyzers:** Basic wave analyzer, Frequency selective wave analyzer, Heterodyne wave analyzer, Spectrum analyzer. **Frequency Counters And Time–Interval Measurements:** Digital frequency meter – Principle of operation, Basic circuit of a digital frequency meter, Digital measurement of time- Principle of operation, Time base selector, Period measurement.
Text books and Reference books	**Text Book** [1] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 **(Unit-I)** [2] H.S.Kalsi, "Electronic Instrumentation", IInd ed, TMH. **(Units-II, III and IV)** **Reference books** [1] A.K. Sawhhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co. [2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	---

14EI3402 – Analog Electronic Circuits

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Basic 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 Multi stage amplifier circuits at low frequency and high frequencies.											
	CO2	Design various types of power amplifiers used in electronics applications.											
	CO3	Analyze various feedback amplifiers and oscillators.											
	CO4	Select and design suitable multivibrator for timer 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	PO k	PO l
	CO1	L	H										
	CO2	L	H										
	CO3	L	H										
	CO4	L	H										

Course Content

UNIT- I

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

UNIT- II

Power Amplifiers: Classification of Power amplifiers, Class A series fed and Transformer Coupled, Second Harmonic distortion, Class B Transformer coupled Push-Pull and Complementary Symmetry Push-Pull, Cross over distortion, Class AB power amplifiers, Phase inverter circuits.

UNIT- III

Feedback Amplifiers: Feedback concepts, General characteristics of Negative feedback Amplifiers, Input resistance & output resistance, Method of analysis of feedback amplifiers - Voltage series, Current series, Voltage shunt, Current shunt feedback amplifiers.

Oscillators: Classification of Oscillators, Sinusoidal oscillators, Barkhausen criteria, RC phase shift oscillator using BJT, Wein bridge oscillator, LC oscillators- Hartley and Colpitts Oscillator

UNIT- IV

MULTIVIBRATORS (using BJTs): Bistable Multivibrator: Fixed bias and self bias transistor binary, Commutating capacitors, Non-saturated binary, Direct coupled binary, Unsymmetrical and symmetrical triggering of binary, Schmitt Trigger circuit, Collector Coupled Monostable and Astable Multivibrators – operation & design.

Text books and Reference books	**Text Book** [1] Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems",XIIth ed, TMH, 1991. (UNIT I,II & III) [2[A.Anand kumar , "Pulse and Digital Circuits", IInd ed, PHI,2010. (UNIT IV) **Reference books** [1] G.KMithal, "Electronic Devices and circuits", XXIIIrd ed, Khanna Publishers 2010. [2] Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", VIth ed, PHI 2000.
E-resources and other digital material	http://nptel.iitm.ac.in/courses.php?branch=Ece

14EI3403 – Industrial Instrumentation

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Sensors and Transducers	**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	Select the relevant transducer for measurement of temperature to meet the requirements of industrial applications.											
	CO2	Apply most suitable transducer for pressure monitoring in real time applications.											
	CO3	Select the relevant transducer for the measurement of flow in industrial applications.											
	CO4	Compare and select suitable transducer for level, humidity, density and viscosity measurement for real time 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	PO k	PO l
	CO1		H		H								
	CO2		H		L								
	CO3		H										
	CO4		H		L								
Course Content	**UNIT –I** **Temperature Measurement:** Introduction, Classification of temperature sensors based on change in dimensions - Bimetals & Liquid-in-Glass thermometers; change in electrical properties - RTD, Thermistor; Thermo electricity - Thermocouples & IC sensors; Radiation pyrometers, Fibre-optic sensors. **UNIT-II** **Pressure Measurement:** Introduction, Manometers, Force summing devices - Diaphragms, Bellows & Bourdon tubes; Secondary transducers - Resistive, Inductive, Capacitive, Piezoelectric; Low pressure measurement **-** Mcleod, Knudsen, Pirani & Ionization gauges**;** Calibration of pressure gauges using dead weight tester. **UNIT- III** **Flow Measurement:** Introduction, Head type flow meters - Orifice plate, Venturi tube and Pitot tube; Variable area type flow meters – Rotameter; Velocity measurement type flow meters - Electromagentic, Turbine, Ultrasonic flow meters**,** Anemometers; Mass flow measurement type - Coriolis mass flow meter; Positive displacement flow meters - Nutating disc and lobed impeller; Open channel flow meters- Weirs, Flumes. **UNIT-IV** **Level Measurement:** Introduction, Mechanical level indicators - Differential pressure type; Optical – Laser sensors, IR and visible light sensors; Electrical type - Resistive, inductive and												

	Capacitive; Radiative methods - Ultrasonic, Gamma ray. **Humidity, Density & Viscosity Measurement:** Electrolytic hygrometers, Wet and dry bulb hygrometers; Moisture analyzer, Ultrasonic and gamma ray densitometers, Saybolt Viscometer, Float viscometers.
Text books and Reference books	**Text Books** [1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrd ed, PHI, 2009. [2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", XIIth ed, Dhanpat Rai & Co, 2012. **Reference Books** [1] Ernest O Doebelin/Dhanesh, N Manik, "Measurement systems", VIth ed, Tata Mc Grawhill. [2] C.S.Rangan, G.R.Sarma & V.S.V.Mani "Instrumentation Devices & Systems", IInd ed, TMH, 2011.
E-resources and other digital material	[1]http://nptel.ac.in/courses/108105064 [2]http://nptel.ac.in/courses/108106074

14EI3404 – Signals and Systems

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	- Linear Algebra and Differential Equations, Calculus, 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	Explain the mathematical descriptions, representations and classification of continuous and discrete signals and systems.											
	CO2	Use Fourier series and Fourier transform techniques for the representation of continuous-time periodic and aperiodic signals.											
	CO3	Explain the input-output relationships for Linear Time Invariant Systems LTIS), characteristics of LTI systems and conditions for distortion less transmission.											
	CO4	Use Fourier and Laplace Transform analysis for continuous-time LTI systems and Z-Transform analysis for discrete time 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	H										
	CO3		H										
	CO4	H	H										
Course Content	**UNIT-I** **SIGNALS AND SYSTEMS:** Introduction, Continuous-Time and Discrete-Time signals, Transformations of the independent variable, Exponential and sinusoidal signals, The unit Impulse and Unit step functions, Continuous-Time and Discrete-Time systems, Basic system properties. **SAMPLING:** Introduction, Representation of a continuous-time signal by its samples, Sampling theorem, Reconstruction of a signal from its samples using interpolation, The effect of under sampling: Aliasing **UNIT-II** **FOURIER SERIES**: Introduction, Fourier series representation of continuous-time periodic signals, Convergence of the Fourier series, Properties of continuous-time Fourier series. **FOURIER TRANSFORMS:** Introduction, Representation of aperiodic signals: The continuous Fourier transform, The Fourier transform for periodic signals, Properties of the Continuous-time Fourier transform. **UNIT-III** **LINEAR TIME INVARIANT SYSTEMS:** Introduction, LTI systems, Impulse response, Transfer function of a LTI system, Convolution integral, Convolution sum, Energy and Power												

	spectral density, Auto correlation, Cross correlation functions, Properties of correlation functions, Parseval's theorem, Filter characteristics of linear systems, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and paly-wiener criterion, Relationship between bandwidth and rise time. **UNIT-IV** **SIGNALS AND SYSTEMS ANALYSIS USING LAPLACE TRANSFORMS:** Introduction, The Laplace transform, The region of convergence for Laplace transforms, The inverse Laplace transform, Properties of the Laplace transform, Analysis and characterization of LTI systems using the Laplace transform, The unilateral Laplace transform. **SIGNALS AND SYSTEMS ANALYSIS USING Z-TRANSFORM:** Introduction, The Z-transform, The region of convergence for Z-transform, The inverse Z-transform, Properties of the Z-transform, Analysis and characterization of LTI systems using the Z-transform, The unilateral Z-Transform
Text books and Reference books	**Text books** [1] Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals & Systems", IInd edition, Prentice Hall India, 1996. [2] P.Ramesh Babu, R Ananda Natarajan, "Signals and Systems", IIIrd edition, Scitech Publishers, 2009. **Reference books** [1] Simon Haykin, Barry Van Veen, "Signals & Systems", IInd edition, John Wiley & Sons, 2001 [2] B P Lathi, "Signals, Systems and Communications", IIIrd edition BS Publications, 2003..
E-resources and other digital material	1] http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011 [2] http://nptel.ac.in/courses/117104074

14EI3405 – Electrical Technology

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Basics of Electrical Engineering	**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 working and performance of DC Machines.											
	CO2	Understand the working and performance of 1-Φ Transformer.											
	CO3	Understand the working and starting methods of 1-Φ and 3-Φ Induction Motors.											
	CO4	Understand the principle and regulation concepts of Synchronous Generator and starting methods of Synchronous Motor.											
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								
	CO2		H		L								
	CO3		H										
	CO4		H										

Course Content

UNIT-I

DC Generators: Introduction, Principle of operation and construction of DC generator, EMF equation, Types of generators, Magnetization and load characteristics of DC generators, Losses and efficiency of DC generator.

DC Motors: Principle of operation and construction 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.

UNIT-II

Transformers: Principle of operation of single phase transformer, Types, Constructional features, Phasor diagram on no load and load, Equivalent circuit, Losses and efficiency of transformer, Regulation of transformer, OC and SC tests.

UNIT-III

Induction Machines

Three phase Induction Motors: Production of rotating magnetic field, Principle of operation induction motors, Slip, Frequency of rotor emf and current, Torque equation,

Single phase Induction Motors: Principle of operation and construction, Capacitor motors, Shaded pole motors, DC and AC servo motors.

Stepper Motors: Principle of operation, Construction, Different types.

UNIT-IV

Synchronous Machines Three Phase Alternators: Introduction, Principle of operation of alternator, Distribution factor, Coil span factor, Emf equation, Regulation of alternator by

	synchronous impedance method. **Synchronous Motors:** Principle of operation, Starting methods and applications of synchronous motors
Text books and Reference books	**Text Book** [1] V.K.Mehta and Rohit Mehta, "Principles of Electrical Machines" S.Chand publications. **Reference Books:** [1] J.B.Guptha, "A Course in Electrical Technology", S.Kataria & Sons. [2] BL Theraja,Nirja "A text book of Electrical Technology"
E-resources and other digital material	---

14EI3406 – Computer Organization

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Digital Circuits 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 basic functional units, principles and the implementation of computer arithmetic.											
	CO2	Understand the operation of modern CPUs including pipelining.											
	CO3	Understand the basic memory circuits, Organization of the Main memory, Cache memory, virtual memory and secondary storage.											
	CO4	Understand the various ways in which I/O operations are performed; hardware details associated with buses, I/O interfaces and commonly used bus standards.											
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											
	CO4	H											
Course Content	**UNIT- I** **Basic Structure of Computers:** Functional unit, Basic Operational Concepts, Bus Structures, Software Performance, Memory locations & addresses, Memory operations, Instruction and instruction sequencing, Addressing modes, Assembly language, Basic I/O operations, Stacks and queues. **Arithmetic:** Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, Signed operand multiplication and fast multiplication, Integer division, Floating point numbers and operations. **UNIT- II** **Basic Processing Unit :** Fundamental concepts, Execution of a complete Instruction, Multiple bus organization, Hardwired control, Microprogrammed control, Pipelining, Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control consideration. **UNIT- III** **Memory System:** Basic concepts, Semiconductor RAMs, ROMs, Speed, size and cost, Cache memories, Performance consideration, Virtual memory, Memory Management requirements, Secondary storage.												

	UNIT- IV **I/O Organization:** Accessing I/O devices, Interrupts, Direct memory access, buses, Interface circuits, Standard I/O interfaces (PCI, SCSI, USB).
Text books and Reference books	**Text Books** 1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Vth ed, McGraw Hill, 2002 2. John P.Hayes, "Computer Architecture & Organization", IIIrd ed., McGraw Hill, 1998 **Reference Books** 1.William Stallings, "Computer Organization & Architecture – Designing for Performance", VIth ed., Pearson Education, 2003 reprint 2. David A.Patterson and John L.Hennessy, "Computer Organization & Design, the hardware / software interface", IInd ed., Morgan Kaufmann, 2002 reprint
E-resources and other digital material	---

14EI3451 – Measurements Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 3- 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	Design and test the working of DC, AC meters, ohmmeters and Calibrate the Voltmeter, Ammeter and ohmmeter											
	CO2	Measure resistance, inductance and capacitance using bridges and Q-meter experimentally.											
	CO3	Explain the function of function generator, true RMS Voltmeter, CRO and spectrum analyser											
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	H			H								
Course Content	**List of Experiments** 1. DC meters using D'Arsonval Galvanometer and their Range extension. 2. AC meters using D'Arsonval Galvanometer and their Range extension. 3. Measurement of Voltage, Frequency, phase angle and phase shift using a CRO. 4. Measurement of resistance using Kelvin Double Bridge. 5. Measurement of inductance using Maxwell Bridge. 6. Measurement of capacitance using Shearing Bridge. 7. Measurement of Harmonics using a Spectrum Analyzer. 8. Measurement of Resistance, Inductance, Capacitance and Quality factor using a Q meter. 9. Measurement of amplitude and frequency of different types of waveforms using a Function generator. 10. Measurement of amplitudes of different types of waveforms using a True RMS voltmeter. 11. Measurement of inductance of high Q coils using Hay Bridge. 12. Measurement of frequency using a Wien Bridge. 13. Calibration of Voltmeter using potentiometer. 14. Calibration of Ammeter using potentiometer. 15. Design, Construction and Calibration of Series and Shunt Type ohmmeters												
Text books and Reference books	**---**												
E-resources and other digital material	---												

