NATIONAL INSTITUTE OF TECHNOLOGYANDHRA PRADESH

SCHEME OF INSTRUCTION AND SYLLABI
FOR B.TECH PROGRAM

Effective from 2015 - 16

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH

VISION

Becoming a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

Create an educational environment to mould the students to meet the challenges of modern Electronics & Communication industry through state of the art technical knowledge and innovative experimental approaches

MISSION

- To create learning, development and testing environment to meet ever challenging needs of the electronic industry
- To create entrepreneurial environment and industry interaction for mutual benefit
- To become a global partner in training human resources in the fields of chip design, instrumentation and networking
- To associate with internationally reputed Institutions for academic excellence and collaborative research

GRADUATE ATTRIBUTES

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication Skill**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

B.TECH IN ELECTRONICS & COMMUNICATION ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Analyze , plan and apply the acquired knowledge in basic sciences and mathematics in solving Electronics and Communication Engineering problems with technical, economic, environmental and social contexts.
PEO2	Design, build and test analog & digital electronic systems for given specifications.
PEO3	Architect modern communication systems to meet stated requirements.
PEO4	Work in a team using technical knowhow, common tools and environments to achieve project objectives.
PEO5	Communicate effectively, demonstrate leadership qualities and exhibit professional conduct in their career.
PEO6	Engage in lifelong learning, career enhancement and adapt to changing professional and societal needs.

Mapping of Mission statements with program educational objectives

Mission Statement	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
MS1	3	3	2	1	1	3
MS2	1	2	1	2	2	2
MS3	1	2	1	3	3	2
MS4	1	2	2	3	1	1

Mapping of program educational objectives with graduate attributes

PEO	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PEO1	3	3	3	3	2	2	1	2	2	2	1	2
PEO2	3	2	3	3	3	2	1	2	2	2	2	2
PEO3	3	3	3	3	3	2	3	3	2	2	2	2
PEO4	1	1	1	2	2	2	3	3	3	3	1	2
PEO5	1	1	1	2	2	2	3	3	3	3	3	3
PEO6	3	3	3	2	2	2	2	2	3	3	1	3

PROGRAM OUTCOMES: At the end of the program the student will be able to:

PO1	Apply basic science and mathematics to analyze complex engineering problems.
PO2	Gather requirement specifications, design and test electronic systems.
PO3	Apply EDA tools to design linear and digital IC systems.
PO4	Specify, design and test power supplies for electronic systems including battery management, and power amplifiers.
PO5	Analyze and design noise-free analog and digital communication systems.
PO6	Evaluate strengths and weaknesses of evolving state of art communication systems.
PO7	Select partitioning technologies for implementation of wired and wireless communication system.
PO8	Understand and practice professional ethics.
PO9	Work in a team using technical skills, common tools and environments to achieve project objective.
PO10	Communicate effectively with peers and others.
PO11	Understand how the organizations work, develop optimal models, generate wealth, and manage their finances.
PO12	Pursue life-long learning as a means of enhancing knowledge and skills for continuous professional advancement.

Mapping of program outcomes with program educational objectives

PEO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	1	1	1	1	1	1	2	1	1	1	1
PEO2	2	3	3	3	1	1	1	1	2	1	1	1
PEO3	1	2	1	1	3	3	3	1	1	1	1	2
PEO4	1	1	3	1	1	1	1	3	3	3	1	1
PEO5	1	1	1	1	1	1	1	3	3	2	2	3
PEO6	2	1	1	1	2	2	2	3	2	2	3	3

CURRICULAR COMPONENTS

Degree Requirements for B. Tech in Electronics and Communication Engineering

S. No.	Category of Courses	Credits offered		Minimum Credits to be Earned
1.	Basic Science Core Credits (BSC)	(≥ 20)	24	24
2.	Other Engineering Core Credits (OEC)	(≥ 28)	39	39
3.	Humanities and Social Science Core Credits (HSC)	(≥ 07)	07	07
4.	Program Core Credits (PCC)	(≥ 81)	90	90
5.	Departmental Elective Credits (DEC)	(≥ 18)	21	18
6.	Open Elective Course Credits (OPC)	(≥ 6)	06	06
7.	Project Credits (PRC)	(=06)	06	06
8.	Mandatory Credits (MDC)	(=00)	00	00
	Total	(≥170)	193	190

SCHEME OF INSTRUCTION

B.Tech. (Electronics and Communication Engineering) Course Structure

<u>B. Tech. I - Year I - Semester</u>

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA101	Mathematics – I	4	0	0	4	BSC
2	HS101 ME102	English for Communication (or) Engineering Graphics	3 2	0 0	2 3	4 4	HSC OEC
3	PH101 CY101	Physics (or) Chemistry	4 4	0 0	0 0	4 4	BSC BSC
4	EC101 EE101	Basic Electronics Engineering (or) Basic Electrical Engineering	3 3	0 0	0 0	3 3	OEC OEC
5	CE102 ME101	Environmental Science and Engineering (or) Basic Mechanical Engineering	3 3	0 0	0 0	3 3	OEC OEC
6	CS101 CE101	Prob. Solving and Computer Programming (or) Engineering Mechanics	4 4	0 0	0 0	4 4	OEC OEC
7	PH102 CY102	Physics Lab (or) Chemistry Lab	0 0	0 0	3 3	2 2	BSC BSC
8	CS102 ME103	Prob. Solving and Computer Programming Lab (or) Workshop Practice	0 0	0 0	3 3	2 2	OEC OEC
9	EA101	EAA: Games and Sports	0	0	3	0	MDC
		Total	**21**	**0**	**11**	**26**	

B.Tech. I - Year II - Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA151	Mathematics – II	4	0	0	4	BSC
2	ME102 HS101	Engineering Graphics (or) English for Communication	2 3	0 0	3 2	4 4	OEC HSC
3	CY101 PH101	Chemistry (or) Physics	4 4	0 0	0 0	4 4	BSC BSC
4	EE101 EC101	Basic Electrical Engineering (or) Basic Electronics Engineering	3 3	0 0	0 0	3 3	OEC OEC
5	ME101 CE102	Basic Mechanical Engg. (or) Environmental Science and Engineering	3 3	0 0	0 0	3 3	OEC OEC
6	CE101 CS101	Engineering Mechanics (or) Problem Solving and Computer Programming	4 4	0 0	0 0	4 4	OEC OEC
7	CY102 PH102	Chemistry Lab (or) Physics Lab	0 0	0 0	3 3	2 2	BSC BSC
8	ME103 CS102	Workshop practice (or) Problem Solving and Computer Programming Lab	0 0	0 0	3 3	2 2	OEC OEC
9	EA151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**20**	**0**	**12**	**26**	

II - Year I –Semester

S.No.	Course No.	Course Title	L	T	P	Credits	
1.	MA213	Complex Variables and Special functions	4	0	0	4	BSC
2.	EE236	Network Analysis	3	0	0	3	OEC
3.	EC201	Electronic Devices and Circuits – I	4	0	0	4	PCC
4.	EC202	Networks and Transmission Lines	3	0	0	3	PCC
5.	EC203	Digital System Design - I	4	0	0	4	PCC
6.	EC204	Signals and Systems	3	0	0	3	PCC
7.	EC205	Electronic Devices and Circuits - I Laboratory	0	0	3	2	PCC
8.	EC206	Electronic Design Automation Laboratory	0	0	3	2	PCC
Total			**21**	**0**	**6**	**25**	

II - Year II – Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. code
1.	CS235	Data structures	3	0	0	3	OEC
2.	EC251	Electronic Devices and Circuits – II	4	0	0	4	PCC
3.	EC252	Electromagnetic Fields and Waves	3	0	0	3	PCC
4.	EC253	Digital System Design – II	4	0	0	4	PCC
5.	EC254	Probability Theory and Stochastic Processes	3	0	0	3	PCC
6	EC255	Electronic Devices and Circuits – II Laboratory	0	0	4	3	PCC
7	EC256	Digital System Design Laboratory	0	0	3	2	PCC
8	CS236	Data Structures Laboratory	0	0	3	2	OEC
Total			**17**	**0**	**10**	**24**	

III - Year I – Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. code
1.	SM335	Engineering Economics and Accountancy	3	0	0	3	HSC
2.	EC301	Pulse Circuits	4	0	0	4	PCC
3.	EC302	Communication Theory	3	0	0	3	PCC
4.	EC303	Linear IC Applications	4	0	0	4	PCC
5.	EC304	Antennas and Wave propagation	3	0	0	3	PCC
6.	EC305	Computer Architecture and Organization	3	0	0	3	PCC
7	EC306	Pulse Circuits Laboratory	0	0	3	2	PCC
8.	EC307	IC Applications Laboratory	0	0	3	2	PCC
Total			**20**	**0**	**6**	**24**	

III - Year II – Semester

S.No.	Course No.	Course Title	L	T	P	Credits	Cat. code
1.	EC351	Digital Communications	3	0	0	3	PCC
2.	EC352	Digital Signal Processing	3	0	0	3	PCC
3.	EC353	Microprocessors and Microcontrollers	4	0	0	4	PCC
4.	EC354	Computer Networks	3	0	2	4	PCC
5.		Departmental Elective-I	3	0	0	3	DEC
6		Open elective-I	3	0	0	3	OEC
7.	EC355	Communication Systems Laboratory	0	0	3	2	PCC
8.	EC356	Microprocessors and Microcontrollers Laboratory	0	0	3	2	PCC
Total			**19**	**0**	**8**	**24**	

IV - Year I – Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. code
1.	EC401	Electronic Instrumentation	3	0	0	3	PCC
2.	EC402	Microwave Engineering	3	0	0	3	PCC
3.		Departmental Elective-II	3	0	0	3	DEC
4.		Open Elective-II	3	0	0	3	OEC
5.		Departmental Elective - III	3	0	0	3	DEC
6.		Departmental Elective – IV	3	0	0	3	DEC
7.		Departmental Elective – V	3	0	0	3	DEC
8.	EC403	Electronic Instrumentation and DSP Laboratory	0	0	3	2	PCC
9.	EC449	Project Work – Part A	0	0	3	2	PRC
Total			**21**	**0**	**6**	**25**	

IV - Year II – Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. code
1.	ME435	Industrial management	3	0	0	3	OEC
2.	EC451	Optical Fiber Communication	3	0	0	3	PCC
3.		Departmental Elective - VI	3	0	0	3	DEC
4.		Departmental Elective - VII	3	0	0	3	DEC
5.	EC452	Microwave and Optical communication laboratory	0	0	3	2	PCC
6.	EC491	Seminar	-	-	-	1	PCC
7.	EC499	Project Work - Part B	0	0	6	4	PRC
Total			**12**	**0**	**12**	**19**	

List of Electives

III Year II Semester

	Course No.	Course Title
Departmental Elective - I	EC361	VLSI Design
	EC362	CMOS VLSI Design
	EC363	ASIC Design

IV Year I Semester

	Course No.	Course Title
Departmental Elective - II	EC411	Modern Radio Communications
	EC412	Software Defined Radio
	EC413	Digital TV Engineering
Departmental Elective - III	EC414	Image Processing
	EC415	Digital Switching and Multiplexing
	EC416	Distributed Computing
Departmental Elective - IV	EC417	Satellite Communications
	EC418	Embedded Systems
	EC419	Networks Security
Departmental Elective - V	EC420	Low Power VLSI
	EC421	Sensor Networks
	EC422	Real Time Operating Systems

IV Year II Semester

	Course No.	Course Title
Departmental Elective - VI	EC461	Cellular and Mobile Communications
	EC462	RADAR Engineering
	EC463	FPGA Design
Departmental Elective - VII	EC464	System Engineering
	EC465	Advanced Digital Signal Processing
	EC466	PC Based Instrumentation

DETAILED SYLLABUS

MA101	Mathematics – I	BSC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Solve linear system equations
CO2	Determine the Eigen values and vectors of a matrix
CO3	Identify the power series expansion of a function
CO4	Estimate the maxima and minima of multivariable functions
CO5	Solve first order ordinary differential equation
CO6	Solve higher order linear ordinary differential equation with constant coefficients.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Matrix Theory: Elementary row and column operations on a matrix, Rank of matrix – Normal form – Inverse of a matrix using elementary operations –Consistency and solutions of systems of linear equations using elementary operations, linear dependence and independence of vectors - Characteristic roots and vectors of a matrix - Caley-Hamilton theorem and its applications, Complex matrices, Hermitian and Unitary Matrices - Reduction to diagonal form - Reduction of a quadratic form to canonical form – orthogonal transformation and congruent transformation.

Differential Calculus: Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Indeterminate forms; Asymptotes and curvature; Curve tracing; Functions of several variables, Partial Differentiation, Total Differentiation, Euler's theorem and generalization, maxima and minima of functions of several variables (two and three variables) – Lagrange's method of Multipliers; Change of variables – Jacobians.

Ordinary differential equations of first order: Formation of differential equations; Separable equations; equations reducible to separable form; exact equations; integrating factors; linear first order equations; Bernoulli's equation; Orthogonal trajectories and Newton's law of cooling.

Ordinary linear differential equations of higher order : Homogeneous linear equations of arbitrary order with constant coefficients - Non-homogeneous linear equations with constant coefficients; Euler and Cauchy's equations; Method of variation of parameters; System of linear differential equations, Vibrations of a beam.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley and Sons, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

HS101	English for Communication	HSC	3-0-2	4 Credits

Pre-requisites:

Course outcomes: After the completion of the course the student will be able to:

CO1	Understand basic grammar principles
CO2	Write clear and coherent passages
CO3	Write effective letters for job application and complaints
CO4	Prepare technical reports and interpret graphs
CO5	Enhance reading comprehension
CO6	Comprehend English speech sound system, stress and intonation

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	2	-	3
CO6	-	-	-	-	-	-	-	-	-	3	-	3

Detailed syllabus:

Grammar Principles and Vocabulary Building: Idioms and Phrases, Mnemonics, Prefixes, Suffixes, Effective Sentence Construction.

Paragraphs: Types and Composition, Note-making.

Letter Writing: Business, Official and Informal.

Reading techniques: Skimming and Scanning, Description of Graphs, bar and pie charts, Reading Comprehension**,** Technical Report-Writing.

Book Reviews- Oral and written review of a chosen novel/play.

Reading:

1. A Textbook of English for Engineers and Technologists (combined edition, Vol. 1 & 2); Orient BlackSwan 2010.

PH101	Physics	BSC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Solve engineering problems using the concepts of wave and particle nature of radiant energy.
CO2	Understand the use of lasers as light sources for low and high energy applications
CO3	Understand the nature and characterization of acoustic design, nuclear accelerators and new materials
CO4	Apply the concepts of light in optical fibers, light wave communication systems, holography and for sensing physical parameters.
CO5	Construct a quantum mechanical model to explain the behavior of a system at microscopic level.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Detailed Syllabus:

INTERFERENCE: Superposition principle, Division of amplitude and wave front division, Interferometers (Michelson, Fabry-Perot, Mach-Zehnder), Applications; Diffraction: Fraunhoffer diffraction (single, double & multiple slits), Resolving power, Dispersive power, Applications

POLARIZATION: Production & detection of polarized light, wave plates, optical activity, Laurents Half-shade polarimeter, photoelasticity and applications; LASERS: Basic principles of Lasers, He-Ne, Nd-YAG, CO_2 and semiconductors lasers, applications of lasers, Holography and holographic NDT

OPTICAL FIBERS: Light propagation in Optical fibers, types of optical fibers, optical fibers for communication and sensing

FUNCTIONAL MATERIALS: Fiber reinforced plastics, fiber reinforced metals, surface acoustic wave materials, biomaterials, high temperature materials, smart materials and their applications, Introduction to Nano materials

MODERN PHYSICS: Qualitative review of different experiments, de-Broglie waves, Dual nature of matter, Schrodinger wave equation, wave function and its interpretation, potential well problems in one dimension, Tunneling, Uncertainty principle, Particle Accelerators: Cyclotron, Synchro Cyclotron, Betatron and applications

ACOUSTICS: Introduction, Reverberation and reverberation time, growth and decay of energy, Sabine's formula, absorption coefficient and its measurement, factors affecting architectural acoustics; Production, detection and applications of Ultrasound.

Reading:

1. Halliday, Resnic and Walker, Fundamentals of Physics, 9th Edition, John Wiley, 2011.
2. Eiser A, Concepts of Modern Physics, 5th Edition, McGraw Hill International, 2003.
3. Ajoy Ghatak, Optics, 5th Edition, Tata McGraw Hill, 2012
4. M.Armugam, Engineering Physics, Anuradha Agencies, 2003

CY101	Chemistry	BSC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand and apply the concepts in electrochemistry and corrosion science
CO2	Understand the concepts in molecular interactions
CO3	Understand the synthesis and analysis of modern materials
CO4	Apply the concepts of organic chemistry for synthesis
CO5	Understand the synthesis and applications of polymer science
CO6	Identify the structure of organic molecules using photo chemistry and chemical spectroscopy

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	3	-	-	-
CO4	1	-	-	-	-	-	-	-	2	-	-	2
CO5	2	-	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Electrochemistry - Review of the concepts of electrode potentials, Nernst equation, Reference electrodes, Ion selective electrodes – Concept – Glass electrode – Determination of pH of a solution using a glass electrode – Derivation of equation between E_{cell} and pH, Determination of F^- ion using fluoride electrode (Numerical calculations), Chemically modified electrodes (CMEs) – Concept, CMEs as potentiometric and amperometric sensors, Electrochemical energy systems, Electrochemistry of secondary cells e.g. Lead – acid and Ni-Cd cells, Rechargeable lithium batteries, Fuel cells – Electrochemistry of a H_2–O_2 fuel cell, methanol–O_2 fuel cell.

Corrosion and Its Prevention - Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, Potential-pH diagram for Iron, temperature and dissolved oxygen on corrosion rate, Corrosion prevention and control by cathodic protection.

Molecular Interactions - Molecular orbital theory applicable to understanding of bonding in heteronuclear diatomic molecules, e.g. CO and NO, Molecular orbital energy diagram of an Octahedral complex, MO diagram of a molecule involving charge transfer (e.g. $KMnO_4$), Nature of supramolecular interactions: ion-ion interactions, ion-dipole interactions, dipole-dipole interactions, hydrogen bonding, cation-л interactions, л-л interactions, van der Walls forces, Concept of self-assembly involving different types of interactions (Micellar formation; Membrane Formation; Surface films).

Chemistry of Nanomaterials - Introduction to Nanomaterials, Chemical synthesis of nanomaterials : sol-gel method, Reverse micellar method, electrolytic method, Characterization of nanoparticles by BET method, Characterization of nanomaterials by TEM (includes basic principle of TEM), Applications of nanomaterials in Industry as drug delivery materials, as catalysts, in water treatment.

Basic Principles Of Organic Chemistry – Introduction, Homolytic and Heterolytic cleavages and free radicals Carbocations, carbanions and addition reactions Elimination and substitution reactions.

Stereochemistry: chirality, optical activity, enantiomers and diastereomers, Projection formulae and geometrical isomerism,_Reactions - Hofmann reaction and Riemer-Tiemann reaction, Diels-Alder reaction and Cannizaro reaction, Skraup synthesis.

Polymer Chemistry - Concept of polymerization – Types of polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Mechanisms of simple anionic polymerization and co-ordination anionic polymerization (complex forming mechanism), Step-growth polymerization ,Mechanism and examples, Thermoplastic resins and Thermosetting resins- examples and applications, Conducting polymers: Mechanism of conduction in polymers – Examples – and applications.

Review Of Chemical Spectroscopy - Review of electromagnetic spectrum, Quantization of energy, Born – Oppenheimer approximation, Frank Condon Principle Vibrational spectra (Infra-red) of diatomic molecules – Selection rules Determination of force constant Problems, Identification of functional groups using IR spectroscopy Electronic spectroscopy - Types of electronic transitions –calculation of chromophoric absorptions For Diene and ene-one chromophors Qualitative analysis by electronic spectroscopy, Lambert – Beer's law- Applications in Quantitative analysis and problems.

NMR spectroscopy: Basic principles, Concept of chemical shift. Concept of spin-spin splitting and examples, Applications of UV,I.R and ^{1}H NMR spectra in the determination of structures of Ethyl alcohol, Dimethyl ether, Acetic acid and Benzyl alcohol.

Photo Chemistry – Principles of photochemistry – Rates of intermolecular processes, Jablonski diagram – fluorescence, phosphorescene and Chemiluminescence, Types of Photochemical Organic reactions, Laws of photochemistry and quantum yields-problems, Photosensitized reactions

Reading:

1. P. W. Atkins & Julio de Paula, Atkins Physical Chemistryl Chemistry, 7th Edition, Oxford University Press York, 2002.
2. Shashi Chawla, A Text Book of Engineering Chemistry, 3rd Edition, Dhanpat Rai & Co New Delhi, 2007.
3. S. Vairam, P. Kalyani & Suba Ramesh, Engineering Chemistry, 1st Edition, John Wiley & Sons, India, 2011.
4. Lee J.D., Concise Inorganic Chemistry, 7th Edition, Blackwel Science Publications Oxford, London, 2004.
5. Jerry March., Advanced Organic Chemistry, 6th Edition, John Wiley & Sons, New Jersey, 2007.
6. FehFuYen, Chemistry for Engineers, Imperial College Press, 2008.
7. Scott Fogler H, Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall of India, 2005.
8. Octave Levenspiel, Chemical Reaction Engineering, 2nd Edition, Wiley India, 2006.
9. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw Hill, 1981.

EC101	Basic Electronic Engineering	OEC	3-0-0	3 Credits

Pre-requisites:
Course Outcomes: After the completion of the course the student will be able to:

CO1	Characterize semiconductors, diodes, transistors and operational amplifiers
CO2	Design simple analog circuits
CO3	Design simple combinational and sequential logic circuits
CO4	Identify functions of digital multimeter, cathode ray oscilloscope and transducers in the measurement of physical variables
CO5	Understand fundamental principles of radio communication

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	2	-	-	-	-	-	-

Detailed Syllabus:
Electronics Systems: Introduction to electronics, review of p-n junction operation, diode applications, Zener diode as regulator.

Transistor and applications: Introduction to transistors, BJT Characteristics, biasing and applications, simple RC coupled amplifier and frequency response. Cascaded amplifiers, FET and MOSFET characteristics and applications.

Feedback in Electronic Systems: open loop and closed loop systems, Negative and positive feedback merits and demerits, Principle of oscillators, LC and RC oscillators.

Integrated Circuits: Operational amplifiers, Applications adder, subtractor, Integrator and Differentiators.

Digital Circuits: Number systems and logic gates, Combinational Logic circuits, Flip-Flops, counters and shift registers, data converters, Analog to Digital and Digital to Analog converters (ADC/DAC's).
Electronics Instrumentation: Measurement, Sensors, Laboratory measuring instruments: digital multi-meters, Cathode ray oscilloscopes (CRO's).

Principles of Communication: Need for Modulation, Modulation and Demodulation techniques.
Reading:

1. Neil Storey, Electronics A Systems Approach, 4th Edition, Pearson Education Publishing Company Pvt Ltd.
2. Salivahanan, N Suresh Kumar Electronic Devices and circuits, 3rd Edition, McGraw Hill publications.
3. Bhargava N. N., D C Kulshreshtha and S C Gupta, Basic Electronics & Linear Circuits, 2nd Edition, Tata McGraw Hill, 2013.

EE101	Basic Electrical Engineering	OEC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Analyze and solve electric and magnetic circuits.
CO2	Understand the principles of operation of DC machines, single phase transformers and three phase induction motors
CO3	Identify the starting methods of starting synchronous and induction motors and speed control methods for DC motors
CO4	Understand the principle of operation of moving coil, moving iron and dynamometer type instruments

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:
DC Circuits: Kirchhoff's Voltage & Current laws, Superposition Theorem, Star – Delta Transformations.

AC Circuits: Complex representation of Impedance, Phasor diagrams, Power & Power Factor, Solution of Single Phase Series & Parallel Circuits. Solution of Three Phase circuits and Measurement of Power in Three Phase circuits.

Magnetic Circuits: Fundamentals and Solution of Magnetic Circuits, Concepts of Self and Mutual Inductances, Coefficient of Coupling.

Single Phase Transformers: Principle of Operation of a Single Phase Transformer, EMF equation, Phasor diagram, Equivalent Circuit, Determination of Equivalent Circuit Parameters, Regulation and Efficiency of a single phase transformer. Principle of Operation of an Auto Transformer.

DC Machines: Principle of Operation, Classification, EMF and Torque equations, Characteristics of Generators and Motors, Speed Control Methods and Starting Techniques.

Three Phase Induction Motor: Principle of Rotating Magnetic Field, Principle of Operation of 3-φ I.M, Torque-Speed Characteristics of 3-φ I.M, Starting Methods and Applications of Three Phase Induction Motors.

Measuring Instruments: Moving Coil and Moving Iron Ammeters and Voltmeters, Dynamometer Type Wattmeter and Induction Type Energy Meter.

Reading:

1. Edward Hughes, ELBS, Electrical Technology, 10th Edition, 2010
2. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd Edition, PHI, 2003
3. V.N. Mittle, Basic Electrical Engineering,TMH Edition, 2000

CE101	Engineering Mechanics	OEC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Determine the resultant force and moment for a given system of forces.
CO2	Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction.
CO3	Calculate the motion characteristics of a body subjected to a given force system.
CO4	Determine the deformation of a shaft and understand the relationship between different material constants.
CO5	Determine the centroid and second moment of area.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-

Detailed syllabus:

Introduction - Specification of force vector, Formation of Force Vectors, Moment of Force – Cross product – Problems, Resultant of a general force system in space, Degrees of freedom - Equilibrium Equations, Kinematics – Kinetics – De' Alemberts principle, Degree of Constraints – Freebody diagrams

Spatial Force systems - Concurrent force systems - Equilibrium equations – Problems, Problems (Vector approach) – Tension Coefficient method, Problems (Tension Coefficient method), Parallel force systems - problems, Center of Parallel force system - Problems

Coplanar Force Systems - Introduction – Equilibrium equations – All systems, Problems on Coplanar Concurrent force system, Coplanar Parallel force system, Coplanar General force system – Point of action, Method of joints, Method of sections, Method of sections, Method of members, Friction – Coulombs laws of dry friction – Limiting friction, Problems on Wedge friction, Belt Friction-problems.