14EI3452 – Electrical Engineering Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 3- 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 various network theorems											
	CO2	Understand the concepts of series and parallel resonance											
	CO3	Analyze the performance characteristics of D.C. and A.C machines.											
	CO4	Analyze the performance characteristics of single phase transformers.											
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		L		L								
	CO3				H								
	CO4				H								
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 a. OC and SC Test on Single Phase Transformer b. Direct Load Test on Single Phase Transformer 12. Regulation of Three Phase Alternator by Synchronous Impedance Method 13. Direct Load Test on Three Phase Induction Motor												
Text books and Reference books	**---**												
E-resources and other digital material	---												

14HS1453 – Communication Skills Lab

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 2- 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	Be proficient in pronunciation of speech sounds including accentuation.											
	CO2	Enhance the awareness of the elements of listening comprehension.											
	CO3	Develop the abilities of rational argumentation and skills of public speaking.											
	CO4	Be aware of the elements of professional communication											
	CO5	Be exposed to the items of various competitive exams.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		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	M	L
	CO2			M	M		H	H	M	H	H	M	M
	CO3	H		M	H	L	M	H	H	H	H	M	H
	CO4	M	L	M	M	L	H	H	H	H	H	H	H
	CO5						H			H	H	M	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	**References** [1]Exercises in Spoken English, Prepared by CIEFL, OUP, XXIst Impression, 2003 [2]O'rell Dll Language Learner's Software, 2012 [3]7 Habits of Highly Effective people, Stephen R Covey, Simon & Schuster UK Ltd, 2004. [4]Oxford Guide to Plain English, Martin Cutts, OUP, 2009 [5]Logic made easy: How to know when Language deceives you, Deborah. J. Bennett, W. W. Norton & Company, (Reprint), 2005 [6]Eclectic Learning Materials offered by the Department.
E-resources and other digital material	---

Third year
(V Semester)

14EI3501 – Control Systems

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Linear Algebra and Differential Equations, Network 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	Apply basic concepts of control systems and mathematical modeling to obtain transfer functions of physical systems.											
	CO2	Analyze the transient and the steady state responses of first order and second order linear control systems for standard input test signals.											
	CO3	Analyze various LTI systems and test for their stability using various tools like Routh Array, Root Locus, Bode Plots, Nyquist plot etc.											
	CO4	Develop the state space model of SISO and MIMO systems and analyze the controllability, observability and stability of the 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	H										
	CO2		H	L	H	H							
	CO3			H		H							
	CO4		H	L									
Course Content	**UNIT – I** **Introduction**: Control system terminology, Examples of simple control systems, Open loop and Closed loop control systems, Effect of feedback on overall gain, Stability, Sensitivity, External noise, Types of feedback control systems. **Mathematical Models of Physical Systems**: Formulation of differential equations for Electrical, Mechanical and Electromechanical systems, Synchros, Tachogenerators, Analogous systems, Transfer functions of open and closed loop systems, Block diagram representation of control systems, Signal flow graph and Mason's gain formula. **UNIT – II** **Time Domain Analysis:** Standard test signals – Step, Ramp, Parabolic and Impulse, Time response of first-order system to standard test signals, Step response of second order system, Time domain specifications, Steady state error and error constants, Dominant poles of transfer function. **Stability Analysis in Complex Plane**: Stability definitions – Bounded Input and Bounded Output (BIBO), Impulse response, Stability study based on poles of closed-loop transfer function, Absolute & relative stability, Routh–Hurwitz criterion. **UNIT – III** **Root Locus Technique:** The root locus concept, Magnitude and angle conditions, Properties												

	and construction of the root loci (**For positive K only**), Effects of adding poles and zeros to G(s) H(s) on the root loci**.** **Frequency Domain Analysis:** Introduction, Frequency domain specifications, Correlation between time and frequency response, Polar plot, Nyquist stability criterion, Nyquist plot, Bode plot - Magnitude plot, Phase plot, Determination of frequency domain specifications and transfer function from Bode plots, Phase margin and gain margin, Stability analysis from Bode plots. **UNIT – IV** **State Space Analysis**: Concepts of state, State variables, Phase variables, Canonical variables, State vector, Input vector, Output vector, Development of state models for simple systems, Solution of state equation, The state transition matrix and its properties, Characteristic equation and transfer function from state models, Eigen values and eigenvectors, Diagonalization, Transformation to phase variable canonical form, Diagonal canonical form, Jordan canonical form, Concepts of controllability and observability.
Text books and Reference books	**Text Book** [1] A.Anand Kumar, " Control Systems ", IInd ed, PHI, 2014 [2] I J Nagrath &M Gopal,"Control Systems Engineering", Vth ed, New Age International, 2008. **Reference books** [1] Benjamin C. Kuo, "Automatic Control Systems", VIIth ed , PHI, 2001. [2] Katsuhiko Ogata, "Modern Control Engineering", IVth ed, Pearson Education, 2003. [3]A.Nagoor Kani, "Control Systems", IInd ed, RBA Publications,2006.
E-resources and other digital material	[1] http://www.nptelvideos.com/control_systems [2] http://www.nptel.ac.in/courses/108101037 [3] http://textofvideo.nptel.iitm.ac.in/108102043

14EI3502– Integrated Circuits & Applications

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Electronic Devices and Circuits Analog Electronic Circuits, Network Theory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Analyze various characteristics of op-amp and design different linear op-amp circuits											
	CO2	Analyze and design different non-linear op-amp circuits and Waveform generators											
	CO3	Understand the concepts of various DACs, ADCs and design Active filters suitable for various applications.											
	CO4	Design 555 Timer circuits, 565 PLL and µA723 voltage regulators based on applications.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
	CO1	L	M		H								
	CO2		H		H								
	CO3		M		H								
	CO4	L	M										

Course Content

UNIT – I **[Text Book No: 1&2]**

OPERATIONAL AMPLIFIERS:

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

LINEAR APPLICATIONS OF OP-AMPS:

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

UNIT – II **[Text Book No: 1&2]**

NON LINEAR APPLICATIONS OF OP-AMPS:

Sample and Hold circuit, Log and antilog amplifiers, Precision diode, Applications- half-wave precision rectifier, full-wave precision rectifier, Peak value detector, clipper, clamper, Absolute value output circuit.

COMPARATORS AND WAVE FORM GENERATORS:

Introduction to comparator, Basic comparator & its characteristics, Limitations of Op-Amps as comparators, Applications: zero-crossing detector, window detector, voltage limiters; Waveform generators- Oscillators, Schmitt Trigger, Square-wave Generator, Triangular wave

	Generator, saw tooth wave Generator. **UNIT – III** **[Text Book No: 1&2]** **ACTIVE FILTERS:** Active LP and HP filters, Sallen key LP and HP filters, Band pass filters – Wideband, Band pass and multiple feedback Band pass filters; Band stop filters, state variable filters, All pass filters. **D/A AND A/D CONVERTERS:** Introduction, Basic DAC techniques - weighted resistor DAC, R-2R Ladder D/A converter; A/D conversion–parallel comparator type ADC, Counter type ADC, Tracking A/D converters, successive approximation ADC and Dual slope ADC,DAC and ADC Specifications. **UNIT – IV** **[Text Book No: 1&2]** **APPLICATIONS OF SPECIAL ICS:** The 555 timer- 555 as Monostable and Astable Multivibrator and applications; voltage controlled oscillator; Phase Locked loops- operating principles, 565 Monolithic PLLs, 565 PLL Applications; IC Voltage Regulators.
Text books and Reference books	**Text books** [1]. Roy and Chowdhary, "Linear Integrated Circuits", 4th Edn., New Age International,2003 [2]. Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits",3rd ed., PHI, 1997 **Reference Books** [1] Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edn., PHI, 1996 [2] Denton J Dailey, "Operational Amplifiers and Linear Integrated Circuits: Theory and Applications", Mc Graw Hill Ltd, 1989
E-resources and other digital material	1. www.analog.com 2. nptel.ac.in/video.php?subjectId=108106068 4. www.linkwitzlab.com/filters.htm 5. www.allaboutcircuits.com.

14EI3503 – Microcontrollers and Applications

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Computer 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	Describe the architecture of 8051 microcontroller.											
	CO2	Use the instruction set of 8051 to solve problems.											
	CO3	Select and use various interfacing peripherals along with microcontroller.											
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	H								
	CO3			H	H	H							
Course Content	**UNIT – I** **Introduction:** Introduction to microcontrollers, Comparison between microprocessors and microcontrollers The 8051 Architecture: 8051 Microcontroller hardware, Input/output pins, Ports & circuits, External memory, Counters and timers, Serial data input/ output, Interrupts. **UNIT – II** **Instruction Set:** Addressing modes of 8051, Data Transfer operations, Arithmetical operations, Logical operations, Jump and call op-codes, Simple Programs. **Microcontroller Design:** A Microcontroller design, Testing the design, Timing Subroutines, Lookup tables for the 8051, Serial Data Transmission. **UNIT – III** **System Design: Peripherals and Interfacing:** Serial IO, USART Communication Interface 8251, ADC circuit interfacing, DAC interfacing, Stepper motor interfacing, LED, Array of LEDs, Keyboard-cum-Display controller 8279, Interfacing with external memory **UNIT – IV** **Systems Design: Digital and Analog Interfacing Methods:** Programmable DMA controller 8257, Programmable Interrupt Controller 8259, Interfacing to high power devices, Analog input interfacing, Analog output interfacing, Optical motor shaft encoders, Industrial control, Industrial process control.												
Text books and Reference books	**Text Book** [1] Kennth J. Ayala, "The 8051 Microcontroller Architecture, programming and applications" III ed, West Publishing Company. (Unit I & II).												

	[2] Raj Kamal, "Microcontrollers Architecture, Programming, interfacing and system design" Pearson Education. (Unit III & IV). **Reference books** [1] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", II ed, Printice Hall.
E-resources and other digital material	[1] http://nptel.iitg.ernet.in (Unit I, Unit II, Unit III, Unit IV)

14EI3504 – Digital Signal Processing

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	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	Discuss the properties of Discrete Fourier Transforms and Fast Fourier Transform algorithms.											
	CO2	Design digital Infinite Impulse Response filters (Butterworth and Chebyshev) using bilinear transformation and impulse invariance transformation methods.											
	CO3	Design the digital Finite Impulse Response filters using windowing techniques.											
	CO4	Explain the realization of digital IIR & FIR filters using direct form, cascade, parallel and ladder realizations.											
	CO5	Use DSP processors for implementing the digital signal processing algorithms											
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	L							
	CO2				H	L							
	CO3				H	L							
	CO4				H								
	CO5				H	L							
Course Content	**UNIT – I** **Introduction to Digital Signal Processing**: Fourier Representation of Finite Duration Sequences - The Discrete Fourier Transform (DFT), Properties of DFT, Linear convolution using DFT, Fast Fourier Transforms (FFT) - Radix-2 Decimation in time and Decimation in frequency FFT algorithms, Inverse FFT. **UNIT – II** **Analog filter approximations:** Butter worth and Chebyshev, Design of IIR digital filters from analog filters - Impulse invariance method, Bilinear transformation method, Design Examples: Analog - Digital transformations, Basic Structures for IIR systems: Direct-Form structures, Cascade-Form structures and Parallel-Form structures **UNIT – III** **Symmetric and Antisymmetric FIR filters:** Design of linear phase FIR filters using Windows, Design of Linear phase FIR filters by the Frequency Sampling method, Comparison of FIR and IIR filters, Basic structures for FIR systems: Direct-Form structures and Cascade-Form structures.												

	UNIT – IV **Architectures for Programmable Digital Signal Processing Devices:** Introduction, Basic architectural features, DSP computational building blocks, Bus architecture and Memory, Data addressing capabilities, Address generation unit, Programmability, Program Execution, Speed issues. **Programmable Digital Signal Processors:** Introduction, Commercial Digital signal processing devices, Data addressing modes of TMS320C54XX Digital signal processors, Memory space of TMS320C54XX Processors, Program control, TMS320C54XX instructions, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX processors
Text books and Reference books	**Text Book** [1] A.V.Oppenheim and R.W.Schafer, "Digital Signal Processing" II ed., Pearson, 2004. [2] J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", IVth ed., Pearson, 2007. [3] Avatar Singh and S. Srinivasan, "Digital signal processing Implementations using DSP Microprocessors with Examples from TMS320C54XX", Ist ed., Cengage Learning, 2004. **Reference books** [1] Sanjit K Mitra, "Digital Signal Processing A Computer Based Approach", Ist ed., Tata McGraw Hill, 1998. [2] Jhony R Jhonson, "Introduction to Digital Signal Processing", Ist ed., Prentice Hall, 1989. [3] P Ramesh Babu, "Digital Image Processing", VIth ed., Scitech, 2010
E-resources and other digital material	[1]http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011 [2] nptel.ac.in/digital signal processing/

Independent Learning (Moocs)

14EI5506/1 – Industrial Safety and Environmental Management

Course Category:	Independent Learning	**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	Infer various hazards and safety methods employed in industries.											
	CO2	Choose suitable risk assessment and management methods.											
	CO3	Outline the safety methods in oil and gas industry.											
	CO4	Explain the impact of industries on 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			H				H					
	CO2			H			H	H					
	CO3			H			H						
	CO4			H			H	H					
Course Content	**UNIT – I** **Safety Assurance & Assessment:** Introduction to HSE, Safety Assurance, Safety in design and operations, Organizing for safety, Hazard Classification and assessment, Hazard Evaluation and Control, Hazop, Hazop case study, FMEA. **UNIT – II** **Accident Modeling, risk assessment and management:** Dose assessment, Safety regulations, Toxic releases-models and methods, Chemical risk analysis, Chemical exposure index(CEI), Case studies in oil industries, Quantitative risk assessment, Fire and explosion models, Flammability diagrams, Exposure models, Fire and explosion-prevention methods, Event tree and fault tree analyses **UNIT – III** **Safety measures in design and operation:** Safety measure in oil & gas industry, Safety methods in design and operation, Process safety management, Software used in HSE. **UNIT – IV** **Environmental issues and management:** Environmental impact and management, Impact of oil and gas industry in marine environment, Oil hydrocarbons in marine environment, Chemical disposal of offshore industry and environmental management, Dispersion models and atmospheric pollution, Hazard assessment.												