Mechanics of Deformable Bodies - Stress & Strain at a point- Normal and shear stresses, Axial deformations – Problems on prismatic shaft, tapered shaft and deformation due to self weight, Deformation of Stepped shaft due to axial loading, Poisson's Ratio – Bulk Modulus - Problems, change in dimensions and volume.

Centroid & Moment of Inertia - Centroid & M.I – Arial & Mass M.I – Radius of Gyration, Parallel axis– Perpendicular axis theorem – Simple Problems.

Dynamics of Particles - Rectilinear Motion – Kinematics Problems, Kinetics – Problems, Work & Energy – Impulse Moment, Direct Central Impact – coefficient of restitution, Curvilinear Motion – Projectile Motion, Work & Energy in Curvilinear motion.

Dynamics of Rigid Bodies - Rigid body rotation – Kinematics - Kinetics, Problems – Work & Energy in Rigid body rotation, Plane Motion – Kinematics, Problem – Instantaneous center of rotation.

Reading:

1. J.L.Meriam & L.G. Kraige, Engineering Mechanics, 7th Edition, John Wiley & sons, 2012.
2. Timoshenko and Young, Engineering Mechanics, 3rd Edition, Mc Graw Hill Publishers, 2006.
3. Gere and Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publishers, 2011.

CE 102	Environmental Science and Engineering	OEC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO2	Estimate the population - economic growth, energy requirement and demand.
CO3	Analyze material balance for different environmental systems.
CO4	Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO5	Identify the major pollutants and abatement devices for environmental management and sustainable development

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-		2
CO2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	1	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3

Detailed syllabus:

Nature and scope of Environmental Problems: Environment and society, environmental disturbances, role of technology, sustainable development, quantification of environmental issues.

Population and Economic growth: Economic growth and industrialization urbanization, Resource consumption, Renewable and nonrenewable resources, Energy requirement and development.

Global Atmospheric systems: Concept of climate change, green house effect, global energy balance, global warming, carbon cycle, Intergovernmental Panel for Climate Change (IPCC) emission scenarios, impact of climate change.

Mass balance and Environmental chemistry: Mass and Energy balance, Particle dispersion, oxygen demand, carbon emission, enthalpy in environmental systems, chemical equilibria.

Ecology and Biodiversity: Energy flow in ecosystem, food chain, nutrient cycles, eutrofication, value of biodiversity, biodiversity at global, national and local levels, threats for biodiversity, conservation of biodiversity

Water Pollution: water pollutants, effects of oxygen demanding waste on water, water quality in lakes, reservoirs and groundwater, contaminant transport, self cleaning capacity of streams and water bodies, water quality standards, principles of water and wastewater treatment.

Air Pollution: Overview of emissions, pollutant standard index, toxic air pollutants, vehicle emissions, indoor air quality, principles of air pollution control.
Solid and Hazardous Waste: Characteristics of Solid and Hazardous Waste, Collection and transfer system, recycling, composting, waste to energy conversion, landfills.

Environmental Management: Sustainable development, Environmental Impact Assessment (EIA), Environmental Ethics, Legal aspects.

Reading:

1. J.G. Henry and G.W. Heinke, Environmental Science and Engineering, Pearson Education, 2004.
2. G.B. Masters, Introduction to Environmental Engineering and Science, Pearson Education, 2004.

ME101	Basic Mechanical Engineering	OEC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand the basics of thermodynamics and components of a thermal power plant.
CO2	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice.
CO3	Understand the basics of heat transfer, mechanisms of heat transfer, refrigeration and internal combustion engines.
CO4	Understand the mechanism of power transfer through belt, rope, chain and gear drives.
CO5	Application of knowledge for power transmission in an automobile and its components with their basic functions.
CO6	Understand the functions and operations of machine tools including lathe, milling, shaping, drilling and grinding machines.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	-	-	-	-	-	-	1
CO2	3	2	2	2	1	-	-	-	-	-	-	1
CO3	2	3	2	1	1	1	1	-	-	-	-	1
CO4	2	3	2	1	1	1	1	-	-	-	-	1
CO5	3	3	2	1	1	1	1	-	-	-	-	1
CO6	3	2	2	2	1	-	-	-	-	-	-	1

Detailed Syllabus:

Introduction: Introduction to Thermodynamics - Concept of a System – Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Zeroth Law, Energy Interactions - Heat and Work, Types of Work, Work interactions in a closed System for various processes

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (c_p and c_v), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

Thermal Power Plant: Thermal Power Plant Layout – Four Circuits, Rankine Cycle, Boilers: Fire Tube vs Water Tube; Babcock & Wilcox, Cochran Boilers, Steam Turbines : Impulse vs Reaction Turbines, Compounding of Turbines: Pressure Compounding, Velocity Compounding, Pressure-Velocity Compounding, Condensers: Types – Jet & Surface Condensers, Cooling Towers

Manufacturing Processes: Engineering Materials: Classification, Properties of Materials, Manufacturing Processes: Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing

Internal Combustion Engines and Refrigeration: IC Engines: 2 - Stroke and 4 - Stroke Engines, S.I. Engine and C.I. Engine: Differences, P-V and T-S Diagrams

Refrigeration System and Refrigerants: Principle and working of standard vapor compression refrigeration system and Brief description of Refrigerants

Heat Transfer: Heat Transfer: Modes; Thermal Resistance Concept, Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Heat Transfer

Welding: Welding: Gas Welding and Arc Welding, Soldering, Brazing

Power Transmission: Transmission of Mechanical Power: Belt Drives – Simple Numerical Problems, Gear Drives – Simple Numerical Problems

Basics of Automotive Vehicle: Layout of Automobile Transmission; Brakes – Types, Clutch, Differential

Machine Tools and Machining Processes: Machine Tools Machine Tools: Lathe Machine, Lathe Operations, Milling Machine-Types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations.

Reading:

1. Mathur, M.L., Mehta, F.S., and Tiwari, R.P., Elements of Mechanical Engineering, Jain Brothers, New Delhi, 2011.
2. Roy, K.P., and Hazra Chowdary, S.K.., Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd., 2002.
3. Rudramoorthy, R.., Thermal Engineering, Tata McGraw Hill Book Company, New Delhi, 2003.
4. Hazra Chowdary., S.K. and Bose. Workshop Technology, Vol. I and II, Media Promoters and Publishers Pvt. Ltd., 2002.

ME102	Engineering Graphics	OEC	2-0-3	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Draw Orthographic projections of Lines, Planes, and Solids
CO2	Construct Isometric Scale, Isometric Projections and Views
CO3	Draw Sections of various Solids including Cylinders, cones, prisms and pyramids
CO4	Draw projections of lines, planes, solids, isometric projections and sections of solids including Cylinders, cones, prisms and pyramids using AutoCAD

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:
Overview of the course, Examination and Evaluation patterns, Types of lines, Lettering, Scales Dimensioning, Geometrical Constructions, Polygons.
Introduction to Auto-CAD, DRAW tools-1,
Orthographic Projection of Points
Orthographic Projection of Lines-1, Auto-CAD DRAW tools-2, MODIFY tools-1,
Orthographic Projection of Lines-2.
Traces, Auto-CAD : MODIFY tools -2, TEXT, DIMENSION , PROPERTIES ,tool bar.
Orthographic Projection of Planes.
Orthographic Projection of Solids.
Section of Solids.
Auto-CAD: Standard Tool bar, LAYERS
Isometric Projection

Reading:

1. Bhatt, N.D., Elements of Engineering Drawing, Charotar Publishers, 2005.
2. Sham Tikoo., Understanding AutoCAD 2002, Tata McGraw Hill Book Company, New Delhi, 2001.
3. Lakshminarayanan, V. and Vaishwanar, R.S., Engineering Graphics including AutoCAD2002, Jain Brothers, New Delhi, 2005.
4. Siddique, A.N., Engineering Drawing with a Primer on AutoCAD, Prentice Hall of India, New Delhi, 2004.

CS101	Problem Solving and Computer Programming	OEC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Develop algorithms for mathematical and scientific problems.
CO2	Explore alternate algorithmic approaches to problem solving
CO3	Understand the components of computing systems
CO4	Choose data types and structures to solve mathematical and scientific problem
CO5	Develop modular programs using control structures
CO6	Write programs to solve real world problems using object oriented features

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-
CO6	-	2	-	-	-	-	-	-	3	-	-	-

Detailed Syllabus:

Introduction to computers and Basics of C++: Hardware, software, SDLC, Algorithm, Program, Origins of the C++ Language, C++ and Object-Oriented Programming, Data types, Identifiers, Variables, Assignment Statements, Escape Sequences, Naming Constants, Arithmetic Operators and Expressions, Integer and Floating-Point Division, Type Casting, Increment and Decrement Operators and Console input/output.

Flow of Control: Boolean Expressions, Branching Mechanism (simple if, if-else, nested if-else, switch case, break, exit statements) and Loops (while, do-while, for, continue statement).

Functions: Predefined Functions, Programmer Defined functions (call-by-value, call-by-reference), Procedural Abstraction, Local and global variables Function overloading and Recursive functions.

Arrays: Introduction to arrays, one dimensional array (selection sort, bubble sort, linear search and binary search), multi dimensional arrays and arrays in function call.

Pointers and Dynamic Arrays: Pointer Variables, Basic Memory Management, Dangling Pointers, Dynamic Variables and Automatic Variables, Pointers as Call-by-Value Parameters, Creating and Using Dynamic Arrays and Multidimensional Dynamic Arrays.

Strings: C Strings, Character Manipulation Tools and Standard String Class.

Streams and File I/O: I/O Streams, File I/O (read, write and appending a file), Character I/O, Checking for the End of a file and Formatting Output with Stream Functions.

Structures and Classes: Structure definition, structure variables, structure variables in function call, Class definition, Encapsulation and Access Specifiers, Inheritance, Polymorphism, Method overloading

Reading:

1. Walter Savitch, Problem Solving with C++, 6^{th} Edition, Pearson, 2007.
2. Cay Horstmann, Timothy Budd, *Big C++*, Wiley, Indian Edition, 2006.

PH102	Physics Laboratory	BSC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Use CRO, Signal generator, spectrometer, polarimeter and GM counter for making measurements
CO2	Test optical components using principles of interference and diffraction of light
CO3	Determine the selectivity parameters in electrical circuits
CO4	Determine the width of narrow slits, spacing between close rulings using lasers and appreciate the accuracy in measurements

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	-	-	-	-	-	-	1	-	-	-
CO2	2	-	-	-	-	-	-	-	2	-	-	-
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	-	2	-	-	-	-	-	-	2	-	-	-

List of experiments:

1. Determination of Wavelength of Sodium light using Newton's Rings
2. Determination of Wavelength of He-Ne laser – Metal Scale
3. Measurement of Width of a narrow slit using He- Ne Laser
4. Determination of Specific rotation of Cane sugar by Laurent Half-shade Polarimeter.
5. Determination of capacitance by using R-C circuit
6. Determination of resonating frequency and bandwidth by LCR circuit
7. Measurement of half life of radioactive source using GM Counter
8. Diffraction grating by normal incidence method

CY102	Chemistry Laboratory	BSC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Synthesize polymers
CO2	Analyze ores and bleaching powder
CO3	Estimate the Hardness of water in terms of Calcium and Magnesium ions
CO4	Separate organic compounds using chromatographic techniques
CO5	Standardize solutions using titration, conductivity meter, pH-meter, potentiometer and colorimeter
CO6	Verify the Freundlich adsorption isotherm

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	-	-	-	1	-	-	-
CO3	2	-	-	-	-	-	-	-	3	-	-	-
CO4	-	2	-	-	-	-	-	-	2	-	-	-
CO5	2	-	-	-	-	-	-	-	3	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

List of Experiments:

Cycle 1

1. Standardization of potassium permanganate
2. Determination of MnO2 in Pyrolusite
3. Determination of Iron in Haematite
4. Determination of available Chlorine in bleaching powder and of Iodine in Iodized salt
5. Determination of hardness of water and of calcium in milk powder
6. Chemistry of blue printing
7. Preparation of phenol formaldehyde resin

Cycle 2

8. Conductometric titration of an Acid vs Base
9. pH-metric titration of an Acid vs Base
10. Potentiometric titration of Fe^{2+} against $K_2Cr_2O_7$
11. Colorimetric titration of potassium permanganate

12. Determination of rate of corrosion of mild steel in acidic environment in the absence and presence of an inhibitor
13. Determination of salt content by Ion-exchange
14. Separation of Ions by paper chromatography
15. Verification of Freundlich adsorption isotherm

CS102	Problem Solving and Computer Programming Laboratory	OEC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Design and test programs to solve mathematical and scientific problems
CO2	Develop and test programs using control structures
CO3	Implement modular programs using functions
CO4	Develop programs using classes

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	2	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	2	-	-	-

Detailed Syllabus:

Introduction to computers and Basics of C++: Hardware, software, SDLC, Algorithm, Program, Origins of the C++ Language, Data types, Identifiers, Variables, Assignment Statements, Escape Sequences, Naming Constants, Arithmetic Operators and Expressions, Integer and Floating-Point Division, Type Casting, Increment and Decrement Operators and Console input/output.