Text books and Reference books	**Text Book** **Reference Books:**
E-resources and other digital material	[1] http://nptel.ac.in/courses/114106039

14EI5506/2 Analog Signal Conditioning in Instrumentation

Course Category:	Independent Learning	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Linear IC applications, Industrial instrumentation	**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	Summarize issues in the design of amplifiers and power supply circuits.											
	CO2	Review IC temperature indicator and controllers..											
	CO3	Outline designing of different industrial drivers.											
	CO4	Summarize the design of analog transmitters.											
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		L							
	CO3		H	L		L							
	CO4		H	L		L							
Course Content	**UNIT – I** **Amplifiers and Power Supplies:** Transistor as amplifier, Problems in the transistor amplifier. Temperature drift and device to device variation. 3-transistor op-amp. Use of op-amp for different applications and basic issues in use of op amps. Design of linear power supply using op amp. Selection of components. Design of heat sink and design of transformer for the linear power supply. Design of low drop out regulators **UNIT – II** **Temperature Indicator and Control:** Design of temperature indicator using IC sensors. Errors due to resistance drift, Op amp offset voltage drift, offset current drift. Error budgeting. Design of an on/off temperature controller. Design of proportional temperature controller circuit using thermocouple temperature Sensor. Error budgeting. Design of PID temperature controllers. Basics of PID parameter selection **UNIT – III** **Driver Circuits:** Design of different types of heater drive circuits. Thyristor and transistor based drive circuit design. Error budgeting. Design of heater drive circuits using triacs and transistors. Use of pulse width modulation circuits. Use of MOSFETS and IGBTs. Short circuit protection techniques **UNIT – IV** **Transmission:** Cable transmission of analog voltage and current signals. Instrument connectivity. Land line telemetry. Design of 4-20 ma current transmitters for resistance sensors. Design of 4-20 ma current transmitters for LVDT sensor.												

Text books and Reference books	**Text Book** [1] Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998 [2] R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999. [3] Ernest O.Doebelin, Dhanesh N Manik, Measurement Sytems.,VI edition McGraw Hill Book Company, 1998 [4] A.K Sawhney , Electrical and Electronic Measurements and Instrumentation
E-resources and other digital material	[1] http://nptel.iitm.ac.in [2]http://nptel.ac.in/courses/117108038/

14EI3507 – Analytical Instrumentation

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	Engineering Chemistry	**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 suitable photometer and spectrophotometer based on the application.											
	CO2	Describe the operation of various spectroscopic instruments.											
	CO3	Outline the various radiation detectors and x-ray spectroscopic instruments											
	CO4	Identify the use of chromatography and gas analyzers in real time industrial environments.											
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											
	CO3		H					L					
	CO4		H					L					

Course Content

UNIT – I

Photometers & Spectrophotometers: Introduction to analytical instruments- Radiation sources, Filters, Monochromators and Detectors, UV-VIS photometers- Single beam and Double beam, Flame photometer, UV-VIS Spectrophotometers- Single beam Null type, Double beam ratio recording, Microprocessor based, FTIR Spectrophotometer, Applications

UNIT – II

Mass Spectroscopy: Principle, Types of Mass Spectrometers- Magnetic Deflection, The Time-of Flight, Radio frequency, Quadrupole, Applications.

NMR and ESR Spectroscopy: Principle of NMR Spectroscopy, Types of NMR spectrometers- Continuous wave and FT NMR, Principle of ESR spectroscopy, ESR Spectrometer, Applications.

UNIT – III

Radiation Detectors: Ionization chamber, Geiger Muller Counter, Proportional Counter, Scintillation Counter, Gamma Counter, Semi conductor Detectors, Pulse Height Analyser.

X-Ray Spectroscopy: Production of X-Rays and X-Ray Spectra, Instrumentation, X-Ray Diffractometer, X-Ray Absorption meter, X-Ray Fluoroscent Spectrometer, Applications

UNIT – IV

Chromatography: Basic definitions, Classification of Chromatographic methods, Gas Chromatography- Introduction, Basic parts of Chromatograph, Liquid Chromatography-

	Introduction, Types, High Performance Liquid Chromatograph -Detection systems, Applications. **Industrial Gas Analyzer**: Types, Paramagnetic Oxygen Analyzer, Infrared Gas Analyzer, Thermal Conductivity Analyzer, Analyzers based on Gas density, Method based on Ionization of gases .
Text books and Reference books	**Text Book** [1] R.S.Khandpur, " Handbook of Analytical Instruments", IInd ed, TMH, 2006. [2] Willard H.H, Merrit L.L, Dean J.A,"Instrumental Methods of Analysis", VIIth ed, CBS publishers and Distributors, 1988. **Reference Books** [1] D.A.Skoog and James J.Leary, "Principles of Instrumental Analysis", Vth ed, Holt-Saunders, 1997. [1] James W.Robinson, Eileen M.Skelly Frame,George M.Frame, "Undergraduate Instrumental Analysis", VIIth ed, CRC Press, 2014.
E-resources and other digital material	[1] http://www.srmuniv.ac.in/sites/default/files/files/IC0309%20Analytical%20Instumentation.pdf [2] http://nptel.ac.in/courses/103108100 [3] http://nptel.ac.in/courses/102107028/34

14EI3551 – Integrated Circuits Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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	Analyze various characteristics of op-amp and design different linear and non-linear op-amp circuits and Waveform generators.											
	CO2	Design active filter circuits suitable for particular application.											
	CO3	Design 555 Timer circuits and voltage regulators.											
	CO4	Design DAC using IC 741											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		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		H								
	CO2				H								
	CO3				H								
	CO4		M										
Course Content	**List of Experiments** 1. Measurement of Op-amp parameters 2. Applications of Op-amp 741IC -Adder, subtractor, comparator 3. Integrator, differentiator using 741IC 4. Instrumentation amplifier using 741IC 5. Waveform generation using 741IC (square, triangular) 6. Design of Clipper and Clamper circuits using 741IC 7. Wein bridge Oscillator using 741IC 8. Design of active filters using 741IC (LPF & HPE-first order) 9. IC 555 Timer Monostable operation circuit 10. IC 555 Timer Astable operation circuit 11. Schmitt trigger using IC 555 Timer 12. IC 565 PLL Applications 13. Three terminal Voltage regulators IC 7805 14. Design of IC Regulator using 723 D-A converter(R-2R ladder												
Text books and Reference books	**Text Book** [1] Roy and Chowdhary, "Principles of Integrated Circuits", 2nd ed., New Age, International, 2003. [2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 3rd ed, PHI, 1997.												
E-resources and other digital material	1. www.allaboutcircuits.com.												

14EI3552 – Microcontrollers Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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	Describe the architecture of 8051 microcontroller.											
	CO2	Use the instruction set of 8051 to solve problems.											
	CO3	Select and use various interfacing peripherals along with microcontroller.											
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	H								
	CO3			H	H	H							
Course Content	**List of Experiments** **PART A** Programs on Data Transfer Instructions Programs on Arithmetic and logical Instructions Programs on subroutines Programs on stack operations Program on Serial data transmission **PART B** Interfacing of stepper motor Interfacing of DAC Interfacing of LED Interfacing of LCD Interfacing of Keyboard Interfacing of DC Motor Interfacing of DAC for ADC & Temperature sensor Interfacing of Elevator Interfacing of traffic signals Interfacing of logic controller Any 10 experiments from the above list												
Text books and Reference	**Text Book** [1] Kenneth J. Ayala, “The 8051 Microcontroller Architecture, programming and applications”												

books	Third edition, West Publishing Company. [2] Raj Kamal, " Microcontrollers Architecture, Programming, interfacing and system design" Pearson Education. **Reference Books**
E-resources and other digital material	1. http://nptel.iitg.ernet.in.

Third Year
(VI Semester)

14EI3601 – Virtual Instrumentation

Course Category:	Program Core	**Credits:**	4
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	Explain the architecture of a virtual instrument and data flow techniques.											
	CO2	Describe the development of virtual instrument using graphical user interface.											
	CO3	Describe and practice the various basic programming techniques.											
	CO4	Explain and demonstrate Data acquisition methods, various interfacing standards and techniques											
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	H							
	CO3					H							
	CO4				H	H							

Course Content

UNIT – I

Review of Virtual Instrumentation: Block diagram and architecture of a virtual instrument, Graphical system design model, Data-flow techniques, Hardware and software in virtual instrumentation, Virtual instrument and traditional instrument, comparison with conventional programming, OPC, HMI/SCADA software, Active X programming.

UNIT – II

VI Programming Techniques: Introduction to Lab VIEW, Advantages of Lab VIEW, Software environment, Creating and saving VI, Controls and indicators, Data types,

Modular Programming: Creating an Icon, Building a connector pane, Creating Sub VI's, Creating a standalone application.

Repetition And Loops: Introduction, For loops, While loops, Structure tunnels, Shift registers feedback nodes, Control timing, Local variables and global variables.

Arrays: Introduction, Creating one dimensional array, Creating two dimensional array, Initializing arrays, Array functions, Auto indexing, Matrix operations with arrays

UNIT - III

Clusters: Introduction, Creating clusters, Cluster operations, Assembling clusters, Dis assembling clusters, Conversion between arrays and clusters, Error handling, Error cluster.

Plotting Data: Introduction, Types of wave forms, Wave form graphs, Wave form charts, Wave form data type, XY graphs, Intensity graphs and charts, Digital wave form graphs, Customizing graphs and Charts.

	Structures: Introduction, case structures, sequence structures, customising structures, formula nodes, math script node. **Srings And File I/O**: Introduction, crating string controls and indicators, string functions, formatting strings, configuring string controls and indicators, basics of file input/ output, choosing a file format, file I/O VI's **UNIT – IV** **Data Acquisition Basics:** Introduction to data acquisition on PC, Sampling fundamentals, Signal conditioning, DAQ hardware configuration, DAQ Hardware, DAQ assistant, channels and task configuration, components of computer based measurement system. **Instrument Control:** Introduction, GPIB communication, software architecture, Instrument I/O assistant, Virtual Instrument Software Architecture (VISA) and IVI, Instrument drivers, USB, firewire.
Text books and Reference books	**Text Book** [1] 1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Ist edition, PHI, 2013. **Reference Books** [1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", Ist edition, Tata McGraw-Hill, 2005. [2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006.
E-resources and other digital material	1. http://www.ni.com

14EI3602 – Industrial Electronics

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0 - 0
Prerequisites:	Basics of Electronics Engineering, Electrical Technology	**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 and explain principles and characteristics of different power devices
CO2	Understand and Analyze SCR converters, Inverters and Chopper circuits
CO3	Explain amplifiers and Regulated power supplies for industrial applications
CO4	Understand and Explain special Industrial operations and 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	PO k	PO l
CO1	H		M									
CO2			M									
CO3	H	M										
CO4	H	M										

Course Content

UNIT – I

Power Devices and Characteristics: Structure and characteristics of power devices: semiconductor Diode, Transistor, MOSFET

Thyristors: SCR structure and operation, Characteristics of SCR: Static V-I characteristics, Switching characteristics and Gate characteristics, SCR turn on methods, SCR commutation techniques, DIAC and TRIAC characteristics

UNIT – II

Thyristor Converters: Single phase converters: Half wave converters, Full wave converters, Bridge converters

Thyristor Inverters and Choppers: Single phase inverters, Mc Murray Inverter, Mc Murray Bedford Inverter, Principle of step down chopper, Principle of step up chopper, Chopper configurations

UNIT - III

Amplifiers and Regulated Power supplies: DC Amplifier, Differential amplifier as a DC amplifier, Chopper stabilized DC amplifier, Regulated power supplies: Principle, DC voltage regulator, Uninterrupted power supply (UPS), Switched mode power supplies (SMPS)

UNIT – IV

Industrial Applications: Industrial timing circuits, Electric welding methods and types, Induction and Dielectric Heating: Principle, Theory and applications, Amplidyne servo mechanism, Ultrasonic generators and applications

Text books and Reference books	**Text Book** [1] G. K. Mithal and Dr. Maneesh Gupta, "Industrial and Power Electronics," Khanna Publications, 9th Ed., 2007. **Reference Books** [1] M. Ramamurthy, Thyristors and their applications, East-West Press, 2nd Ed., 1998. [2]M. H. Rashid, Power Electronics-Devices, Circuits and Application, Prentice Hall of India, 2003. [2] P. S. Bimbra, "Power Electronics," Khanna Publications, 4th Ed., 2010
E-resources and other digital material	www.nptel.ac.in/downloads/108105066/ http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/lecture-notes/ http://www.nptelvideos.in/2012/11/power-electronics.html http://onlinevideolecture.com/?course_id=510

14EI3603 – Industrial Communication Networks

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	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	Acquire comprehensive knowledge of various industrial networks, topologies, transmission modes and functions of each layer of the OSI model.											
	CO2	Understand the technical issues related to HART communication protocol.											
	CO3	Identify various types of network devices and hardware suitable for Foundation Fieldbus.											
	CO4	Explain the features of PROFIBUS standard for process automation.											
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									
	CO4			H									

Course Content

UNIT – I

Introduction to Data Communication and Industrial Networks: Introduction, Data communication, Data types, Data flow methods, Transmission modes, Transmission impairments, Data rate and bandwidth relationship.

Introduction to networks, Data communication standards and organizations, Network topology, Network components, Classification of networks, OSI model, TCP/IP reference model.

UNIT – II

Networks in Process Automation: Introduction, I/O bus networks, Networking at I/O & field levels, Control level, Enterprise/Management level.

Highway Addressable Remote Transducer (HART): Introduction to HART protocol, HART encoding and waveform, HART addressing, Arbitration, Communication modes, HART networks, HART communication layers.

UNIT – III

Foundation Field Bus: Introduction**,** Definition and features, Foundation field bus data types, Architecture, HSE benefits, Communication process, Technology of Foundation Fieldbus, Device information, Redundancy.

UNIT – IV

PROFIBUS: Introduction**,** Transmission technology, Communication protocols, Device classes, PROFIBUS in automation, OSI model of PROFIBUS protocol stack, PROFIBUS - DP Characteristics, Communication profile of PROFIBUS – DP, Physical layer, Data link layer,

	DDIM and user interface, , PROFIBUS - PA characteristics, Bus monitor, Time stamp, Redundancy, PROFIsafe, PROFIdrive, PROFInet, Foundation Fieldbus and PROFIBUS a comparison.
Text books and Reference books	**Text Book** [1] S. Sunit Kumar " Fieldbus and Networking in Process Automation" CRC Press, Taylor and Francis Group, Ist ed, 2014 [2] S.Mackay, E.Wrijut, D.Reynders and J.Park, "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, Ist ed,, 2004 **Reference books** [1] S. Mackay, J. Park and E. Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier,2002 [2] R. Bowden, 'HART application Guide', HART Communication Foundation,1999
E-resources and other digital material	[1] https://www.youtube.com/watch?v=DgAwOJMN2N0 [2] http://nptel.iitg.ernet.in/Elec_Engg/IIT [3] http://www.nptel.ac.in/courses/106105081

14HS1604 - Engineering Economics and Finance

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 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 various forms of organizations and principles of management											
	CO2	Understand the various aspects of business economics.											
	CO3	Acquire knowledge on Human resources and Marketing functions											
	CO4	Understand best alternatives for various investment decisions and different depreciation methods											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		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				H							M
	CO3	M											M
	CO4	M				H							M

Course Content

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
Text books and Reference books	**Text Book** [1] P.PremchandBabu and M.Madan Mohan,"Managerial Economics and Financial Analysis",Himalaya publishing house, 2011 edition [2] M. Mahajan,"Industrial Engineering and Production Management",IInd,ed.,DhanpatRai Publications. **Reference Books** [1] Heusen & 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 XIth Edition [5] R.Panneerselvam, "Production and operations management", PHI Learning pvt Ltd, New Delhi, 2012
E-resources and other digital material	www.tectime.com www.exinfm.com www.slideshare.net www.economywatch.com

14EI3605 – Process Control

Course Category:	Program Core	**Credits:**	4
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	Realize the mathematical models for various physical systems.											
	CO2	Understand and select the different controllers with different control actions for different process variables.											
	CO3	Analyze the various advanced control strategies. and Apply different tuning procedures to various process control systems											
	CO4	Identify the process transfer function by process identification.											
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								
	CO2	H	L										
	CO3	H			L								
	CO4		H										

Course Content

UNIT – I

Introduction to Process Control: Introduction to process control, Definition, Elements of process control, Characteristics of physical systems- Liquid, Gas and Thermal systems- Mathematical modeling, Self regulation, Servo and regulatory operation. Lumped Vs Distributed parameter model - Binary distillation column - Heat exchanger-CSTR-Linearization of nonlinear system.

Controller Modes: Basic control actions - Characteristic of on-off, proportional, single speed floating, integral and derivative control modes-P+I, P+D and P+I+D control modes

UNIT – II

Controlling Elements: Self-operated controllers, Pneumatic controllers, Hydraulic controllers, Electrical and Electronic controllers

Final Control Elements: Pneumatic actuators, Electro-Pneumatic actuators, Hydraulic actuators, Electric motor actuators. Control Valves- Sliding stem control valves, Rotating shaft control valves, Control valve sizing.

UNIT - III

Controller Tuning & Process Identification: Controller tuning- Criteria for good control, Tuning rules-Ziegler- Nichols and Cohen-Coon rules, Process Identification- Step, Frequency and Pulse testing

Advanced Control Strategies: Cascade control, Feed forward control, Ratio Control, Smith

	predictor control and internal model control **UNIT – IV** **Applications:** Energy transfer and conversion- Heat transfer, Controlling chemical reactions-pH control, Mass transfer operations- Distillation, Evaporation, Drying
Text books and Reference books	**Text Book** [1] Stephanopoulos G, "Chemical Process Control", IIIrd ed, PHI, 1994. [2] EckmanD.P, "Auntomatic process control', Wiley Eastern Ltd., 1993. [3] Donald R. Coughnnowr, "Process system analysis and control, IInd ed, TMH, 1991. **Reference Books** [1] D Patranabis, "Principles of Process Control" IInd ed, TMH,2007. [2] F.G.Shinskey, " Process Control Systems" IIIrd ed, TMH,1988
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/**Process-Control**-and-Instrumentation 2. nptel.ac.in/courses/103105064/

14EI3651 – Virtual Instrumentation Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	14EI3601-Virtual Instrumentation	**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 graphical programming terminology and able to create a virtual instruments for simple problems.											
	CO2	Able to use the various looping constructs, arrays, matrices and clusters.											
	CO3	Able to use various data plotting techniques and structures											
	CO4	Able to use the data acquisition device to acquire the measurement data from real world into PC											
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	H							
	CO3				M	H							
	CO4				M	H							
Course Content	1. Programs on controls and indicators 2. Programs on Arithmetic operations 3. Programs on Boolean operations 4. Programs on Sub VI's 5. Programs on repetition and loops 6. Programs on Arrays 7. Programs on Matrices 8. Programs on Clusters 9. Programs on Data plotting 10. Programs on Structures 11. Programs on Formula nodes and Math script nodes 12. Programs on Strings, File I/O 13. Programs on Data acquisition 14. Programs on Data logging 15. Programs using NI ELVISmx												
Text books and Reference books	**Text Book** [1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Ist edition, PHI, 2013 **Reference Books** [1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", Ist edition, Tata												

	McGraw-Hill, 2005. [2] Gary Johnson, Richard Jennings, “LabVIEW Graphical Programming”, Tata McGraw-Hill, 2006.
E-resources and other digital material	[1] http://www.ni.com

14EI3652 – Process Control Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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 the various performance characteristics of various transmitters used in industrial process control.											
	CO2	Analyze the characteristics of control valve and I/P converter experimentally.											
	CO3	Compare the characteristics of control actions on various process stations practically.											
	CO4	Analyze the characteristics of various advanced control strategies experimentally											
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								
	CO2	H			H								
	CO3		H		L								
	CO4				H								
Course Content	1. Characteristics of Chromel – Alumel thermo couple and temperature transmitter 2. Characteristics of PID controller in Temperature Process Station. Using PC/PLC 3. Characteristics of Level transmitter 4. Characteristics of I/P converter and control valve (LPS) 5. Characteristics of P I D controller in Level Process Station using PC/PLC 6. Characteristics of P I controller in Level Process Station (LPS)using PC/PLC 7. Characteristics of Flow transmitter 8. Characteristics of I/P converter and control valve (FPS) 9. Characteristics of P I controller in Flow Process Station (FPS)using PC/PLC 10. Characteristics of pressure transmitter and I/P converter (PPS) 11. Characteristics of PID controller in Pressure Process Station(PPS)using PC/PLC 12. Characteristics of Cascade Control 13. Characteristics of Ratio Control 14. Characteristics of Digital PID Control 15. Characteristics of pH control system												
Text books and Reference books	**Text Book** [1] Stephanopoulos G, "Chemical Process Control", IIIrd ed, PHI, 1994. [2] EckmanD.P, "Automatic Process Control', Wiley Eastern Ltd., 1993. [3] Donald R. Coughnnowr, "Process system analysis and control, IInd ed, TMH, 1991.												

	Reference Books [1] 1] D Patranabis, “Principles of Process Control” IInd ed, TMH, 2007. [2] F.G.Shinskey, “Process Control Systems” IIIrd ed, TMH, 1988. .
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2.nptel.ac.in/courses/103105064

14EI 3653 TERM PAPER

Internal Assessment Marks: 30M

External Assessment Marks: 70M

Total: 100M

Course Objective

To identify a technical topic beyond curriculum, review the existing literature and prepare report.

Learning Outcomes

Students will be able to familiarize with new technical topics and participate in technical seminars and paper contests.

Distribution of Marks:

Continuous Evaluation: 30 Marks

Day to Day Assessment: 10M

Two Seminars : 10M + 10M

Semester End Evaluation: 70 Marks

Report : 40M

Seminar & Viva: 30

Fourth Year
(VII Semester)

14EI3701 – Robotics and Control

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Mechanics for Engineers, Control 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 fundamental concepts and working principles of Robot anatomy.											
	CO2	Understand the kinematics and inverse kinematics problems applicable to manipulators.											
	CO3	Apply various control strategies to manipulator design.											
	CO4	Explain the use of Robots in industrial 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	PO k	PO l
	CO1	H											
	CO2		H										
	CO3			H									
	CO4			L									

Course Content

UNIT – I

Introduction to Robotics: Evolution of Robots and Robotics. Laws of robotics, Robot anatomy, Manipulators, Links, Types of joints, Degrees of freedom, Required DOF in a manipulator, ARM and Wrist configuration, End effectors, Robot actuators, Sensors and vision.

UNIT – II

Robot Kinematics:

Direct kinematic model, Mechanical structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denavit Hartenberg notation. Kinematic relationship between adjacent links, Manipulator transformation matrix, Case study- 3DOF articulated arm kinematic model, Inverse kinematics, Manipulator work space, Solvability of inverse kinematic model, Solution echniques, Closed form solution, Case study – 3DOF articulated arm inverse kinematics.

UNIT – III

Control of Manipulators: Block diagram of manipulator control system, Open and closed loop control system, Manipulator control problem, Linear control schemes, Linear second order SISO model of a manipulator joint, Model of a DC motor, Partition PD and PID control schemes. Force control of robotic manipulator, Hybrid position/ force control.

UNIT – IV

Applications Of Robots: Industrial applications: Material handling-Material transfer applications, Machine loading and unloading application, Picking and placing, Palletizing and depalletizing, Processing applications-Welding. Assembly applications, Peg in hole assembly,

	Inspection application. An overview of non industrial applications, Work place design considerations for safety, Safety sensors and safety monitoring,
Text books and Reference books	**Text Book** [1] R.K.Mittal &, I.J.Nagarath, "Robotics and Control", Tata McGraw Hill pvt ltd, XVth ed, 2010. [2] S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill pvt ltd, 2002. **Reference books** [1] R.D.Klafter, T.A.Chimielewski & M. Negin, "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994 [2] P.J.Mc Kerrow, "Introduction to Robotics", Addison Wesley, USA, 1991
E-resources and other digital material	[1] http://academicearth.org/courses/introduction-to-robotics [2] http://nptel.iitm.ac.in/video.php?courseId=1052

14EI3702 – Computer Control of Processes

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Signals and Systems, Control systems, Process Control.	**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	Describe the role of computers in industrial automation.											
	CO2	Develop the mathematical modeling of various processes in discrete domain.											
	CO3	Analyze the response and stability of computer control system using pulse transfer function and state space approach.											
	CO4	Design the appropriate digital control algorithm for industrial processes.											
	CO5	Select suitable intelligent controllers for real time 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	PO k	PO l
	CO1	H											
	CO2		H										
	CO3		H	H		L							
	CO4			H									
	CO5			L		H							
Course Content	**UNIT – I** **Introduction to Computers in Process Control:** Need of computer in a control system; Functional block diagram of a computer control system; Applications of computers in process industries - Data loggers, Supervisory control, Direct digital control , Supervisory Control and Data Acquisition (SCADA). **Mathematical Modeling of Discrete Systems:** Introduction to mathematical modeling, Mathematical model for processes in discrete domain - First order and second order processes without and with pure delay , Higher order systems ; Pulse transfer functions **UNIT – II** **Analysis of Discrete Time Systems Using Pulse Transfer Functions:** Mathematical representation of sampler and zero order hold, Modified z transforms, Open loop and closed loop analysis of discrete data systems, Stability in Z- domain, Jury stability test. **Analysis of Discrete Time Systems Using State Space Approach:** Introduction, State space representation of digital processors, Conversion of state variable models to pulse transfer function, State space representation of computer control system, Solution of state difference equations, Stability, Controllability and Observability of computer control system												

	UNIT – III **Design of Digital Control Algorithms :** General expression for digital control algorithm for set point changes, Dead beat algorithm , Dahlin's algorithm, Ringing effect, Kalman's algorithm , Design of digital control algorithm for load changes, Digital PID algorithms-Position and velocity forms, Selection of sampling time **UNIT – IV** **Intelligent Controllers:** Introduction, Model based controllers - Adaptive controller, Optimal controller, Predictive controller; Artificial intelligence(AI) based systems, Expert control system, Introduction to fuzzy control, Fuzzy control system, Artificial neural networks – Introduction, Neural controllers and Neuro Fuzzy control system
Text books and Reference books	**Text Book** [1] Pradeep B.Deshpande and Raymond H Ash, "Elements of Computer Process Control with Advanced Applications", Instrument society of America.,1981.[Unit-I,II & III] [2] M.Gopal, "Digital Control and State Variable Methods", IIInd ed., TMH, New Delhi, 2009. [Unit- II] [3] Krishna Kant, "Computer-Based Industrial control", IInd ed., PHI, Delhi, 2010. [Unit-IV] **Reference books** [1] C.D. Johnson, "Process Control Instrumentation Technology", IVth ed., Prentice Hall Inc, 2000. [Unit-I]
E-resources and other digital material	[1] http://nptel.ac.in/courses/108103008/

14EI3703 – Industrial Automation

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -0- 0
Prerequisites:	Industrial Instrumentation Process Control	**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 basics of programmable logic controllers											
	CO2	Design and implement Ladder diagram for simple applications.											
	CO3	Describe the evolution and overview of Distributed control systems (DCS).											
	CO4	Summarize applications DCS in different industries.											
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	H	H							
	CO3	H											
	CO4	H											

Course Content

UNIT – I

Overview Of Programmable Logic Controllers: Definition, Parts of PLC, Principles of operation, PLC vs computer, PLC size and applications, PLC hardware –I/O section, Discrete I/O modules, Analog I/O modules, Special I/O, Modes of CPU, Memory types and design, Programming device. Fundamentals of logic, Field I/O devices- Electromagnetic relays, Switches and output devices.