Flow of Control: Boolean Expressions, Branching Mechanism (simple if, if-else, nested if-else, switch case, break, exit statements) and Loops (while, do-while, for, continue statement).

Functions: Predefined Functions, Programmer Defined functions (call-by-value, call-by-reference), Local and global variables, Recursive functions.

Arrays: Introduction to arrays, one dimensional array (selection sort, bubble sort, linear search and binary search), multi dimensional arrays and arrays in function call

Pointers and Dynamic Arrays: Pointer Variables, Basic Memory Management, Dangling Pointers, Dynamic Variables and Automatic Variables, Pointers as Call-by-Value Parameters, Creating and Using Dynamic Arrays and Multidimensional Dynamic Arrays.

Structures and Classes: Structure definition, structure variables, structure variables in function call, Class definition, Encapsulation and Access Specifiers, Inheritance, Polymorphism, Method overloading.

Strings: C Strings, Character Manipulation Tools and Standard String Class.

Streams and File I/O: I/O Streams, File I/O (read, write and appending a file), Character I/O, Checking for the End of a file and Formatting Output with Stream Functions.

ME103	Workshop Practice	OEC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Study and practice on machine tools and their operations.
CO2	Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
CO3	Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping.
CO4	Apply basic electrical engineering knowledge for house wiring practice.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2

List of Experiments:

A. _Fitting Trade:
   1. Preparation of T-Shape Work piece as per the given specifications.
   2. Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding.
   3. Practice marking operations.

B. Plumbing:
   1. Practice of Internal threading, external threading, pipe bending, pipe fitting.
   2. Pipes with coupling for same diameter and with reducer for different diameters.
   3. Practice of T-fitting, Y-fitting, Gate valves fitting.

C. Machine shop:
   i) Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools)
   ii) Demonstration of different operations on Lathe machine
   iii) Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting.
   iv) Study of Quick return mechanism of Shaper.

D. Power Tools:
   i) Study of different hand operated power tools, uses and their demonstration
   ii) Practice of all available Bosch Power tools.

E. Carpentry:
   i) Study of Carpentry Tools, Equipment and different joints
   ii). Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

F. House Wiring:

i) Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols.

ii) Stair case wiring: Demo and Practice (2 switches with one lamp control)

iii) Godown wiring

G. Foundry Trade:

i) Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes

ii) Demo of mould preparation

iii) Practice – Preparation of mould by using split pattern.

H. Welding:

i) Introduction, Study of Tools and welding Equipment (Gas and Arc welding)

ii) Selection of welding electrode and current, Bead practice.

iii) Practice of Butt Joint, Lap Joint.

Reading:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edition, Scitech publishers
3. John K.C., Mechanical Workshop Practice, 2nd Edition, PHI, 2010.
4. Jeyapoovan T.and Pranitha S., Engineering Practices Lab Manual, 3rd Edition, Vikas Publishers, 2008.

MA151	Mathematics – II	BSC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

Mapping of course outcomes with program outcomes:

CO1	Solve linear differential equations using Laplace transforms
CO2	Evaluate multiple integrals and improper integrals
CO3	Convert line integrals to area integrals
CO4	Convert surface integrals to volume integrals
CO5	Determine potential functions for irrotational force fields

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Laplace Transformation: Laplace transform - Inverse Laplace transform - properties of Laplace transforms - Laplace transforms of unit step function, impulse function and periodic function - convolution theorem - Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform.

Integral Calculus: Fundamental theorem of integral calculus and mean value theorems; Evaluation of plane areas, volume and surface area of a solid of revolution and lengths. Convergence of Improper integrals – Beta and Gamma integrals – Elementary properties – Differentiation under integral sign. Double and triple integrals – computation of surface areas and volumes – change of variables in double and triple integrals.

Vector Calculus : Scalar and Vector fields; Vector Differentiation; Level surfaces - directional derivative - Gradient of scalar field; Divergence and Curl of a vector field - Laplacian - Line and surface integrals; Green's theorem in plane; Gauss Divergence theorem; Stokes' theorem.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, 8^{th} Edition, John Wiley and Sons, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

EC201	Electronic Devices and Circuits-I	PCC	4–0–0	4 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Study and analyze the behavior of semiconductor devices.
CO2	Characterize the current flow of a bipolar transistor in CB,CE and CC configurations
CO3	Bias the transistors and FETs for amplifier applications.
CO4	Realize simple amplifier circuits using BJT and FET**.**
CO5	Design half wave and full wave rectifiers with filters

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	3	-	-	-	-	-	-	-	-
CO2	-	3	-	3	3	-	-	-	-	-	-	2
CO3	-	3	-		-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-
CO5	-	2	1	3	-	-	-	-	1	-	-	-

Detailed Syllabus:

Introduction

SEMICONDUCTORS: Review of Band Theory of solids, intrinsic semiconductors, Generation and Recombination of electrons and holes. Thermal equilibrium, Doped semiconductors n and p types, Fermi level and carrier concentrations of n and p type semiconductors. Carrier mobility and conductivity, diffusion, Continuity equation, Hall Effect and its applications.

SEMICONDUCTOR DIODES: Band structure of pn junction, current components, Quantitative theory of pn diode, Volt-ampere characteristics and its temperature dependence, Narrow-base diode, Transition and diffusion capacitance of p-n junction diodes, Breakdown of junctions on reverse bias, Zener and Avalanche breakdowns, Tunnel diode and its V-I characteristics, The principles of photo diode, photo transistor, LED & LCD.

JUNCTION TRANSISTOR: PNP and NPN junction transistors, Characteristics of the current flow across the base regions, Minority and majority carrier profiles, Transistor as a device in CB, CE and CC configurations, and their characteristics, Ebers-Moll Model of BJT.

TRANSISTOR BIASING: The operating Point , DC & AC load lines, Fixed Bias and problems, Collector Feedback Bias, Emitter Feed Back Bias, Self Bias and problems, Stabilization, various stabilization circuits, Thermal runaway and thermal stability.

FIELD EFFECT TRANSISTORS: JFET and its characteristics, Pinch off voltage and drain saturation current, MOSFET: enhancement, depletion modes, Biasing of FETs.

SMALL SIGNAL LOW FREQUENCY TRANSISTOR AMPLIFIER CIRCUITS: Transistor hybrid model, Analysis of transistor amplifier circuits using ‘h’ parameters, Conversion formulae for the parameters of the three configurations, Analysis of single stage transistor amplifier circuits, RC coupled amplifier. Effect of bypass and coupling capacitors on the low frequency response of the amplifier, Emitter follower amplifier, FET amplifiers - low frequency and high frequency models, Amplifier configurations, Low and high frequency response of amplifier circuits, Analysis of single stage FET amplifier circuits.

RECTIFIERS: Diode as a rectifier, Half wave and Full wave, Half wave and Full wave with filters, Bridge rectifiers with and without filters, Ripple factor and regulation characteristics, Electron dynamics: Motion of charged particles in Electric and Magnetic fields, Simple problems involving either electric or magnetic field only, Electro static and electromagnetic focusing, Principle of CRT, Deflection sensitivity.

Reading:

1. Millman and Halkias, *Integrated Electronics*, 2nd Edition, Tata Mc Graw Hill, 2010.
2. Y.N. Bapat, *Electronic devices and circuits, Discrete and Integrated, 3rd Edition,* Tata Mc Graw Hill, 2011.

EC202	Networks and Transmission Lines	PCC	3-0-0	3 Credits

Prerequisites:

Course outcomes: After completion of the course student will be able to:

CO1	Understand the concept of impedance matching and its significance.
CO2	Design filters and equalizers for given applications.
CO3	Analyze and interpret the voltage and current distributions on the transmission lines.
CO4	Use the smith chart as a graphical tool to solve impedance matching issues.

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-

NETWORKS: Image and iterative impedances. Image and iterative transfer constants. Insertion loss. Attenuators and pads. Lattice network and its parameters. Impedance matching networks. Networks designed for specified phase shift.

FILTERS: Filter fundamentals, Low pass, high pass, band pass and band elimination filters. Constant K and M derived sections. Composite filters.

EQUALISERS: Inverse impedances. Series and shunt equalisers. L type equalisers. T and Bridged T equalisers. The Lattice equalisers.

TRANSMISSION LINE THEORY: Primary and secondary constants. Phase and Group velocities. Transmission line equations. Distortion. Loading of lines. Characteristics of LF lines.

RF LINES: RF lines, lossless lines, reflection coefficient and VSWR. Quarter-wave, half-wave and 1/8 wave lines. Smith chart - Impedance matching with single and double stub.

Reading:

1. JOHNSON - Transmission Lines and Networks, Mc-Graw Hill, 1950
2. JOHN D RYDER - Networks, Lines and Fields - Prentice Hall, 1970

EC203	Digital System Design - I	PCC	4–0–0	4 Credits

Prerequisites:

Course outcomes: After completion of the course student will be able to:

CO1	Design and analyze combinational and sequential logic circuits through HDL models
CO2	Optimize combinational and sequential logic circuits
CO3	Understand fault detection techniques for digital logic circuits
CO4	Analyze a memory cell and apply for organizing larger memories

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	2	-	-	-

Introduction to Number Systems: Number representation, conversion of bases, binary arithmetic, binary codes, weighted and non-weighted codes, and Error detection and correction codes.

Boolean algebra: Switching algebra basic properties, De Morgan's theorems, switching functions, Definitions, simplifications, canonical forms, functional properties

Minimization of switching functions: Simplification and minimization of functions by Karnaugh map method, five variable map, minimal functions and their properties, prime implicants, tabulation procedure, decimal representation, prime implicant chart, essential rows, don't-care combinations, irredundant expressions, reduction of the chart, two level and multi-level circuit minimization.

Combinational circuit design: Design with basic logic gates, comparators, data selectors, priority encoders, decoders, full adder, ripple-carry adder, carry-look ahead adder, HDL models.

Logic families: TTL, ECL, CMOS Logic circuits, Transfer characteristics, fan-in, fan-out, rise time and fall time analysis

Sequential circuit design: Memory elements and their excitation functions SR, JK, T, and D latches and flip-flops, master slave JK flip-flop, edge-triggered flip-flop, synchronous and asynchronous counters, finite-state machine, sequence detector, minimization and transformation of sequential machines, merger graphs and tables.

Testing of Combinational circuits: Fault models, structural testing: path sensitization

Memory Devices: Types of memories, RAM BJT cell and MOS RAM cells, organization of a RAM

Reading:

1. Zvi Kohavi, Switching and Finite Automata Theory, Princeton University, New Jersey, 3rd Edition, 2009.
2. Schilling, Herbert Taub and Donald, Digital Integrated Electronics, Tata McGraw-Hill, 2008.
3. Jayaram Bhasker, A VHDL Primer, 3rd edition, Prentice-Hall India, 1998.
4. John F Wakerly, Digital Design Principles and Practices, 3rd Edition, Prentice Hall India, 2001.
5. Fletcher, William I., An Engineering Approach to Digital Design, 1st Edition, Prentice Hall India, 1980.

EC204	Signals and Systems	PCC	3–0–0	3 Credits

Prerequisites:

Course outcomes: After completion of the course student will be able to:

CO1	Classify the signals as Continuous time and Discrete time
CO2	Analyze the spectral characteristics of signals using Fourier analysis.
CO3	Classify systems based on their properties and determine the response of LTI system using convolution.
CO4	Identify system properties based on impulse response and Fourier analysis.
CO5	Apply transform techniques to analyze continuous-time and discrete-time signals and systems.

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	3	-	-	-	-	-	1

SIGNALS AND SYSTEMS: Continuous Time and Discrete Time signals, Exponential and Sinusoidal Signals, Unit Impulse and Unit Step Functions, Continuous and Discrete Time Systems, basic System Properties.

LINEAR TIME INVARIANT SYSTEMS: Discrete Time LTI Systems, Continuous Time LTI Systems, properties of LTI Systems, causal LTI Systems Described by Difference equations.

FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS: Response of LTI systems to Complex Exponentials, Fourier series Representation of CT periodic Signals, properties of CT Fourier Series, Fourier Series representation of DT periodic Signals, properties of DFS, Fourier series and LTI Systems, Filtering, Examples of CT filters, Examples of DT filters.