UNIT – II

Programming Of PLC: Basics of programming of PLC - Program SCAN, Programming languages, Relay type instruction, Branch instructions, Programming Timers and Counters, Program control instructions, Data manipulation instructions, Math instructions.

PLC Based Process Control and Data Acquisition Systems: Types of processes, Structure of control systems.

UNIT – III

Distributed Control Systems (DCS): Evolution, Resulting system architectures, Generalized distributed control system architecture. Local control unit (LCU), Function blocks, LCU architectures, LCU process interface issues - Overview of security design approaches, Control output configurations. Operator Interface –Installation and equipment configurations, Operator interface requirements, Low-level operator interface, High-level operator interface, Operator displays - Engineering interface.

UNIT – IV

Application Of DCS: Power plant process, DCS applications in power plants, Iron and steel making process, Integrated control of a steel plant, Cock ovens plant control, Blast furnace

	control, Bio-technology plant control, Cement plants, Pulp and paper process control, DCS application in pulp and paper plants, Oil and gas fields - onshore oil and gas field automation, Offshore oil and gas field automation.
Text books and Reference books	**Text Book** [1] Frank D. Petruzella, "Programmable Logic Controllers", IInd ed, Glencoe McGraw Hill [2] Michael P. Lucas, "Distributed Control Systems" Their Evaluation and Design, Van Nostrand Reinhold Co.,1986. [3] D.Popovic and V.P.Bhatkar, "Distributed Computer Control for Industrial Automation", Marcel Dekkar Inc., 1990 **Reference books** [1] G.K.McMillan, "Process/ Industrial Instrument and Handbook", McGraw-Hill, New York, 1999. [2] Krishna Kanth, " Computer - Based Industrial Control" PHI, IInd ed, 2010.
E-resources and other digital material	[1] www.sea.siemens.com [2] www.pacontrol.com [3] www.engin.umich.edu/group/ctm/digital/digital.html

14EI3704 – Embedded Systems

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Microcontrollers and Applications	**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 Embedded Systems and select the hardware components.											
	CO2	Select various embedded software.											
	CO3	Explain the embedded architecture, implement & test the design.											
	CO4	Use the ARM instruction set.											
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									
	CO4				H								

Course Content

UNIT – I

Introduction to Embedded System: Embedded systems Vs General computing systems, History of embedded systems, Classification, Major application areas, Purpose of embedded systems.

Hardware: ISA architecture models, Internal processor design, Processor performance, ROM, RAM, Auxiliary memory, memory management of external memory, Managing data: Serial Vs Parallel I/O, Interfacing I/O components, Bus arbitration and timing, Integrating the bus with other board components, Bus performance.

UNIT – II

Embedded Software: Device drivers: Device drivers for interrupt handling, Memory device drivers, On-board bus device drivers**.**

Embedded Operating Systems: What is a process, Multi-tasking and process management, Memory Management, I/O and file system management, OS standards example: POSIX.

Middleware and Application Software: Middleware, Application, Middleware Examples, Application layer software Examples

UNIT – III

Defining the System- Creating the architecture and documenting the design: Creating an embedded architecture, ABC's (Architecture Business Cycles) of embedded system, Architectural patterns and reference models, Architectural structures, Document the architecture, Analyze and evaluate the Architecture**.**

Implementation and Testing: Implementing the design, The main software utility tool, Writing

	code in an editor or IDE, Computer Aided Design (CAD) and the hardware, Translation tools, Preprocessors, Interpreters, Compilers, Linkers, Debugging tools, System boot up, Quality assurance and testing of the design, Maintaining the embedded system . **UNIT – IV** **ARM Processor Fundamentals:** Registers, Current program status register, pipeline, Exceptions, Interrupts and the vector table, Core Extentions, ARM processor families. **ARM Instruction Set:** Data processing instructions, Branch instructions, Load – Store instructions, Software interrupt instruction, Program status register instruction, Loading constants, Conditional execution
Text books and Reference books	**Text Book** [1] K.V. Shibu "Introduction to Embedded Systems", Mc Graw Hill Education [2] Tammy Noergaard, "Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers" Elsevier, 2005. [3] Sloss Andrew N, Symes Dominic and Wright Chris, "ARM System Developer's guide: Designing and and Optimizing", Morgan Kaufman Publication, 2004 **Reference books** [1]Raj Kamal, "Embedded Systems - Architecture: Programming and Design", IIIrd ed. Tata McGraw- Hill Education, 2003
E-resources and other digital material	[1] http://nptel.ac.in/courses/108102045

14EI4705/1 – Advanced Digital System Design

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -01- 0
Prerequisites:	Digital Electronics	**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 design Synchronous sequential logic circuits and machine											
	CO2	Analyze and design Asynchronous sequential logic circuits											
	CO3	Design combinational and sequential programmable devices											
	CO4	Understand the basics of FPGA and Xilinx											
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	H			L								
	CO4	H			L	H							

Course Content

UNIT – I

Sequential Logic Circuits: Mealy machine - Moore machine- Trivial/Reversible/Isomorphic sequential machines - State diagrams - State table minimization - Incompletely specified sequential machines - State assignments -Design of synchronous sequential logic circuits.

Synchronous Sequential Circuit Design: Analysis of clocked synchronous sequential networks (CSSN), Modeling of CSSN state table assignment and reduction - Design of CSSN - Design of iterative circuits - ASM chart - ASM realization.

UNIT – II

Asynchronous Sequential Circuit Design: Analysis of Asynchronous sequential circuits (ASC), Flow table reduction - Races in ASC state assignment problem and the transition table - Design of ASC - Static and dynamic hazards - Data synchronizers -Designing of vending machine controller - Mixed operating mode Asynchronous circuits.

UNIT – III

Programmable Logic Devices: Basic concepts, Programming technologies-Programmable Logic Element (PLE), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Structure of standard PLD's - Complex PLD's CPLD - System design using PLD's - Design of combinational and sequential circuits using PLD's - Programmable PAL device using PALASM - Design of state machines.

UNIT – IV

FPGA and XILINX: Introduction to Field Programmable Gate Arrays-Types of FPGA –Xilinx XC3000 series- Logic Cell Array LCA-Configurable Logic Blocks CLB-Input/output Block

	IOB Programmable Interconnect Point PIP-Introduction to ACT2 family and Xilinx XC4000 families- Design examples.
Text books and Reference books	**Text Book** [1] Thomas Floyd, "Digital fundamentals", Pearson Education, 2011 [2] Donald G. Givone, "Digital Principles and Design", Tata McGraw Hill, 2002. **Reference books** [1] John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001 [2] Charles H Roth, "Fundamentals of Logic Design", Thomson Learning 2004
E-resources and other digital material	-

14EI4705/2– Fiber Optic Sensors

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -0- 0
Prerequisites:	Engineering Physics, Sensors and Transducers.	**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 basics of Fiber Optics and Identify the different types of Optical Sources.											
	CO2	Identify the different types of Optical detectors and select the appropriate fiber optic sensors to measure physical and electrical parameters.											
	CO3	Use Polarimetric and Frequency modulated sensors to measure different physical and electrical parameters.											
	CO4	Select the appropriate fiber optic sensor to measure various physical and biomedical parameters.											
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										
	CO2	H	L										
	CO3	H			L								
	CO4		L										
Course Content	**UNIT – I** **Basics of Fiber Optics**: Introduction; Light propagation in an optical fiber - Ray propagation, Mode propagation; Acceptance angle and numerical aperture ; Fiber characteristics – Fiber losses, Dispersion; Types of optical fibers ; Optical fibers for sensors; Fiber selection for sensors. **Optical Sources:** Introduction; General requirements; Light Sources – Thermal sources, Non thermal sources Laser, Gas laser, semiconductor laser (Laser diode), Light emitting diode. **UNIT – II** **Optical Detectors:** Introduction; Basic requirements for detectors; Classification of optical detectors; Photomultiplier tube; Semiconductor photodetectors – Photoconductor, Photodiodes, PIN photodiode, Avalanche photodiode. **Interferometric Sensors**: Fiber Optic Interferometers - Mach Zehnder interferometer, Michelson interferometer, Sagnac interferometer, Febry Perot interferometer; Magnetic field / Electric current sensor; Electric field / Voltage sensor; Acoustic sensor; Gyroscope; Temperature sensor; Hydrogen gas sensor; Strain sensor. **UNIT – III** **Polarimetric Sensors:** Introduction; Faraday effect; Kerr effect; Electric current sensor; Magnetic field sensor; Voltage sensor; Pressure sensor; Temperature sensor; Strain sensor; **Frequency Modulated Sensors:** ; Doppler effect; Raman effect; Doppler effect based sensors -												

	Measurement of blood flow velocity, Fiber optic Doppler anemometer; Raman scattering based sensors - Fiber optic Raman spectrometer. **UNIT – IV** **Miscellaneous Sensors**: Introduction; Displacement sensor – Transmissive concept, Reflective concept; Flow measurement; Acoustic sensor; Refractive index sensor – Uniform and straight unclad probe; Detection of oil in water; Liquid level sensor; Temperature sensors – Temperature dependent refractive index of the liquid, Thermal expansion of core and cladding, Rare earth doped optical fibers, Liquid core fiber, Birefringent crystal, Thermochromic transducer, Liquid crystals, Thermal expansion of metals; Pressure sensor – Micro bending loss, Diaphragm curvature, Cantilever; Hydrocarbons detection in water; Oxy hemoglobin concentration measurements; Cardiac output measurement.
Text books and Reference books	**Text Book** [1] B.D.Gupta , "Fiber Optic Sensors", Ist ed, New India Publishing Agency, 2006 **Reference books** [1] Asit Baran Maity , "Optoelectronics and Optical Fiber Sensors" PHI , 2013 [2] J.Wilson and J.F.B.Hawkes., "Optoelectronics an Introduction", II nd ed., PHI [3]R.P.Khare , "Fiber Optics and Optoelectronics" IXth Impression 2010 , Oxford University Press
E-resources and other digital material	

14EI4705/3 – Process Modelling and Simulation

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Process Control	**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 and simulate the linear and nonlinear models for a given process											
	CO2	Design the PID controller for a given process with suitable tuning method											
	CO3	Design Internal Model Controller for stable processes											
	CO4	Design Model Predictive Controller for a given nonlinear process											
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							
	CO2			H		H							
	CO3			H		H							
	CO4			L									
Course Content	**UNIT – I** **Introduction TO Process Modelling**: Definitions, Model representation, Types of modeling equations, Classification of mathematical models, Process models and dynamic behaviour, Reasons for modelling, Balance equations, Material balances, Constitutive relationships, Material and energy balances, Form of dynamic models, Linear models and deviation variables, Dynamic behaviour , Linear state space models. **UNIT – II** **PID Controller Tuning and Enhancements :** Introduction, PID controller forms, Closed-loop oscillation-based tuning, Tuning rules for first-order + dead time processes, Direct synthesis for minimum-phase and non minimum phase processes, Antireset windup, Autotuning techniques, Nonlinear PID control, Controller parameter (gain) scheduling **UNIT – III** **Internal Model Control:** Introduction to model based control, Practical open-loop controller design, Generalization of the open-loop control design procedure ,Model uncertainty and disturbances, The IMC structure, The IMC design procedure, Effect of model uncertainty and disturbances, Improved disturbance rejection design, The equivalent feedback form to IMC, The IMC based PID control design procedure. **UNIT – IV** **Model Predictive Control**: Basic concept of MPC, Optimization problem- Objective functions and models, Dynamic matrix control and examples, Constraints and multivariable systems, Other MPC methods.												

Text books and Reference books	**Text Book** [1] B.Wayne Bequette, "Process Control - Modelling, Design and Simulation", Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 2003 [2] Amiya K.Jana, "Chemical Process Modelling and Computer Simulation", PHI, IInd ed, 2011. **Reference books** [1] B. Wayne Bequette, "Process Dynamics - Modelling, Analysis, and Simulation"**,** Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1998.
E-resources and other digital material	[1] http://nptel.ac.in/courses/108105062/13 [2] https://in.mathworks.com/help/control/examples/design-internal-model-controller-for-chemical-reactor-plant.html?requestedDomain=www.mathworks.com [3] http://www.cc.ntut.edu.tw/~jcjeng/Model%20Predictive%20Control.pdf [4] https://www.sheffield.ac.uk/acse/staff/jar/mpcmaster

14EI4705/4 – Digital Image Processing

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -0- 0
Prerequisites:	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	Explain the fundamentals of digital image processing.											
	CO2	Use the Image Enhancement techniques in spatial and frequency domains.											
	CO3	Explain various image restoration techniques.											
	CO4	Explain the image compression methods and segmentation techniques.											
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							
	CO4				H								
Course Content	**UNIT – I** **Digital Image Fundamentals:** Fundamental steps in digital image processing, Components of an image processing system, Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Some basic relationship between pixels, Linear and nonlinear operations, Color fundamentals, Color models, Pseudo color image processing. **UNIT – II** **Image Enhancement:** Some basic gray level transformations, Histogram processing, Enhancement using arithmetic and logical operations, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods, Introduction to the Fourier transform and frequency domain, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering. **UNIT – III** **Image Restoration:** A model of the image degradation/restoration process, Noise models, Restoration in the presence of noise only, Spatial filtering, Periodic noise reduction by frequency domain filtering, Linear, Position-Invariant degradations, Inverse filtering, Minimum mean square error (Wiener) filtering, Constrained least squares Filtering. **Wavelets and Multiresolution Processing:** Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in two dimensions. **UNIT – IV** **Image Compression:** Fundamentals, Image compression models, Elements of information theory, Error free compression, Lossless predictive, Lossy compression. **Image segmentation:** Detection of discontinuities, Edge linking and boundary detection,												

	Thresholding, Region based segmentation, Segmentation by morphological watersheds.
Text books and Reference books	**Text Book** [1] Gonzalez and Wood, "Digital Image Processing", II nd ed, Person Education, 2002 **Reference books** [1] Anil K. Jain, "Fundamentals of Digital Image Processing", Person Education, 2003. [2] William K Pratt, "Digital Image Processing", IV th ed, A Wiley-Interscience Publication, 2007. [3] S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing ", Tata Mc Graw Hill Publishers, 2009. [4] Jähne, Bernd, "Digital Image Processing and Image Formation", Springer-Verlag Berlin Heidelberg, 2005.
E-resources and other digital material	[1] http://www.imageprocessingplace.com [2]http://cgrava.webhost.uoradea.ro/teaching/PAI/documentatie/Jahne_Digital_Image_Processing.pdf

14EI4706/1– Electromagnetic Interference and Electromagnetic Compatibility

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Network 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	Explain and understand basic concept of EMI and EMC.											
	CO2	Understand various EMI coupling principles.											
	CO3	Explain various EMI tests and EMC technologies.											
	CO4	Understand various EMI/EMC standards.											
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							
	CO2			H		L							
	CO3			H		L							
	CO4			L									
Course Content	**UNIT – I** **EMI Environment:** Concepts of EMI and EMC and definitions, Sources of EMI – Celestial electromagnetic noise - Lightning discharge - Electrostatic discharge - Electromagnetic pulse - Electromagnetic emissions - Noise from relays and switches- Nonlinearities in circuits **UNIT – II** **EMI Coupling Principles:** Capacitive coupling - Inductive coupling - Common impedance ground coupling - Ground loop coupling - Transients in power supply lines - Radiation coupling - Conduction coupling - Common mode and Differential mode interferences - Conducted EM noise on power supply lines. **UNIT – III** **EMI Measurements:** Open area test site measurements - Measurement precautions, Open area test site, Anechoic Chamber - TEM reverberating, TEM GTEM cell: Comparisons. **EMC Techniques:** EMC technology- Grounding – Shielding - Electrical bonding-Power line filter - CM filter – DM filter - EMI suppression Cables - EMC Connectors - Isolation transformer. **UNIT – IV** **EMI / EMC Standards:** Introduction-Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, National and International EMI Standardizing Organizations; Standards for EMI/EMC- MIL-STD-461/462-IEEE/ANSI standard-CISPR/IEC standard, AS/NZS, BSI, CENELEC, ACEC, FCC regulations-British standards-VDE standards-Euro norms-Performance standards-Electro Magnetic Emission and												

	susceptibility standards and specifications.
Text books and Reference books	**Text Book** [1] K. Prasad, "Engineering Electromagnetic Compatibility – Principles, Measurements, and Technologies", IEEE press **Reference books** [1] Henry W. Ott, "Noise Reduction Techniques in Electronic Systems"- IInd ed, John Wiley & Sons. [2] Bernharo Q'Keiser, 'Principles of Electromagnetic Compatibility', Artech house, IIIrd ed, 1986
E-resources and other digital material	-

14EI4706/2 – Measurement and Control in Food Processing

Course Category:	Program Elective	**Credits:**	4
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	Elucidate the Quality control specifications and the role of transducers in food processing industries.											
	CO2	Measure different parameters for quality control in food processing.											
	CO3	Explain about various controllers and indicators for food processing and preservation etc											
	CO4	Elucidate the importance of computer based monitoring and control in food processing.											
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		L									
	CO4			L									

Course Content

UNIT – I

Food Processing Industries: Introduction, Role of transducers in food processing, Process instrumentation and control.

Moisture Content Measurement: Role of moisture content in quality of food- Microwave absorption method - Radio Frequency (RF) impedance technique; Moisture release during drying of food.

UNIT – II

Measurements in Food Processing: Humidity in the food processing environment –definition - Electrical type of humidity meters; Food and process temperature measurement; Food flow metering; Viscosity of liquid foods - Definition and units- Rotating cylinder viscometer

UNIT – III

Measurements in Food Processing: Brix of food - Brix standards - Refractometers; pH values of food -- pH scale – ion - sensitive field effect transistor, pH sensors; Food enzymes - Importance of food enzyme detection - Enzyme sensors; Flavor measurement- Electronic nose.

UNIT – IV

Controllers and Indicators: Introduction; Temperature control in food dehydration and drying; Electronic controllers; Atmosphere control in food preservation; Timers and indicators in food processing; Food sorting and grading control.

Computer-Based Monitoring and Control: Introduction; Importance of monitoring and

	control with computers; Hardware features of a data acquisition and control computer; Examples of computer-based measurement and control in food processing
Text books and Reference books	**Text Book** [1] Manabendra Bhuyan, 'Measurement and Control in Food Processing' . © 2007 by Taylor & Francis Group **Reference books** [1] Erika Kress-Rogers and Christopher J. B. Brimelow "Instrumentation and Sensors for the Food Industry", IInd ed. [2] N.N.Potter and J.H.Hotchkiss, "Food science", Vth ed Gaithersburg, MD: Coultate TP,1995. [3] R.Sridhar, P.K.Anil, P.E.Sankaranarayyan and R. Rakowski, "New Refractometer for On-Line Brix Measurement in the Food Processing Industry" Proc. TIMA-96, 85–90, 1986. [4] G.C.Barney, "Intelligent Instrumentation: Microprocessor Applications in Measurement and Control". Englewood Cliffs, NJ: Prentice Hall International, 1985.
E-resources and other digital material	[1] http://www.nptel.iitm.ac.in

14EI4706/3 – Wireless Sensor Networks

Course Category:	Program Elective	**Credits:**	4
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	Illustrate the basic concepts of wireless sensor networks											
	CO2	Elucidate the node and network architecture of sensor nodes and its execution environment.											
	CO3	Understand the design concepts of MAC layer protocols for wireless sensor networks											
	CO4	Identify the importance of topology control and clustering in wireless sensor networks											
	CO5	Describe the sensor node hardware and software platforms.											
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											
	CO4		L										
	CO5	H											
Course Content	**UNIT – I** **Overview of Wireless Sensor Networks**: Characteristic requirements, Required mechanisms, Unique constraints and challenges of sensor networks, Emerging technologies for wireless sensor networks, Advantages of sensor networks, Sensor network applications, Collaborative processing and Key definitions of sensor networks. **UNIT – II** **Architectures:** Single-node architecture - Hardware components; Energy consumption of sensor nodes , Operating systems and execution environments, Network architecture - Sensor network scenarios; Optimization goals and figures of merit, Gateway concepts. **UNIT – III** **Networking Sensors:** Physical layer and Transceiver design considerations, MAC protocols for wireless sensor networks - Low duty cycle protocols and wakeup concepts; Address and name management - Naming and addressing, Assignment of MAC addresses; Routing protocols- Geographic routing, Energy-Efficient routing. **UNIT – IV** **Infrastructure Establishment:** Topology control, Clustering - Hierarchical networks by clustering; Time synchronization, Localization and positioning, Localization and services, Sensor tasking and control. **Sensor Network Platforms and Tools**: Sensor node hardware, Programming challenges, Node-level software platforms												

Text books and Reference books	**Text Book** [1] Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks” , John Wiley, 2005 [2]Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007 **Reference books** [1] Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007 [2] V.Gagri gungor, Gerhard P. Hancke “Industrial Wireless Sensor Networks”, CRC Press, 2013
E-resources and other digital material	[1] http://nptel.ac.in/courses/114106035/37 [2] http://computerscienceppt.blogspot.in/2010/08/introduction-to-wireless-sensor.html

14EI4706/4 – Internetworking

Course Category:	Program Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -0- 0
Prerequisites:	Industrial Communication Networks	**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	Explain the architecture and technologies used in internet.											
	CO2	Describe the function of Internet Protocol and Transmission Control Protocol in Internetworking											
	CO3	Explain the various routing protocols used in internetworking.											
	CO4	Describe the protocols of application layer used in internetworking.											
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		L							
Course Content	**UNIT – I** **Introduction:** A brief history, Protocols and standards, Standards organizations, Internet standards, Internet administration. **Underlying Technologies:** TCP/IP protocol suite, Addressing, IP versions, Local area networks (LAN), Point-to-Point WANs, Switched WANs, Connecting devices, Classless addressing, Classful addressing, Delivery, Forwarding and routing of IP packets, Address Resolution Protocol (ARP) and Reverse Address Resolution Protocol (RARP). **UNIT – II** **Internet Protocol (IP):** Datagram, Fragmentation, Checksum, IP package, Internet Control Message protocol (ICMP), Internet Group Management Protocol (IGMP). **Transmission Control Protocol (TCP):** TCP services, TCP features segment, A TCP connection, Congestion control, Flow control, and Stream Control Transmission Protocol (SCTP). **UNIT – III** **Unicast Routing Protocols:** Intra and inter domain routing, Distance vector routing, Routing Information Protocol (RIP), Link State Routing, Open Shortest Path First (OSPF), Path vector routing, Border Gateway Protocol (BGP). **Multicasting and Multicast Routing Protocols:** Unicast - Multicast- Broadcast, Multicast applications, Multicast routing, Multicast link state routing, Multicast Open Shortest Path First (MOSPF), Multicast distance vector routing, Distance Vector Multicast Routing Protocol(DVMRP).												

	UNIT – IV **Host Configuration**: Bootstrap Protocol (BOOTP) and Dynamic Host Configuration Protocol (DHCP), Domain Name System (DNS), Name space, Domain name space, Distribution of name space, DNS in the internet, Resolution. Remote Login: TELNET, File transfer: File Transfer Protocol (FTP) and Trivial File Transfer Protocol (TFTP), Electronic mail, Network management, World Wide Web (WWW), Private networks, Virtual private networks, Network address translation
Text books and Reference books	**Text Book** [1] Behrouz A. Forouzan,"TCP/IP Protocol Suite", IIIrd ed, TMH, 2005. **Reference books** [1] Douglas E Comer, "Computer Networks and Internet", VIth ed, Pearson, 2015. [2] Laura Lambert, "The Internet: A Historical Encyclopedia", MTM Publishing, Ist ed, 2005. [3] Deon Reynders, Edwin Wright, "Practical TCP/IP and Ethernet Networking", Ist ed, Elsevier, 2003. [4] Jeff Doyle, Jennifer Carroll, "Routing TCP/IP", Volume I, IInd ed, Cisco Press, 2006. [5] Andrew G Blank, "TCP/IP Foundations", Ist ed, John Wiley, 2004.
E-resources and other digital material	[1] http://www.nptel.iitm.ac.in

14EI3751 – Programmable Logic Controllers Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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	Design and conduct experiments to understand the basic programming of various Programmable Logic Controllers (PLC's).											
	CO2	Design and conduct experiments to control various process variables and to automate different processes using PLC.											
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							
Course Content	**List of Experiments** 1. Implementation of basic Logic using PLC ladder diagram (LD). 2. Implementation of timers and counters using PLC. 3. Level control using PLC. 4. Pressure Control using PLC. 5. Motor speed control using PLC. 6. Automation of Bottle filling System using PLC. 7. Temperature control using PLC. 8. Elevator control using PLC. 9. Control of Batch Process Reactor System using PLC. 10. Automation of Material Handling System using PLC. 11. Pressure control using SCADA. 12. Level control using SCADA. 13. Automatic Drilling system using PLC. 14. Automatic Pneumatic stamping machine using PLC. 15. Controlling Traffic lights using PLC. Any 10 experiments from the above list												
Text books and Reference books													
E-resources and other digital material													

14EI3752 – Embedded Systems Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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	Classify embedded systems and can select the hardware components											
	CO2	Select various embedded software.											
	CO3	Explain the embedded architecture, implement & test the design											
	CO4	Use the ARM instruction set											
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												
	CO2												
	CO3				L								
	CO4			H	H	H							

Course Content

List of Experiments

The following experiments are to be carried by using ARM 7 processor

Interfacing of stepper motor
Interfacing of Elevator
Interfacing of DAC
Interfacing of LCD
Interfacing of Seven Segment Display
Interfacing of musical tone generator
Interfacing of Keyboard
Interfacing of real time clock
Interfacing of traffic light control
Interfacing of DAC for ADC & Temperature sensor interface
Interfacing of DC motor
Interfacing of logic controller
Interfacing of 6-digit 7-segment display with calculator keyboard
Interfacing of graphical LCD
Interfacing of 16 channel 8 bit ADC

Any 10 experiments from the above list

Text books and Reference books	**Text Book** [1] Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication, 2004 **Reference Books**
E-resources and other digital material	1. http://nptel.ac.in/courses/108102045

14EI5755 – Mini Project

Internal Assessment Marks: 30M
External Assessment Marks: 70M
Total: 100M

Course Objective
To validate a simple idea through model preparation/software package or solve simple industrial/theoretical problem.
Learning Outcomes
Students will be able to demonstrate an idea or industrial problem through model development or software application.