CONTINUOUS TIME FOURIER TRANSFORM: Representation of a periodic Signals by continuous FT, FT of periodic signals, convolution and multiplication property of continuous FT, systems characterized by Linear Constant Coefficient Differential Equations.

TIME AND FREQUENCY CHARACTERIZATION OF SIGNALS AND SYSTEMS: Magnitude and phase representation of FT, Magnitude and phase response of LTI systems, Time de main and Frequency domain aspects of ideal and non ideal filters.

DISCRETE TIME FOURIER TRANSFORM (DTFT) and DISCRETE FOURIER TRANSFORM (DFT): Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations.

SAMPLING: Sampling theorem, Impulse sampling, sampling with zero order Hold, Reconstruction of signal from its samples using interpolation, Effect of under sampling,

Z-TRANSFORM: Z-transform , Region of convergence and its properties, Inverse Z transform, properties of ZT, Analysis and characterization of LTI systems using ZXT, LTI Systems, System function algebra and block diagram representations.

SIGNAL FLOWGRAPHS: Impulse Response and Transfer function of linear Systems, Block diagrams, Signal flow graphs, Basic properties of SFG, SFG Terms, SFG Algebra, Gain formula, Application of gain formula to block diagrams.

Reading:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems Prentice Hall India, 2^{nd} Edition, 2009.
2. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, 4^{th} Edition, PHI, 2007.
3. Robert A. Gable, Richard A. Roberts, Signals & Linear Systems, 3^{rd} Edition, John Wiley, 1995.

EC205	Electronic Devices and Circuits - I Laboratory	PCC	0–0–3	2 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Plot the characteristics of electronic devices to understand their behavior.
CO2	Design, construct and test amplifier circuits and interpret the results.
CO3	Operate electronic test equipment and hardware/software tools to characterize the behavior of devices and circuits.
CO4	Design and test rectifiers with filters

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	-	3	2	-	-	-	-	-	1	-	-	-
CO3	-	2	3	-	-	-	-	-	1	-	-	-
CO4	-	3	-	2	-	-	-	-	1	-	-	-

Expe

riments are based on the Course No. EC 201 (ELECTRONIC DEVICES & CIRUITS-I)

List of Experiments:

1. Study of Instruments
2. Study of Components
3. Soldering Practice
4. V-I Characteristics of Si and Ge Diodes
5. Zener Diode Characteristics and Zener Diode as Voltage Regulator
6. Half Wave and Full Wave Rectifiers
7. Rectifiers with Filters
8. BJT Characteristics
9. FET Characteristics
10. BJT Biasing
11. FET Biasing
12. BJT as an Amplifier

EC206	Electronic Design Automation laboratory	PCC	0–0–3	2 Credits

Prerequisites:

Course outcomes: After completion of the course student will be able to:

CO1	Simulate and verify the functionality of simple transistor circuits using PSpice
CO2	Perform DC and AC analysis on transistor circuits using EDA tools
CO3	Obtain frequency response of amplifier circuits at low and high frequencies through simulations

Mapping of course outcomes with program outcomes:

List of Experiments:

- Introduction to PSPICE

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	1	-	-	-	-	-	-	-	-

- MS Windows and Operating system acquaintance
- DC Circuit Analysis

  Thevenin's theorem and applications
  Norton's theorem and applications
  Mesh analysis and DC sweep
  Nodal analysis

- AC Circuit Analysis

  Series AC Circuit with R and L
  Series AC Circuit with R and C
  RLC Series resonance circuit
  RLC Parallel resonance circuit
  Frequency Sweep for series and parallel circuits

- Transistor Circuits

  Biasing of BJT
  Analysis of small signal h-parameter models CE, CC, CB configurations
  Millers theorem
  Frequency response of CE, CC, CB amplifiers
  FET biasing and frequency response
  High frequency analysis of CE, CC, CB amplifiers

EE236	Network Analysis	OEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Solve network problems using mesh current and node voltage equations
CO2	Design resonant circuits for given bandwidth
CO3	Compute responses of first order and second order networks using time domain analysis
CO4	Obtain circuit response using Laplace Transform
CO5	Analyze networks using Thevenin, Norton, Maximum power transfer, Superposition, Miller and Tellegen's theorems

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction

CIRCUIT ELEMENTS AND RELATIONS: Types of Sources and Source Transformations - Dot convention and formation of loop and node equations, NETWORK GRAPHS AND ANALYSIS: Graph of a network, Incidence matrix, Cutset and tie set matrices - Formation of equilibrium equations - Dual networks. TIME DOMAIN ANALYSIS: Solution of network equations in time domain - classical differential equations approach - Initial conditions and their evaluation - Applications to simple RLC - circuits only.

APPLICATIONS OF LAPLACE TRANSFORMS IN CIRCUIT THEORY: Laplace transforms of various signals of excitation - Waveform synthesis, Laplace transformed networks - Determination and representation of initial conditions - Response for impulse function only and its relation to network admittance - convolution integral and applications.

STEADY STATE ANALYSIS OF CIRCUITS FOR SINUSOIDAL EXCITATIONS: 1-phase series, parallel, series - parallel circuits - Solution of AC networks using mesh and nodal analysis.
RESONANCE AND LOCUS DIAGRAMS: Series and parallel resonance - Selectivity - Bandwidth - Q factors – Times circuits. Locus diagrams for RL and RC circuits with AC excitation for parametric and frequency variations under steady state conditions.

NETWORK THEOREMS AND APPLICATIONS: Superposition theorem; Thevenins and Nortons theorems; substitution and compensation theorems - Reciprocity theorem; Millman's theorem; Maximum power transfer theorem; Tellegen's theorem - Their applications in analysis of networks.

Reading:

1. M.E.Van Valkenberg, Network Analysis, Prentice Hall India, 3rd Edition, 2002.
2. Charles A Desoer, Ernest S Kuh, Basic Circuit Theory, McGraw Hill, 1969.
3. M.L. Soni and J.C. Gupta, A Course in Electrical Circuits Analysis, Dhanpat Rai & Co.(P), 2001.
4. G.K. Mithal and Ravi Mittal, Network Analysis, Khanna Khanna Pub, 1998.

MA213	Complex variables and Special Functions	BSC	4–0–0	4 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Evaluate contour integrals of functions of complex variables
CO2	Examine improper integrals using complex variables
CO3	Determine the series solutions of Legendre and Bessel equations
CO4	Assess series solution of ordinary differential equations at a singular point
CO5	Construct a function for data using cubic splines

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Review of complex numbers, nth roots of complex number, Regions in the complex plane, Functions of a complex variable, Limit and continuity, Functions of a complex variable, Limit and continuity, Derivative, CR-equations, analytic functions, Contour integrals, anti-derivatives, Contour integrals, anti-derivatives, Cauchy-Goursat Theorem, Cauchy Integral Formula.

Taylor's and Laurent's series expansions, Zeros and singularities, Residues, Residue theorem, Evaluation of improper integrals, Mapping by Elementary functions, Linear fractional transformations (Bilinear transformation), conformal mapping, Schwartz Christoffel transformation

Ordinary points, Classification of singular points of an ordinary differential equation Series solutions-Power series method, Legendre equation, Legendre polynomials and their orthogonal property, Generating function, Regular Singular Points, Method of Frobenius.

Bessel equation, Bessel function of first kind, Generating function, orthogonal property of Bessel functions, Sturm-Liouvelle Problems, Splines and cubic spline functions, Properties and applications, Piecewise approximation with M's and m's

Reading:

1. R.V. Churchill, *Complex variables and its applications*, McGraw Hill, 1960.
2. S.S. Sastry, *Introductory methods of Numerical Analysis*, PHI, 2010.
3. W.W. Bell, *Special Functions for Scientists and Engineers*, Dover Publications, 2004.
4. Erwin Kreyszig: *Advanced Engineering Mathematics*, John Wiley and Sons, 8th Edition, 2008.
5. B.S. Grewal: Higher Engineering Mathematics, Khanna Publications, 2009.

CS235	Data Structures	OEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the basic techniques of algorithm analysis and assess how the choice of data structures impact the performance of programs.
CO2	Solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, binary search trees, AVL trees and writing programs for these solutions.
CO3	Implement graphs as adjacency matrix, adjacency list, Searching technique - Breadth First Search and Depth First Search.
CO4	Analyze, evaluate and choose appropriate data structures and algorithms for a specific application.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	1

Detailed Syllabus:

Introduction to Data Structures, Asymptotic Notations, Theorems and Examples based on Asymptotic Notations, Stack Data Structure and its Applications, Queue Data Structure and its Applications, Linked Lists, Trees and tree traversals, Dynamic Sets and Operations on Dynamic Sets, Binary Search Tree and its Operations ,Heap Data Structure

Priority Queue, AVL Trees., Direct Addressing; Introduction to Hashing , Collision Resolution by Chaining, Collision Resolution by Open Addressing, Lower Bound for Comparison based Sorting Algorithms, Insertion Sort, Merge Sort, Quick Sort.

Heap Sort and Counting Sort , Radix Sort, Introduction to Graphs and Representation of Graphs, Depth First Search (DFS), Breadth First Search (BFS), Applications: BFS and DFS .

Prim’s Algorithm for finding Minimum Spanning Tree (MST), Kruskal’s Algorithm for finding MST, Dijkstra’s Algorithm for Single Source Shortest Paths

Floydd-Warshall Algorithm for All-Pairs Shortest Path Problem

Reading:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, PHI, 2nd Edition, 2009.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++*, Third Edition, Pearson Education, 2006
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Universities Press, 2nd Edition, 2011.
4. Michael T.Goodrich and Roberto Tamassia, *Algorithm Design: Foundations, Analysis and Internet Examples*, Wiley India, 2nd Edition, 2006.

EC251	Electronic Devices and Circuits- II	PCC	4–0–0	4 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Design and analyze multistage amplifiers.
CO2	Apply compensation techniques for stabilizing analog circuits against parameter variations
CO3	Design negative feedback amplifier circuits and oscillators
CO4	Analyze and design solid state power amplifier circuits.
CO5	Analyze and design tuned amplifier circuits.

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	-
CO4	1	3	2	-	-	-	-	-	-	-	-	-
CO5	1	3	2	-	-	-	-	-	-	-	-	-

MULTISTAGE AMPLIFIERS: Classification of amplifiers, Distortion in amplifiers, Frequency response of an Amplifier, Bode plots, Step response of an amplifier, CE short circuit current gain, High frequency response of a CE stage, Gain bandwidth product, Emitter follower at high frequencies, Analysis of Multistage amplifier, Design of two stage amplifier, Common Source and Common Drain amplifier at high frequencies, Frequency response of cascaded stages, Cascode amplifiers (CE-CB),The effect of coupling and bypass capacitors, Differential amplifiers, Analysis of Differential amplifiers.

FEEDBACK AMPLIFIERS: Classification and representation of amplifiers, Feedback concept, The transfer gain with feedback, General characteristics of negative feedback amplifiers. Impedance in feedback amplifiers, Properties of feedback amplifier topologies, Approx. analysis of feedback amplifiers, Method of analysis of a feedback amplifier, The shunt feedback triple, Shunt- series pair, Series shunt pair, series triple, General analysis of multistage feedback amplifiers.

STABILITY AND RESPONSE OF FEEDBACK AMPLIFIER: Effect of feedback on bandwidth, Stability, Test of stability, Compensation, General method of compensation, Frequency response of feedback amplifier double pole transfer function, Phase Margin and gain Margin, Three pole transfer function with feedback amplifier response, approximate analysis of a multi-pole feedback amplifier.

OSCILLATORS: Sinusoidal oscillators, Barkhausen Criterion, Analysis and design of RC phase shift (FET/ BJT) oscillator, Wien bridge oscillators, Resonant circuit oscillators, General form of oscillator circuit (Hartley & Colpitts), Crystal oscillators.

POWER AMPLIFER: Class A, B, AB, and C power amplifiers, push – pull and complementary symmetry push-pull amplifier. Design of heat sinks, power output, efficiency, crossover distortion and harmonic distortion.

TUNED AMPLIFIER: Design and analysis of single tuned amplifier circuit with a capacitor coupled load, Double tuned inter-stage design. Stability consideration, Class B and class C tuned power amplifiers.

Reading:

1. J. Millman and Halkias, Integrated Electronics, TMH, 2nd Edition, 2010.
2. J. Millman and A. Grabel, Micro Electronics, TMH, 2nd Edition, 2009.
3. A. S. Sedra and K. C. Smith, Micro Electronic Circuits, Oxford press, 4th Edition, 1998.
4. Md. Gausi, Electronic circuits, John Wiley, 1st Edition.