Distribution of Marks:
Continuous Evaluation: 30 Marks
Day to Day Assessment: 10M
Two Seminars : 10M + 10M

Semester End Evaluation: 70 Marks
Report: 40M
Seminar\Project Demonstration: 30M

Fourth Year
(VIII Semester)

14EI3801 – Biomedical Instrumentation

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -0- 0
Prerequisites:	Nil	**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 physical foundations of biological systems and bioelectric potentials in medical field											
	CO2	Have a detailed understanding about the various electro physiological measurements in the human body.											
	CO3	Gain knowledge on the measurement of non-electrical parameter in the human body											
	CO4	Understand medical assisting and therapy equipments.											
	CO5	Explain the working of blood gas analyzers, X-ray, CT scanners, and applications of Ultra sounds used in medicine.											
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										H	
	CO3	H										H	
	CO4						H					H	
	CO5	H					H					H	
Course Content	**UNIT – I** **Introduction**: Introduction to Bio-Medical Engineering field, Components of Man-Instrument system, Problems encountered in measuring a living system. **Physiological Systems of the Body:** Basic features of cardiovascular system, Nervous system, Muscular system, Respiratory system. **Resting Potential & Action Potential Concepts:** Resting potential concept, Characteristics of resting potential, Action potential concept, Propagation of action potential. **Bio-electric Potentials:** Bio-electric potential, Electro physiology of nerve and nerve to muscle function, Transmission of impulse from nerve to muscle, Evoked potentials. **UNIT – II** **Bio Medical Transducers, Electrodes and Recorders:** Various types of electrodes, Block diagram of ECG, Types of ECG recorders, EEG in diagnostics, EMG and applications, Introduction to various cardiovascular parameters - Blood Pressure, Blood flow, Cardiac output, Heart sounds, Blood pressure measurement techniques, Blood flow measurement techniques, Measurement of heart sounds - Phonocardiography, Echocardiography. **UNIT – III** **Assisting and Therapeutic Instruments:** Cardiac pacemakers, Cardiac defibrillators, Ventilator, Anesthesia machine, Nerve and Muscle stimulator, Heart lung machine, Kidney machine, Diathermy, Audiometers, Endoscopes.												

	UNIT – IV **Instruments in Clinical Laboratory:** Blood gas analyzers, Measurements of blood pH, pCO2, pO2, A complete blood analyzer, Blood cell counters, **Modern Technologies in Bio-Medical Field:** Use of X-Rays in medicine, X-ray machine, CT scan, MRI scan, PET, SPECT, Diagnostic Ultrasound, LASERS in biomedicine.
Text books and Reference books	**Text Book** [1] Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, "Biomedical Instrumentation and Measurements", IInd ed, Prentice Hall of India, 2004 [2] R.S.Kandpur. "Handbook of Biomedical Instrumentation", IInd ed, Tata McGraw Hill, 2011 **Reference books** [1] Webster, Medical Instrumentation Application & Design, John Wiley & Sons [2] Jog: Electronics in Medicine and Biomedical Instrumentation, Prentice Hall of India, 2006 [3] Dr M. Arumugam, "Biomedical Instrumentation", IInd Edition, Anuradha publications, 2009
E-resources and other digital material	[1] www.iannauniversity.com/2012/07/ei2311-**biomedical-instrumentation**.html [2] www.eeeuniversity.com/2013/08/ei2311-**biomedical-instrumentation**.html [3] https://www.scribd.com/doc/.../**biomedical-instrumentation**-tic-801

14EI4802/1– Nanotechnology

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Engineering Physics	**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 nanotechnology											
	CO2	Explain various processing techniques of nano materials and carbon nano tubes											
	CO3	Explain the working principles of various nano electronic devices, nano optical devices and quantum computers											
	CO4	Understand the applications of Nanotechnology											
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		H									
	CO3	L		H									
	CO4			H									

Course Content

UNIT – I

Introduction to Nanotechnology: Scientific revolutions, Types of nanotechnology and nano machines, Atomic structure molecules and phases, Energy, Molecular and atomic size, Surface and dimensional space; Synthesis routes - Top -Down approach and Bottom - Up approach.

Tools to Characterize Nano Materials: Tools-X-ray diffraction, Scanning electron microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscope (STM).

UNIT – II

Nanomaterials: Introduction to Nano materials, preparation – plasma arcing, chemical vapor deposition, SOL GELs, Electro deposition, ball milling**.**

Nanostructured Materials With High Application Potential: Nano manipulator, Nano tweezers, Nano dots, Carbon nano tubes (CNT) - Types of nano tubes, Formation, Properties, Uses.

UNIT – III

Nanoelectronics: Introduction, tools for nano Fabrication-optical lithography, Electron beam lithography, Atomic lithography; Quantum electronic devices- Quantum interference transistor, Single electron transistors, Carbon nano tube transistors; Quantum computers, Quantum algorithms**.**

Optics, Photonics and Solar Energy: Properties of light and nanotechnology; Interaction of light and nanotechnology, Nano holes and photons; Solar absorbers based on nano particles; Optically useful nano structured polymers.

	UNIT – IV **Applications Of Nano Technology :** Nano electronic devices, Nano sensors, Nano mechanics, Micro electromechanical systems, Nano robots, Nano elasticity, Nano medical applications, Food and agricultural industries, Textile, Water treatment, Nano particle coatings, Defence and space applications.
Text books and Reference books	**Text Book** [1] Michael Wilson, Kamali Kannangara, Geoff Smith, Michelk Simon, Burkhard Raguse, "Nano technology: Basic Science and Emerging Technologies", A CRC Press Company Boca Raton London New York Washington, D.C [2] BS Murty, P Shankar, Baldev Raj, BB Rath and James Murday "Text book of Nano Science and Nanotechnology", Universities press-IIM **Reference books** [1] Bharat Bhushan, "Handbook of Nanotechnology", 1st Edition, Springer, 2004 [2] P Poole, Frank J Owens, "Introduction to Nanotechnology", John Wiley and Sons Inc, 2003
E-resources and other digital material	[1] www.physicsforums.com [2] http://www.crnano.org/whatis.htm

14EI4802/2 – Power Plant Instrumentation

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Process Control	**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 importance of instrumentation and control in Thermal power plants.											
	CO2	Explain the role of instrumentation and control in air fuel circuits.											
	CO3	Explain the combustion process in boilers and the safety measure to be followed**.**											
	CO4	Explain various process parameters in steam turbine and Lubrication System in power plants.											
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					
	CO2	H		H	H								
	CO3	H		H	H								
	CO4	H		H	H								
Course Content	**UNIT – I** **Overview of Thermal Power Generation:** Introduction to thermal power plants, Objectives of instrumentation and control in thermal power plants , Layout of typical thermal power plants, Classification of instruments in a power plant, Piping and Instrumentation Diagram (P and I Diagram). Comparison of various conventional power plants. **Instrumentation and Control in Water Circuit:** Water circuit, Boiler feed water circulation, Measurements in water circuit, Controls in water circuit, Impurities in water and steam .. **UNIT – II** **Instrumentation and Control in Air-Fuel Circuit:** Air-Fuel circuit - Fuels ,Combustion air, Flue gases, Waste gases, Measurements in air-fuel circuit -Measurement of flow, Measurement of pressure, Measurement of temperature , Measurement of level, Controls in air-fuel circuit - Combustion control, Furnace draft control, Analytical measurement, Oxygen measurement in flue gas, Measurement of carbon dioxide in flue gas, Combustibles analyser, Infrared flue Ggas analysers Smoke detector, Dust monitor, Fuel analysers, Chromatography, Pollution monitoring instruments. **UNIT – III** **Power Plant Management:** Introduction, Master control, Combustion process- stoichiometric Air requirement, Excess air requirement, Products of combustion, Boiler efficiency - Calculation of boiler efficiency, Types of maintenance, Maintenance costs, Life cycle costs, Maintenance procedures, Intrinsic safety of instruments, Electrical safety, Explosion hazards, Interlocks for boiler control, Application of DCS in power plants.												

	UNIT – IV **Turbine Monitoring and Control: I**ntroduction, Classification, Principle parts of steam turbines, Turbine steam inlet system, Turbine measurements - Process parameters, Mechanical parameters, Electrical parameters, Turbine control system -Safety control systems, Process control systems, Lubrication for turbo-alternator -Lubrication system, Controls in lubrication system, Turbo-alternator cooling system -Lube oil cooling system, Condensate cooling system, Alternator/generator cooling system.
Text books and Reference books	**Text Book** [1] K. Krishnaswamy & M. Ponni Bala, " Power Plant Instrumentation", PHI Learning PVT ltd, Delhi. **Reference books** [1] P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2001 [2] Modern Power Stations Practice, vol. 6, Instrumentation, Controls and Testing - Pergamon Press, Oxford. [3]A.Nagoor Kani, "Control Systems", IInd ed, RBA Publications,2006. S.M. Elonka and A.L. Kohal, 'Standard Boiler Operations', Tata McGraw Hill, New Delhi,1994
E-resources and other digital material	[1] http://www.instrumentationguide.com/article/boilerlevelcontrol.htm

14EI4802/3 – Intelligent Systems and Control

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Process Control	**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 fuzzy logic controller for simple applications.											
	CO2	Use neural networks for system identification and control applications.											
	CO3	Describe various configurations of neuro fuzzy systems											
	CO4	Discuss the steps involved in various evolutionary computing techniques											
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									
	CO3		H										
	CO4		H										
Course Content	**UNIT – I** **Fuzzy Logic**: Introduction, Fuzzy sets, Membership functions, Features of MFs, Operations on Fuzzy Sets, Linguistic variables and hedges, Fuzzy relations, Fuzzy If–Then rules, Fuzzification, Defuzzification, Inference mechanism, Examples, Fuzzy system, Fuzzy modelling, Fuzzy control, Design of fuzzy controller **UNIT – II** **Neural Networks and Applications:** Introduction, Artificial neuron model, Activation functions, Network architecture, Learning in neural networks, Recurrent neural networks, Neural systems, System identification and control, Neural networks for control. **UNIT – III** **Neuro Fuzzy Systems:** Introduction, Combination of neural and fuzzy systems, Cooperative neuro-fuzzy systems, Concurrent neuro-fuzzy systems, Hybrid neuro-fuzzy systems, Adaptive neuro-fuzzy System, Fuzzy neurons. **UNIT – IV** **Evolutionary Computing:** Introduction, Terminologies of evolutionary computing (EC), Genetic operators, Performance measures of EA, Evolutionary algorithms - Genetic algorithm and Differential evolution, Swarm intelligence- Particle swarm optimization.												
Text books and Reference books	**Text Book** [1] N. Siddique & H. Adeli, "Computational Intelligence -Synergies of Fuzzy Logic, Neural Networks and Evolutionary Computing", Wiley, 2013												

	[2]A.P.Engelbrecht, "Computational Intelligence - An introduction", Wiley, IInded, 2007 **Reference books** [1] Robert E. King, "Computational Intelligence in Control Engineering", Marcel Dekker Inc., USA, 1999 [2] Witold Pedrycz, "Computational Intelligence-An introduction", CRC Press
E-resources and other digital material	[1] http://nptel.ac.in/courses/108104049/27# [2] http://uni-obuda.hu/users/fuller.robert/nfs.html [3] http://nptel.ac.in/courses/112106064/38

14EI4802/4 – ARM System on Chip

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Embedded 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	Explain the ARM architecture and how it differs from the traditional RISC architecture											
	CO2	Use the ARM instruction set to write simple programs											
	CO3	Explain the Thumb Instruction set and Advanced Microcontroller Bus Architecture (AMBA)											
	CO4	Explain the Memory Management Unit and Architectures of various ARM processor cores											
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	H							
	CO3			H									
	CO4			H									
Course Content	**UNIT – I** **The ARM Architecture:** The Acorn RISC Machine, Architectural Inheritance, The ARM Programmer's model, ARM Development tools, ARM Assembly Language Programming: Data Processing Instructions, Data transfer Instructions, Control flow Instructions, **ARM Organization and Implementation:** 3-stage pipeline ARM organization, 5-stage pipeline ARM Organization, ARM Instruction Execution, ARM Implementation, The ARM coprocessor Interface **UNIT – II** **ARM Instruction Set:** Introduction, Exceptions, Conditional Execution, Branch and Branch with Link (B,BL), Branch, Branch with Link and exchange (BX,BLX), Software Interrupt, Data Processing Instructions, Multiply Instructions, Count Leading Zeros, single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple Register Transfer Instructions, Swap memory and Register Transfer Instructions, Status Register to General Register Transfer Instructions, General Register to Status Register Transfer Instructions, Coprocessor Instructions, Coprocessor Data Operations, Coprocessor Data Transfers, Coprocessor Register Transfers, Breakpoint Instruction, Unused Instruction Space, Memory Faults, ARM architecture variants. **UNIT – III** **The Thumb Instruction Set:** The Thumb bit in the CPSR, The Thumb Programmers Model, Thumb Branch Instructions, Thumb Software Interrupt Instruction, Thumb Data Processing Instructions, Thumb Single Register Data Transfer Instructions, Thumb Multiple Register Data												

	Transfer Instructions, Thumb Breakpoint Instruction, Thumb Implementation. **Architectural Support for System Development:** The ARM Memory Interface, The Advanced Microcontroller Bus Architecture (AMBA), The ARM Reference Peripheral Specification, Hardware System Prototyping Tools, The ARMulator, The JTAG Boundary Scan Test Architecture, The ARM Debug Architecture, Embedded Trace, Signal Processing Support. **UNIT – IV** **Memory Hierarchy:** Memory Size and Speed, On Chip Memory, Caches, Memory Management **Architectural Support For Operating Systems:** An Introduction to Operating Systems, The ARM System Control Coprocessor, CP15 Protection Unit Registers, ARM Protection Unit, CP15 MMU Registers, ARM MMU Architecture, Synchronization, Context Switching, Input/Output. **ARM Processor Cores:** ARM7TDMI, ARM8, ARM9TDMI, ARM10 TDMI.
Text books and Reference books	**Text Book** [1] Steve Furber, "ARM System-On-Chip Architecture", IInd ed, Pearson Education, 2000 **Reference books** [1] Andrew N Sloss, "ARM System Developers Guide, Designing and Optimizing System Software", ELSEVIER, 2004. [2] William Hohl, Christopher Hinds, "ARM Assembly Language: Fundamentals and Techniques", IInd ed, CRC Press, 2015.
E-resources and other digital material	[1] www.nptel.ac.in

14EI4803/1 – VLSI Design

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Electronic Devices and Circuits, Digital Circuits Design, Linear Circuits & Applications	**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	Explain the different fabrication methods of Integrated Circuits.											
	CO2	Analyze basic electrical properties of MOSFET.											
	CO3	Apply the Design rules of Mask Layouts for MOS and BiCMOS circuits.											
	CO4	Analyze the Design concepts of MOS 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										
	CO3		H										
	CO4			H									

Course Content

UNIT – I

IC Fabrication:

Introduction to IC Technology, MOS and related VLSI technology, Basic MOS transistors, Enhancement and depletion modes of transistor action, IC fabrication process, MOS and CMOS fabrication processes, BiCMOS technology, Comparison between CMOS and bipolar technologies**.**

UNIT – II

Basic Electrical Properties Of MOS and Bi-CMOS Circuits: Ids versus Vds relationships, Aspects of MOS transistor Threshold voltage, MOS transistor trans, Output conductance and figure of merit. The pass transistor, NMOS inverter, Pull-up to pull-down ratio for NMOS inverter. Alternative forms of pull-up, The CMOS inverter, MOS transistor circuit model, Bi-CMOS inverter, Latch-up

UNIT – III

MOS and Bi-CMOS Circuit Design Processes: MOS layers, Stick diagrams, Design rules and layout, General observations on the design rules, 2μm Double metal, Double poly, CMOS/BiCMOS rules, 1.2μm Double metal, Double poly CMOS rules, Layout diagrams of NAND and NOR gates and CMOS inverter, Symbolic diagrams-Translation to mask form.