EC252	Electro Magnetic Fields and Waves	PCC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Solve Maxwell's equations using vector calculus in three standard coordinate systems
CO2	Deduce EM wave propagation in free space and in dielectric medium
CO3	Analyze electromagnetic wave propagation in guiding structures under various matching conditions
CO4	Understand the power flow mechanism in guiding structures and in unbounded medium

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	2	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	2	-	-	-	-	-	-

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

STATIC ELECTRIC FIELD: Introduction, Coulomb's law of forces, Principle of Superposition of fields, Electric scalar potential, Relation of Electric field lines and equi-potential contours, The electric dipole and dipole moment, Gauss's law, Characteristics of dielectrics. Boundary relations, Capacitance, Divergence of flux density, Divergence Theorem, Poisson's and Laplace Equations, Joule's law, Ohm's law at a point, Kirchoff's laws, Current and field at boundaries.

STATIC MAGNETIC FIELD: Magnetic field of current carrying element - Biot Savart law, Force between two parallel linear conductors, Magnetic flux and flux density, Magnetic field relations, Torque of a loop, Energy stored in a magnetic field, Inductance, Ampere's law, Maxwell's First curl equation, Comparison of divergence and curl, The vector potential, permeability, Analogies between electric and magnetic fields. MAXWELL'S EQUATIONS: The equation of continuity for time varying fields, Maxwell's equations, Conditions at a boundary surface, Applications of circuit and field theory, Comparison of field and circuit theory, Maxwell's equations as generalization of circuit equations.

ELECTROMAGNETIC WAVES: Plane waves: Wave equations, plane waves in dielectric media, Plane waves in conducting media, polarization, skin effect and surface impedance, direction cosines, reflection of plane waves: Reflection of normally and oblique plane waves from conductors and dielectrics, total reflection.

POYNTING VECTOR AND THE FLOW OF POWER: Poynting theorem, power flow for a plane wave and power loss in a plane conductor, GUIDED WAVES: Waves between parallel planes, TE and TM waves, Characteristics of TE and TM waves, TEM waves, Velocities of propagation, Attenuation in parallel plane guides, Wave impedance, Electric field and current flow within the conductor.

WAVE GUIDES: Rectangular wave-guides, TE and TM modes in wave-guides, Velocity, wavelength, impedance and attenuation in rectangular waveguides.

Reading:

1. E.C.Jordan and K.G.Balmain, Electromagnetic waves and Radiating Systems, Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1968.
2. John D.Kraus, Electromagnetics, McGraw Hill Book Co., 1973.

EC253	Digital System Design II	PCC	4–0–0	4 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Analyze combinational and sequential circuits and simulate using VHDL
CO2	Design and implement arithmetic and sequential circuits
CO3	Perform functional simulation, timing analysis and power analysis using CAD tools
CO4	Understand the concepts of programmable logic devices(CPLD, FPGAs)

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	2	3	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Overview of fabrication techniques of integrated active and passive components, Elements of Design style, top–down design, separation of controller and architecture, Refining architecture and control algorithm, Algorithmic state Machines (ASM), ASM chart notations.

HDL modules for Adders, ALUs, Encoders, Decoders, Multiplexers, Demultiplexers, Comparators. Flip Flops, Counters, Shift Registers, PLA, PAL, timing devices, Traditional synthesis for ASM charts and Multiplexer controller method, One - shot method and ROM based method.

Asynchronous ASMs, Design for testability test vectors, fault analysis tools, Single pulsar, system clock and serial to parallel data conversion, Traffic light controller, Vending machine controller and Serial adder.

Shift and add multiplier, Booth's multiplier and ALU, Power distribution, noise, cross talk, reflections line drivers and receivers.

CAD tools, Simulators, Schematic entry, VHDL synthesis.

Reading:

1. William Fletcher, *An Engineering Approach to Digital Design*, Prentice Hall India, 1st Edition 1997.
2. William J. Dally and John W. Poulton, *Digital Systems Engineering,* Cambridge University Press, 2008.
3. Jayaram Bhaskar, *A VHDL Primer,* Prentice Hall India, 3rd Edition, 2009.

EC254	Probability Theory and Stochastic Processes	PCC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Distinguish between random and stochastic processes.
CO2	Model communication system as a stochastic process
CO3	Characterize LTI systems driven by a stationary random process using autocorrelation and power spectral density functions.
CO4	Understand the probability distribution functions of noise in a communication link.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Scheme of Instructions, Introduction to Subject, Axioms of Probability, Probability Space, Conditional Probability, Bays Theorem, Repeated Trails , Bernoulli's Trails , Problems, Concept of a Random Variable, Distribution and density functions, Properties of distribution functions, Continuous type random variable, Normal, Exponential , chi-square, Rayleigh, Nakagami-m, uniform etc distributions , Problems, Bernoulli, Binomial, Poission distributions, Negative binomial distributions.

Conditional distributions, Total probability and bays theorem, passion approximation Problems, Functions of one random variable: Expectation, Variance, Moments, Characteristic functions Problems, One function of two random variable, joint moments, joint characteristic functions, conditional distributions, conditional expected values, Random Process concept, Stationarity and independence.

Distribution and density functions, statistical independence, First-order stationary processes, Second order and wide sense stationary process, Problems, N- order and strict- sense stationary process, Problems

Time averages and ergodicity , Mean ergodic process, Auto correlation function and its properties, Cross- correlation function and its properties, Covariance functions, discrete time processes and sequences, Power density spectrum and its properties, Problems, Problems, Linear systems with random inputs.

Random signal response, Auto correlation functions of the response, Cross correlation functions of input and output system, Power density spectrum of the response, Problems.

Reading:

1. P.Z. Peebles.Jr., PROBABILITY, RANDOM VARIABLES AND RANDOM SIGNAL PRINCIPLES, Tata McGraw Hill Education, 3rd edition, 2002.
2. A.Papoulis, Probability, Random variables and Stochastic Processes, McGraw Hill, 3rd edition, 1991.

EC255	Electronic Devices and Circuits II Laboratory	PCC	0–0–4	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Measure the h parameters of the given transistor.
CO2	Synthesize and evaluate single stage and two stage amplifiers
CO3	Realize the given performance using feedback amplifiers
CO4	Design and test Oscillator circuits using BJT and FET.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	2	-	-	-
CO2	2	3	-	2	-	-	-	-	2	-	-	-
CO3	3	2	-						-			
CO4	2	3	-	2					2			

List of Experiments:

1. Measurement of h-parameters
2. Single stage BJT amplifier
3. Two stage BJT amplifier
4. FET amplifier
5. Differential amplifier
6. Voltage series feedback amplifier
7. Voltage shunt feedback amplifier
8. Current series feedback amplifier
9. Current shunt feedback amplifier
10. RC phase shift oscillator
11. Wien bridge oscillator
12. LC/ crystal oscillator

EC256	Digital System Design Lab	PCC	0–0–3	2 Credits

Prerequisites:

Course outcomes: After completion of the course student will be able to:

CO1	Write structural, behavioral and data flow models for digital circuits
CO2	Simulate VHDL models of digital circuits using CAD tool
CO3	Analyze the subsystems/ modules using CAD tool
CO4	Implement and test simple digital circuits on FPGA

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	3	-	-	-	-	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	2

List of Experiments:

1. Write structural and dataflow VHDL models for
   a) 4-bit ripple carry adder.
   b) 4-bit carry Adder – cum Subtractor.
   c) 2-digit BCD adder / subtractor.
   d) 4-bit carry look ahead adder
   e) 8-bit comparator

2. Write a VHDL program in structural model for

   a) 16:1 mux realization
   b) 3:8 decoder realization through 2:4 decoder

3. Write a VHDL program in behavioral model for

   a) 16:1 mux
   b) 3:8 decoder
   c) 8:3 encoder
   d) 8 bit parity generator and checker

4. Write a VHDL program in structural and behavioral models for

   a) 8 bit asynchronous up-down counter
   b) 8 bit synchronous up-down counter

5. Write a VHDL program for 4 bit sequence detector through Mealy and Moore state machines.
6. Write a VHDL program for traffic light controller realization through state machine.
7. Write a VHDL program for vending machine controller through state machine.
8. Write a VHDL program in behavioral model for 8 bit booth’s multiplier.

9. Write a VHDL program in behavioral model for 8 bit shift and add multiplier.
10. Write a VHDL program in structural model for 8 bit Universal Shift Register.
11. Write a VHDL program for implementation of data path and controller units
    a) Serial Adder
    b) Shift and add multiplier
    c) Booth's multiplier
    d) ALU
    e) MIPS processor.

CS236	Data Structures Lab	OEC	0–0–3	2 Credits

Prerequisites: Knowledge in C/C++ programming language.

Course Outcomes: After completion of the course student must be able to:

CO1	Write structured programs using the concepts of data structures.
CO2	Implement and analyze sorting algorithms.
CO3	Identity the data structure for a given problem.
CO4	Understand and implement the Stack ADT using array based and linked-list based data structures and also implement Stack applications.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (de queue) using arrays.
6. Write a program to implement a stack using two queues such that the *push* operation runs in constant time and the *pop* operation runs in linear time.
7. Write a program to implement a stack using two queues such that the *push* operation runs in linear time and the *pop* operation runs in constant time.
8. Write a program to implement a queue using two stacks such that the *enqueue* operation runs in constant time and the *dequeue* operation runs in linear time.
9. Write a program to implement a queue using two stacks such that the *enqueue* operation runs in linear time and the *dequeue* operation runs in constant time.
10. Write programs to implement the following data structures:
    (a) Single linked list
    (b) Double linked list
11. Write a program to implement a stack using a linked list such that the *push* and *pop* operations of stack still take O(1) time.
12. Write a program to implement a queue using a linked list such that the *enqueue* and *dequeue* operations of queue take O(1) time.

13 . Write a program to create a binary search tree(BST) by considering the keys in given order and perform the following operations on it.

(a) Minimum key

(b) Maximum key

(c) Search for a given key

(d) Find predecessor of a node

(e) Find successor of a node

(f) delete a node with given key

14. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.

15. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.

16. Implement the following sorting algorithms:

    (a) Insertion sort

    (b) Merge sort

    (c) Quick sort

    (d) Heap sort

17. Write programs for implementation of graph traversals by applying: (a) BFS   (b) DFS

18. Write programs to find out a minimum spanning tree of a simple connected undirected graph by applying: (a) Prim's algorithm   (b) Kruskal's algorithm

19. Write a program to implement Dijkstra's algorithm for solving single source shortest path problem using priority queue.

20. Write a program to implement Floydd-Warshall algorithm for solving all pairs shortest path problem.

SM335	Engineering Economics and Accountancy	HSC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Prepare the Accounting records and interpret the data for Managerial Decisions
CO2	Understand Macro Economic environment of the business and its impact on enterprise
CO3	Identify various cost elements of the product and its effect on decision making.
CO4	Understand the concepts of financial management and smart investment

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-
CO3	-	1	-	-	-	-	-	-	-	-	3	-
CO4	1	-	-	-	-	-	-	-	-	2	-	-

Detailed Syllabus:

Introduction to Engineering economics - Fundamental concepts - Time value of money - Cash flow and Time Diagrams-Choosing between alternative investment proposals-Methods of Economic analysis (pay back, ARR,NPV,IRR and B/C ratio), The effect of borrowing on investment - Equity Vs Debt Financing - concept of leverage – Income tax leverage.

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting-Methods of estimation-Various concepts of National income-Significance of national income Estimation and its limitations.

Inflation: Definition – Process and Theories of inflation and Measure of control. New economic policy 1991(industrial policy, Trade policy, Fiscal policy), Impact on Industry.

Accounting Principles, procedure – Double entry system – Journal, ledger, Trial balance – Cashbook – preparation of Trading and Profit and Loss account – Balance sheet.

Cost Accounting – Introduction – Classification of costs – Methods of costing – Techniques of costing – cost sheet and preparation of cost sheet – Breakeven Analysis – Meaning and its application, Limitation.

Reading:

1. Henry Malcom steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N.Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

EC301	Pulse Circuits	PCC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Analyse RC circuits for low pass and high pass filtering
CO2	Design Bistable,Monostable and Astable Multivibrators using discrete components.
CO3	Understand the Negative Resistance behavior of semiconductor devices.
CO4	Analyze voltage and current sweep circuits and identify methods to mitigate sweep errors.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	2

Mapping of Course outcomes with Program outcomes:

Detailed Syllabus:

Introduction: Wave Shaping Circuits**:** High pass and low pass circuits, Response to sine, step, pulse, square, exponential and ramp inputs with different time constants, High pass as a differentiator, Low pass as an Integrator, Attenuators- response to step input, compensated attenuator.

Clipping circuits: Diode clippers, transistor clippers and two level clippers, Clamping circuits using diodes, Clamping theorem.

Switching Circuits: Transistor switch, switching times, Astable, Mono-stable and Bistable Multivibrators (both collector and emitter coupled), Schmitt trigger circuit, Symmetric and Asymmetric triggering for bistable, Schmitt trigger circuit.

Negative Resistance Switching Circuits: Voltage controlled and Current controlled negative resistance circuits, Negative –Resistance Characteristics, Monostable , Bistable, and Astable operations, Applications using Tunnel diode and UJT only, Blocking Oscillator: Triggered transistor blocking oscillators, Base timing and emitter timing, Astable diode controlled and RC controller.

Sweep Circuits: General Features of a Time-Base Signal, Linearization of sweeps, and Methods of generating a time-base waveform. Bootstrap and Miller sweep circuits, Principle of current sweeps.

Reading:

1. Millman and Taub, Pulse, Digital and Switching Waveforms, 3rd Edition, Tata McGraw-Hill Education, 2011.
2. L. Strauss, Wave Generation and Shaping, 3rd Edition, TMH, 1995.
3. David A. Bell, Solid State Pulse Circuits, 4th Edition, Prentice Hall India, 2009.

EC302	Communication Theory	PCC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Compare the performance of AM, FM and PM schemes with reference to SNR
CO2	Understand noise as a random process and its effect on communication receivers
CO3	Evaluate the performance of PCM, DPCM and DM in a digital communication system
CO4	Identify source coding and channel coding schemes for a given communication link

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	2	-	-	-	-	-	-	-
CO2	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	1	-	-	3	-	-	-	-	-	-	-
CO4	-	1	-	-	3	-	-	-	-	-	-	1

Introduction

Introduction to Communication Process, Communication Channels, Modulation, Information Theory, Coding Analog vs Digital, Review of Signals and Systems.

Modulation Techniques: Amplitude Modulation (AM), Envelop Detection, Limitations of AM, DSB-SC Modulation, Coherent Detection, SSB, Frequency Division Multiplexing, Angle Modulation, Frequency Modulation, Narrowband FM, Generation of FM, Detection of FM, Phased locked Loop.

Review of Random Process –I, Review of Random Process – II, Transmission of Random Process through an LTI filter, PSD, Properties of PSD. Gaussian Process, Noise, Narrow Band Noise, Noise Figure, Noise Bandwidth, Noise Temperature. Noise in AM Receivers, Noise DSB-SC, Noise SSB Receivers, Noise in FM, Pre -emphasis, De-emphasis in FM.

Pulse Modulation – Sampling process, Pulse Amplitude Modulation. TDM, PPM, Generation and detection of PPM, Noise in PPM, Bandwidth –Noise Tradeoff, Quantization Process, Quantization Noise, PCM. PCM encoding generation and decoding, Delta Modulation, Delta-Sigma Modulation, Differential Pulse-code Modulation. Sub band Coding, Matched Filter, Properties of Matched Filter, ISI, Distortionless baseband binary transmission. Raised Cosine Spectrum, Baseband M-ARY PAM, Equalization.

Source Coding, Huffman Coding, Channel Coding. Channel Capacity Calculation.

Reading:

1. Leon W.Couch II., Digital and Analog Communication Systems, 6th Edition, Pearson Education Inc., New Delhi, 2001.
2. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems, 4th Edition, McGraw Hill New York, 2002.

EC303	Linear IC Applications	PCC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Design op-amp circuits to perform arithmetic operations.
CO2	Analyze and design linear and non-linear applications using op-amps.
CO3	Analyze and design oscillators and filters using functional ICs.
CO4	Choose appropriate A/D and D/A converters for signal processing applications.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-	-	-
CO4	1	2	-	-	2	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction to op-amps, ideal Characteristics, Pin configuration of 741 op-amp. Bias, offsets and drift, bandwidth and slew rate. Offset and Frequency compensation. Exercise problems. Inverting and non-inverting amplifiers and their analysis, Applications: inverting and non- inverting summers, difference amplifier, differentiator and integrator, Voltage to current converter, Exercise problems. Instrumentation amplifier, Log and antilog amplifiers. Precision rectifier, Non-linear function generator, solving differential equations using analog computing blocks.

Analog IC Multipliers and applications Comparators, regenerative comparators, input - output Characteristics, Astable and Monostable multivibrator, Triangular wave- generators,

RC-phaseshift oscillator, Wein’s bridge oscillator, Active Filters, Low pass, High pass, Band pass and Band Reject filters, Butterworth, Chebychev filters, Different first and second order filter Topologies, Frequency Transformation.

555 Timer functional diagram, monostable and astable operation, applications.

Voltage Regulator Series op amp regulator, Three terminal IC voltage regulator exercise problems. IC 723 general purpose regulator, Switching Regulator.

PLL- basic block diagram and operation, capture range and lock range; applications of PLL IC 565, AM detection, FM detection and FSK demodulation. VCO IC 566,

Weighted resistor DAC, R-2R and inverted R-2R DAC. IC DAC-08. counter type ADC, successive approximation ADC, Flash ADC, dual slope ADC, conversion times of typical IC ADC.

Reading:

1. G B Clayton, Operational Amplifiers, 5th Edition, Elsevier science, 2003

2. Sergio Franco, Design With Operational Amplifier And Analog Integrated Circuits, 4th Edition, TMH, 2011.
3. Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4th Edition, New Age International Publishers, 2010
4. Ramakant A.Gayakward, Op-Amps and Linear Integrated Circuits, 4th Edition, PHI, 2010.

EC304	Antennas and Propagation	PCC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand the concept of radiation through mathematical formulation
CO2	Plot the characteristics of wire and aperture antennas
CO3	Develop the performance characteristics of array antennas
CO4	Measure the antenna parameters
CO5	Understand the behavior of nature on em wave propagation

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	2	-	-	-	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	1	1	-	-	-	-	-
CO4	-	-	2	-	-	1	-	-	-	-	-	-
CO5	3	1				1	1					1

Detailed Syllabus:

Introduction

Introduction to antennas & its significance, review of electromagnetic fields Scalar electric potential, vector magnetic potential, radiation from an alternating current element, Induction field, radiation field power radiated by a current element, Definition of electric dipole, radiation by a half wave dipole. Power by a half wave dipole & its radiation resistance, Radiation from a quarter wave monopole Power radiation and radiation resistance of dipole & monopole(approximate analysis), Radiation resistance of aerials and loop, problems Isotropic radiator, network theorem, application of network theorem to antennas, Radiation pattern, power pattern, field pattern Radiation intensity, Antenna impedance, mutual impedance, power gain, antenna gain, directivity gain & directivity Antenna efficiency, effective area or aperture, scattering loss, Collecting aperture, physical aperture---relation between large aperture and gain Effective aperture of a small elementary dipole, half wave antenna, effective length, front to back ratio, Antenna beam width and side lobe.

Two element arrays, Linear arrays, multiplication of patterns Effect of earth on vertical pattern mutual impedance effects, Binomial arrays, problem solving.

Practical antennas VLF, LF, MF transmitting antennas freq antennas High speed antennas resonant antennas & non resonant antennas V antenna, travelling wave antenna, inverted wave antenna Rhombic antenna, design of antenna, advantages & disadvantages. Radio direction finding, VHF &UHF antennas, corner reflector, problems Micro wave antenna, paraboloidal reflection antenna, horn antenna Folded dipole & Yagi uda antenna Broad band antenna, Narrow band antenna. Feeds for parabolic reflector Lens antenna and problem solving Turnstile Antenna Helical Antenna- Axial mode helix Normal mode helix. Biconical Antenna, Log periodic Dipole Array Spiral Antenna, Micro strip Antennas

Antenna impedance measurements Radiation pattern measurements Measurement of antenna beam width and gain, Polarization measurements. Measurement of radiation resistance

Propagation of radio waves, mode of propagation Ground wave propagation, sky wave propagation Space wave propagation, atmospheric effects, structure of atmosphere General picture of ionosphere, and its effect on radio waves. Ray path, skip distance, MUF, ionospheric propagation.

Reading:

1. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, PHI, 2007
2. J.D. Kraus, R.J. Marhefka and Ahmad S Khan, Antennas and Wave Propagation, 4th Edition, Mc Graw Hill, 2010
3. A. R Harish and M. Sachidananda, Antennas and Wave Propagation, Oxford University Press, 2011.
4. John D. Kraus, Antennas, 2nd Edition, McGraw Hill, 1988.
5. R.E.Collins, Antennas and Radio Propagation, Singapore: McGraw Hill, 1985.

EC305	Computer Architecture and Organization	PCC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Recognize the architectures of processors used in computing systems.
CO2	Understand memory hierarchy and virtual memory concept
CO3	Design ALU and IEEE-754 single precision floating point processor
CO4	Realize Micro-programmed control units for a simple processor and a floating point processor.
CO5	Identify I/O data transfer techniques and future trends

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	2	-	-	-	-	2

Introduction: Historical review - Architecture and Organization- Structure and Function.

The Computer System: Computer interconnection structure - Computer components Functions, interconnection structures. Internal and external memory - Overview of computer memory Systems, Semiconductor main memory virtual memory concept, cache memory, magnetic disc, magnetic tape, large storage memories. Input/Output - External devices - Modems of I/O data Transfer, I/O channels and Processors. Operating System - Operating Systems Overview, Scheduling and memory management.

The Central Processing Unit: Computer arithmetic, ALU, integer and floating point numbers representations and arithmetic. Instruction Sets - Machine instruction characteristics - types of Operands and Operations, addressing –instruction formats CPU structure and function - Processor and register organization.

The Control Unit: Control Unit Operation - Micro Operations, Control of the CPU, hardware implementation. Micro programmed control - Sequencing and execution of Micro instructions, bit slice architecture, applications.

Recent Trends in Computer Systems: Parallel organization - Multiprocessing, Vector Computation, Faulty tolerant Systems.

Reading:

1. W.Stallings, Computer Organisation and Architecture - Principles of structure and function, 2nd Edition, Macmillan Int. Edition, 1987.
2. J.Hayes, Computer Architecture and Organisation, McGraw Hill Int. Edition., 2001.
3. KAI Hwang, Advanced Computer Architecture, McGraw Hill, 2000.

EC306	Pulse Circuits Laboratory	PCC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Implement digital circuits and evaluate their performance
CO2	Design and test bistable, monostable and astable multivibrators
CO3	Build a sweep circuit and study its performance.
CO4	Implement and measure the performance of a blocking oscillator

Mapping of course outcomes with program outcomes:

List of Experiments:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	-		-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-

1: RC High Pass & low pass responses to square input for various time constants.

2**:** Diode Clipper and Clamper

3: Transistor Switching timer

4: a) Bistable multivibrator circuit (b) Schmitt trigger

5: Monostable multivibrator

6: Astable multivibrator

7: Miller Sweep circuit

8: Boot Strap Sweep circuit

9: Astable Blocking Oscillator

10: U.J.T. (Relaxation) Sweep Generator.

EC307	Integrated Circuit Applications Lab	PCC	0-0-3	2 Credits

Prerequisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Measure the parameters of IC 741 Op-amp.
CO2	Realize analog filters using Op-amp.
CO3	Plot the characteristics of TTL NAND Gate.
CO4	Design monostable and astable multivibrators using 555 IC.
CO5	Design modulo-N counters using TTL ICs. .

Mapping of course outcomes with program outcomes:

List of Experiments:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-

1: Study and Operation of IC testers, pulse generator and digital trainer.

2: Study of logic gate ICs and their applications

3: Frequency response of inverting and non-inverting amplifier.

4: Measurement of Op.amp parameters: (i) Offset voltage (ii) Offset current (iii) CMRR and (iv) Slew rate

5: Characteristics of TTL NAND gate: (i) Sourcing (ii) Sinking (iii) Transfer

6: Verify the functionality of Mux and Decoder ICs and their application.

7: Op.amp monostable and astable multivibrators.

8: Design 2's complement adder/subtractor using IC74283 and verify experimentally.

9: Verify the functionality of Flip-Flop ICs and its application.

10: Mod-N counter using 7490 and 74190.
.
11: 555 timer: Monostable and astable multivibrators.

12: Mod-N counter using 7492 and 74192.

13: Shift register IC 7495.

14: Low voltage regulator IC 723.

EC351	Digital Communications	PCC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Model a digital communication system.
CO2	Compute probability of error and inter symbol interference from eye diagram in data transmission.
CO3	Obtain the power spectra of digital modulated signals.
CO4	Design encoder and decoder schemes for error control.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	2	-	1	-	-	-	-	-
CO2	2	3	-	-	1	2	1	-	-	-	-	-
CO3	2	1	-	-	1	-	1	-	-	-	-	-
CO4	2	3	-	-	-	1	-	-	-	-	-	-

Detailed Syllabus:

Introduction: Analog communications versus digital communications, conversion of analog signal to digital form, baseband signal, band pass signal, Block diagram of digital communications, overview, Signal processing operations in digital communications, quantitative analysis of modulation schemes.

Communication channels and their characteristics, Model of digital communication system. Geometrical interpretation of signals-numerical examples, Detection of known signals in noise, Union bound on probability of error, Correlation receiver, Matched filter receiver, numerical examples. Detection of signals with unknown phase in noise.

Estimation: concepts and criteria, Maximum likelihood estimation, Wiener filter for waveform estimation. Discrete PAM signals, Intersymbol interference, Nyquist's criterion for distortion less baseband binary transmission. Nyquist's criterion for distortion less baseband binary transmission-numerical examples, Correlative coding, Baseband M-ary PAM systems, Eye pattern, Adaptive equalization for data transmission.