UNIT – IV

Circuit Design Concepts: Sheet resistance, Sheet resistance concept applied to MOS transistors and inverters, Area capacitance of layers, Standard unit of capacitance, The delay unit, Inverter delays, Propagation delays, Wiring capacitances, Fan-in and fan-out characteristics, Choice of layers, Transistor switches, Realization of gates using NMOS, PMOS and CMOS technologies**.**

	Scaling Of MOS Circuits: Scaling models, Scaling factors for device parameters, Limits due to sub threshold currents, Current density limits on logic levels and supply voltage due to noise.
Text books and Reference books	**Text Book** [1] Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian "Essentials of VLSI Circuits and Systems", Ist edition, Prentice-Hall of India Private Limited.2005. [2] Wolf, "Modern VLSI Design", IVth edition, Pearson Education. **Reference books** [1] A.Albert Raj and T.Latha, "VLSI Design", PHI Learning Private Limited, 2010. [2] A.Shanthi and A.Kavita, "VLSI Design", Ist edition, New Age International Private Limited, 2006.
E-resources and other digital material	[1] http://nptel.iitg.ernet.in

14EI4803/2 – Instrumentation and Control in Paper Industries

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Transducers, Electronic Measurements and Instrumentation, Process Control	**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	Describe the pre-processing stages of raw material in paper making process.											
	CO2	Select the suitable sensors used in wet and dry end instrumentation of paper making industry											
	CO3	Identify the paper quality and explain the control strategies used in thick and thin stock system											
	CO4	Explain the applications of computers in pulp and paper industries.											
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			L									
	CO4			L									

Course Content

UNIT – I

Papermaking and Properties: Process fundamentals, Raw materials, Pulping and preparation, Screening, Bleaching, Cooking, Chemical addition, Papermaking machine, Drying section, Calenders, Drive, Finishing, Other-after treatment processes, Coating, Elementary properties of liquids- hydrostatics, Liquids in motion. Properties of paper making suspensions.

UNIT – II

Wet and Dry End Instrumentation: Overview of basic sensors used in wet and dry end measurements, Measurement of ORP, Primary viscosity measurement devices, Continuous consistency measuring devices, Granular and wood chip moisture measurements, Paper moisture measurements- Electrical, energy absorption, Pilot dryer types. Freeness measurement, Grammage or basis weight measurement, Thickness measuring systems-Contacting and non-contacting types.

UNIT – III

Quality Measurement: Paper quality measurements – Brightness (dual wavelength), Color, Gloss, Opacity, Ash, Modulus, Hole detection, Reel hardness, Off-line.

Thick and Thin Stock Systems Control: Thick Stock Systems: Introduction, Simple thick stock system, Refining, Breakers and beaters, Thick stock flow control.

Thin Stock Systems: Introduction, Basic thin stock system, Cleaners, Screens, The flow box and its controls.

	UNIT – IV **Computer Applications in the Paper Industry:** **Computers in the Pulp Mill:** Batch digesters, Continuous digesters - Vertical type, inclined type, Bleach plant. **Computers in the Paper Mill:** Stock preparation - Refiners, Stock proportioning, Stock blending. Paper machine - Rush/drag, Basis weight and moisture, Speed change, Coordinated control.
Text books and Reference books	**Text Book** [1] Robert J.McGill, "Measurement and Control in Papermaking", Adam Hilger Limited, Bristol, 1980. (Unit I & III) [2] John R.Lavigne, "An Introduction to Paper Industry Instrumentation", Miller Freeman Publications, California, 1985 series. (Unit II, III & IV) [3] John R.Lavigne, "Instrumentation Applications for the Pulp and Paper Industry", Miller Freeman Publications, California, 1990. (Unit IV) **Reference books** [1] Benjamin C. Kuo, "Automatic Control Systems", VIIth ed , PHI, 2001. James P.Casey, Pulp Paper Chemistry and Chemical Technology, John wiley & sons, New york, 1981. [2] Sankarnarayanan P.E, "Pulp Paper Industry–Technology & Instrumentation", Kothari's Deskbook
E-resources and other digital material	1. http://www.nptelvideos.com/control_systemshttp://www.biltpaper.com/atoz.a 2. http://www.wateronline.com/product.mvc/Instrumentation-for-the-Pulp-Paper Industry0002?VNETCOOKIE=NO sp. 3. http://www.paperhall.org/info/glossary.html 4. http://www.tappi.org/Bookstore/Books--CD-ROMs/Books/Process-Control/Process-Control- Fundamentals-for-the-Pulp-and-Paper-Industry.asp

14EI4803/3 – Optimal and Non Linear Control Systems

Course Category:	Program Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Control Systems, Process Control	**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 state regulators, state observers and compensators for SISO continuous and discrete time systems using pole-placement method.											
	CO2	Analyze the optimal state regulators and state observers for continuous and discrete time systems through Lyapunov synthesis											
	CO3	Analyze the non linear systems using describing function, phase plane and Lyapunov stability methods											
	CO4	Explain the nonlinear control structures used for practical control problems in industry											
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** **Pole – Placement Design and State Observers**: Introduction; Stability Improvement by State Feedback; Necessary and Sufficient Conditions for Arbitrary Pole-Placement; State Regulator Design; Design of State Observers; Compensator Design by the Separation Principle; Servo Design: Introduction of the Reference Input by Feed forward Control; State Feedback with Integral Control; Digital Control Systems with State Feedback. **UNIT – II** **Linear Quadratic Optimal Control Through Lyapunov Synthesis:** Introduction; The Concept of Lyapunov Stability; Lyapunov Functions for Linear Systems; Parameter Optimization and Optimal Control Problems; Quadratic Performance Index; Control Configurations; Optimal state Regulator; Optimal Digital Control Systems; Constrained State Feedback Control. **UNIT – III** **Nonlinear System Analysis:** Introduction; Common Nonlinear System Behaviours; Common Nonlinearities in Control Systems; Describing Function Fundamentals; Describing Functions of Common Nonlinearities; Stability Analysis by the Describing Function Method; Concepts of Phase Plane Analysis; Construction of Phase Portraits; System Analysis on the Phase Plane; Simple Variable Structure Systems; Lyapunov Stability Definitions; Lyapunov Stability Theorems; Lyapunov Functions for Nonlinear Systems.												

	UNIT – IV **Nonlinear Control Structures:** Introduction; Feedback Linearization; Model Reference Adaptive Control; System Identification and Generalized Predictive Control in Self-Tuning Mode; Sliding Mode Control; Reinforcement Learning Control.
Text books and Reference books	**Text Book** [1] M.Gopal, "Digital control and state variable methods", IIIrd ed., TMH, New Delhi,2009 [2] B.C.Kuo, "Digital control systems", IInd ed., Oxford university press, 2012 **Reference books** [1] K.Ogata, "Discrete time control systems", IInd ed.,PHI,2009
E-resources and other digital material	[1] http://nptel.ac.in/courses/108103008/ [2] http://nptel.ac.in/courses/108106024/

14EI4804/4 – Internet of Things

Course Category:	Program Elective	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -0- 0
Prerequisites:	Microcontrollers and Applications	**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	Explain the characteristics of IoT and building blocks of IoT.											
	CO2	Describe the IoT system management and IoT system design methodology.											
	CO3	Design the IoT system using Python and Raspberry Pi.											
	CO4	Use the cloud computing to develop the IoT 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	PO k	PO l
	CO1				H								
	CO2				H								
	CO3					H							
	CO4					H							
Course Content	**UNIT – I** **Introduction to Internet of Things (IoT):** Introduction, Physical design of IoT, Logical design of IoT, IoT enabling technologies, IoT levels & deployment templates. **IoT and Machine to Machine (M2M):** Introduction, M2M architecture, difference between IoT and M2M, Software defined networking, Network function virtualization **UNIT – II** **Domain Specific IoTs:** Introduction, Home automation, Cities, Environment energy, Retail, Logistics, Agriculture, Industry, Health & life style **IoT System Management with NETCONF-YANG:** Need for IOT systems management, Simple Network Management Protocol (SNMP), Network operator requirements, NETCONF, YANG, IoT system management with NETCONF-YANG- NETOPEER. **IoT Platforms Design Methodology:** Introduction, IoT design methodology **UNIT – III** **Logical Design Using Python:** Motivation for using Python, Introduction to Python, Installing Python, Python data types & data structures, Control flow, Functions, Modules, Packages, File Handling, Date/Time Operations, Classes, Python Packages of Interest for IoT. **IoT physical devices and End points:** What is an IoT device, Exemplary device-Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IoT devices. **UNIT – IV** **IoT Physical Servers & Cloud Offerings:** Introduction to cloud storage models & communication APIs, Web Application Messaging Protocol (WAMP), Xively cloud for IoT,												

	Python web application Framework-Django, Designing a RESTful web API, Amazon web services for IoT, SkyNet IoT messaging platform. **Case Studies Illustrating IoT design:** Introduction, Home automation, Cities, Environment, Agriculture.
Text books and Reference books	**Text Book** [1] Arshdeep Bahga, Vijay Madisetti, "Internet Of Things: A Hands-On Approach", Ist ed, Published by Arshdeep Bahga and Vijay Madisetti, 2014. **Reference books** [1] Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet Of Things: Principles and Paradigms", Elsevier, 2016. [2] Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons, 2014. [3] Dr.Ovidiu Vermesan, Dr.Peter Friess, "IoT-From Research and Innovation to Market Deployment", River Publishers, 2014.
E-resources and other digital material	[1] http://www.internet-of-things-book.com [2] http://www.raspberrypi.org [3] http://www.python.org

14EI3851– Advanced Instrumentation Lab

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**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	Analyze heart rate, ECG and PCG signals											
	CO2	Design Data Acquisition to measure vibration parameters											
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				H	H							
	CO3			L		H							

Course Content

List of Experiments

Experiments based on NI-COMPACT DAQ and NI-myDAQ hardware

1. Data Logging of RTD based Temperature Data Acquisition
2. Design of Data Acquisition to measure Vibration Parameters
3. Studying Earthquakes with the myQuake NI mini System for NI myDAQ
4. Studying Flight Dynamics with the myVTOL NI mini System for NI myDAQ
5. Study of digital filters with the myDSP NI mini System for NI myDAQ

Experiments based on NI-ELVIS II+ and Vernier biosensor module

1 a) Interfacing of Vernier's hand-grip heart rate monitor with ELVIS
b) Design of a Heart Rate Analyzer.

2 a) Acquiring and analysing an electrocardiogram using Vernier's EKG sensor
b) Spectrum Analysis of ECG and PCG signals.

3 Study of muscle activity and fatigue using Vernier's hand dynamometer and EKG sensor.

4 a) Acquisition of Bio potentials using NI LabVIEW
b) Time domain and Frequency Domain Measurements on Bio signals.

5 Implementation of Digital Filter to remove noise in bio signals.

Experiments based on myRIO

1 Interfacing of DC motor and Rotary Encoder

	2 Interfacing of Photointerupter, Hall-Effect sensor and Piezoelectric-Effect sensor 3 Interfacing of Servo motor, H-Bridge and Geared motor 4 Interfacing of Accelerometer, Gyroscope and compass 5 Interfacing of Webcam and GPS receiver **Note: Minimum of 3 experiments must be carried out from each section to complete the course.**
Text books and Reference books	**Text Book** **Reference Books**
E-resources and other digital material	

14EI5852 – Major Project

Internal Assessment Marks: 30M
External Assessment Marks: 70M
Total: 100M

Course Objective
To identify real world problems, analyze and find solutions through application of Electronics and Instrumentation Engineering concepts and various software tools.

Learning Outcomes
Students will become aware of design methodologies, implementation, advanced programming techniques and technical report writing.

Distribution of Marks:
Continuous Evaluation: 30 Marks
Day to Day Assessment: 10M
Two Seminars : 10M + 10M

Semester End Evaluation: 70 Marks
Report: 30M
Presentation: 20M
Project Demonstration\Execution: 20M