Digital modulation formats-coherent binary modulation techniques, Coherent quadrature modulation techniques Coherent quadrature modulation techniques, Noncoherent binary modulation techniques, Comparison of binary and quaternary modulation techniques M-ary modulation techniques- M-ary PSK, M-ary QAM, M-ary FSK.

Power spectra, bit versus symbol error probabilities, Error control coding-example, methods of controlling error, types of errors, types of codes. Linear block codes, Binary cyclic codes, Convolutional codes, Trellis.

Reading:

1. S.Haykin, Digital Communications, John Wiley & Sons, 2009.
2. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
3. John G.Proakis, Digital Communications, 3rd edition, McGraw Hill, 1995.

EC352	Digital Signal Processing	PCC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Find DFT of a given signal through Fast Fourier Transform Techniques
CO2	Design FIR and IIR type digital filters.
CO3	Identify filter structures and evaluate the coefficient quantization effects
CO4	Understand sample rate conversion techniques.
CO5	Compare the architectures of DSP and General Purpose Processors.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	1	3	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	1

Detailed Syllabus:

Introduction to signals and Systems:

DISCRETE FOURIER TRANSFORM (DFT): The DFT & its properties; Inverse DFT, Linear filtering methods based on DFT - Use of DFT in linear filtering, filtering of long data sequences, Efficient computation of DFT algorithms - Radix 2 (DIT & DIF), Radix 4, Split radix algorithms. Linear filtering approach to computation of DFT - Goertzel algorithm, Chirp z transform, Quantization effects in the computation of DFT - Direct & FFT method.

DIGITAL FILTERS: Linear phase FIR filter, characteristic response, location of zeros, Design of FIR filter - Windowing, Frequency sampling, Design of IIR filters from Analog filters - Impulse invariance, Bilinear transformation, Matched z-transform.

DIGITAL FILTER STRUCTURES: FIR filters - Direct form, Cascade form, Frequency sampling, Lattice IIR filter - Direct form I, Direct form II cascade form parallel form Lattice & Lattice loader, Quantization of filter coefficients - Sensitivity to Quantization of filter coefficients, Quantization of coefficients in FIR filters, Round off effects in digital filters - Limit cycle, scaling to prevent overflow.

MULTIRATE DIGITAL SIGNAL PROCESSING: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D.

DSP PROCESSORS: TMS 320X/ ADSP 21XX Architecture and Applications.

Reading:

1. J.G.PROAKIS & D.G.MANOLAKIS, Digital Signal Processing - Principles, algorithms & Applications, PHI, 2000.
2. Handouts on DSP Processors
3. A.V. Oppenheim and Ronald W. Schafer, Discrete Time Signal Processing, 2nd Edition, PHI, 2000.

4. S.K.MITRA, Digital Signal Processing – A computer Based Approach, 2^{nd} Edition, MGH, 2001.
5. Reference Manuals of Texas TMS 320X and Analog Devices 21XX Processors

EC353	Micro Processors & Micro Controllers	PCC	4-0-0	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand the evolution of processor architectures
CO2	Write simple programs in assembly language of Pentium processor
CO3	Interface peripheral devices and memory with microcontrollers
CO4	Program an ARM processor for DSP Applications

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	1	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction: Microcomputer organization, CPU, Memory, I/O, Operating systems, Multi Programming, Multi-threading, Review of 8086, salient features of 80386, Architecture and Signal Description of 80386. Register Organization of 80386, Addressing Modes, 80386 Memory management, protected mode, Segmentation, Paging, Virtual 8086 Mode, Enhanced Instruction set of 80386, the Co- Processor 80387.

Salient features of Pentium microprocessor, Pentium architecture, Special Pentium registers, Ability to learn Microprocessor and Microcontroller Architecture, Instruction Translation look aside buffer and branch Prediction, Rapid Execution module, Memory management, Hyper threading technology, Extended Instruction set in advanced Pentium Processors

Overview of micro controllers- 8051 family microcontroller architecture, instruction set, pin out, memory interfacing. 80196 microcontrollers' family architecture, instruction set, pin out, memory interfacing.

ARM Processor Fundamentals**:** Registers, current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table. Architecture Revisions, ARM Processor families, ARM instruction set, Thumb Instruction Set-Exceptions Handing Interrupts, Interrupt Handling schemes, firmware, Embedded Operating systems. Caches-cache architecture, Cache policy, Introduction to DSP on the ARM, DSP on the ARM7TDMI, ARM9TDMI,

Case study**-**Industry Application of Microcontrollers

Reading:

1. Barry B.Brey: Intel Microprocessor Architecture, Programming and Interfacing-8086/8088,80186,80286,80386 and 80486,PHI,1995.
2. Muhammad Ali Mazidi and Mazidi: The 8051 Microcontrollers and Embedded systems, PHI, 2008.
3. Intel and ARM Data Books on Microcontrollers.

EC354	Computer Networks	PCC	3-0-2	4 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Identify the issues and challenges in the architecture of a computer network.
CO2	Understand the ISO/OSI seven layers in a network.
CO3	Realize protocols at different layers of a network hierarchy.
CO4	Recognize security issues in a network.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	2	-	-	-	-	-
CO2	-	2	-	-	-	-	2	-	-	-	-	-
CO3	-	3	-	-	-	-	2	-	-	-	-	-
CO4	-	2	-	-	-	1	-	-	-	-	-	-

Detailed Syllabus:

Introduction: Data Communication, Networks, Protocols and Standards, Topology, Categories of Networks, OSI & TCP/IP Protocol suites

Physical Layer: Transmission modes, DTE-DCE Interface, Modems, Guided media, Unguided media, Performance, Multiplexing, Switching, DSL, FTTC.

Data Link Layer: Data Link Control - Line discipline, Flow control, Error control; Data Link protocols – Asynchronous Protocols, Synchronous protocols, Character oriented protocols, Bit oriented protocols, Link Access Procedures

LANS and MANS: Project 802, Ethernet, Token Bus, Token Ring, FDDI, Fast Ethernet, Gigabit Ethernet, DQDB, SMDS, PPP.

Network Layer: Repeaters, Bridges, Hubs, Switches, Routers, Gateways, Routing algorithms - Shortest path routing, Distance vector routing, Link state routing; X.25 layers and protocols, Congestion control - Leaky bucket algorithm, TCP/IP Protocol Suite- IP protocol, IP addresses, Subnetting, ARP, RARP; ICMP, ISDN Services and channels, Broadband ISDN, ATM- Design goals, architecture and layers

Transport Layer: Duties of Transport layer, Transport connection, OSI Transport protocol, TCP, UDP

Application Layer: BOOTP and DHCP, DNS, TELNET, FTP, SMTP, HTTP, WWW, VoIP, Four aspects of Network security, Privacy, Digital Signatures.

Reading:

1. BEHROUZ A. FOROUZAN, Data Communications and Networking, 2nd Edition, Tata McGraw-Hill, New Delhi, 2003
2. ANDREW S. TANENBAUM, Computer Networks, 4th Edition, Prentice-Hall of India, New Delhi, 2000.
3. WILLIAM STALLINGS, Data and Computer Communication, 6th Edition, Prentice Hall of India, New Delhi, 1999.
4. DOUGLAS E COMER, Computer Networks and Internet, Pearson Education Asia, 2000.

EC362	CMOS VLSI Design	DEC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Model the behaviour of a MOS Transistor
CO2	Design combinational and sequential circuits using CMOS gates
CO3	Identify the sources of power dissipation in a CMOS circuit.
CO4	Analyze SRAM cell and memory arrays

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	-	`3	-	-	-	-	-	-	-	-	-	1

Detailed Syllabus:

MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Fabrication, Packaging, and Testing**,** MOS transistor Theory, Long Channel I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics

CMOS Processing Technology, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Technology-Related CAD Issues, Manufacturing Issues, Circuit Simulation, A SPICE Tutorial, Device Models, Device Characterization, Circuit Characterization, Interconnect Simulation. Combinational Circuit Design, Circuit Families, Silicon-On-Insulator Circuit Design, Sub Threshold Circuit Design. Sequential Circuit Design, Circuit Design of Latches and Flip-Flops, Static Sequencing Element Methodology, Sequencing Dynamic Circuits, Synchronizers, Wave Pipelining

Power, Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures, Robustness, Variability, Reliability, Scaling, Statistical Analysis of Variability, Variation-Tolerant Design. Delay, Transient Response, RC Delay Model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding, Shifters, Multiplication

Array Subsystems, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content-Addressable Memory, Programmable Logic Arrays, Robust Memory Design, Special-Purpose Subsystems.

Packaging and Cooling, Power Distribution, Clocks, PLLs and DLLs, I/O, High-Speed Links, Random Circuits, Design Methodology and Tools, Testing, Debugging, and Verification.

Reading:

1. Neil H.E. Weste, David Money Harris, CMOS VLSI Design – A Circuits and Systems Perspective, Addision – Wesley, 2011.
2. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.

EC363	ASIC Design	DEC	3-0-0	3 Credits

Pre-requisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Describe the different phases of the design flow for digital ASICs
CO2	Understand basic clocking issues
CO3	Familiarize with CAD tool capabilities and limitations
CO4	Use automatic synthesis, placement and routing tools to implement a design

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	3	-	-	-	-	-	-	-	-	-
CO4	2	2	3	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Introduction, Types of ASIC's Design Flow, CMOS Logic. ASIC Library Design, Transistor Parasitic Capacitance, Input Slew Rate,Library-Cell Design, Library Architecture.Programmable ASICs, The Antifuse Metal Antifuse, Static RAM, EPROM and EEPROM Technology, Practical Issues.

Programmable ASIC Logic Cells, Actel,Xilinx LCA., XC3000 CLB, XC4000 Logic Block, XC5200 Logic Block, Xilinx CLB Analysis,. Logic Expanders.. Programmable ASIC I/O Cells, Totem-Pole Output, Mixed-Voltage Systems, Metastability, Xilinx I/O Block. Boundary Scan.

Programmable ASIC Interconnect and Programmable ASIC Design Software.Actel ACT, RC Delay in Antifuse Connections, Xilinx EPLD Logic Synthesis, FPGA Synthesis, Third-party Software. Low level design entry, logic synthesis, simulation,

Test and ASIC construction, VHDL, Verilog HDL, Logic Synthesis, Simulation.

Reading:

1. Michael John, Sebastian Smith, Application Specific Integrated Circuits, Addison Wesley Publishing Company, 1997.
2. Elaine Rhodes: ASIC Basics, Lulu, 2005.

EC355	Communication System Laboratory	PCC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Generate AM and FM signals and evaluate their performance
CO2	Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals
CO3	Generate digital modulation signals for ASK, PSK and FSK and perform their detection
CO4	Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	3	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-	-
CO3	1	-	-	-	3	1	-	-	-	-	-	-
CO4	2	-	-	-	3	2	-	-	1	-	-	-

List of Experiments:

1. Fourier Synthesis
2. AM Transmitter & Receiver
3. FM Transmitter & Receiver
4. AM/FM Radio Receiver
5. Analog signal sampling & Reconstruction
6. Generation & Detection of PAM/PWM/PPM
7. Generation & Detection of PCM
8. Generation & Detection of DM/SIGMA DELTA/ ADM
9. Baseband digital data transmission
10. Data conditioning & Reconditioning
11. Generation & Detection of BPSK/DPSK/DEPSK
12. Simulation of digital modulation schemes

EC356	Micro Processors and Micro controller Laboratory	PCC	0-0-3	2 Credits

Pre-requisites:

Course Outcomes: After the completion of the course the student will be able to:

CO1	Write assembly language, C and C++ programs for arithmetic operations using Pentium processor based system
CO2	Write 8051 assembly language programs to control inbuilt timer and communication modules.
CO3	Interface ADC and DAC modules with microprocessor based system.
CO4	Implement DSP functions using ARM processor.

Mapping of course outcomes with program outcomes:

List of Experiments:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	2	2	-	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-	-	1

1. Write a simple program for arithmetic operations – addition, subtraction, multiplication and division of 16 – bit number. (8086 Program)
2. Write a simple program for string operations like string concatenation, swapping.
   Write a program for interfacing LCD with 8086 and display a message.
3. Write a program for performing simple arithmetic operations. (8051 Programming)
4. Write a simple program for flashing LEDs using software delays, timers and interrupts.
   Write a program for interfacing Seven Segment Display and LCD with 8051 and display messages.
5. Write a program for interfacing Keypad with 8051 and display keypad input on LCD.
6. Write a program for square waveform generation, with different frequencies and duty cycles.
7. Write a program for serial communication through UART using polling and interrupt methods.
8. Write a program for interfacing ADC 0804 with 8051.
9. Write a program for Pulse Width Modulation using on-chip PWM and analog I/O modules.
10. Write a program for interfacing Seven Segment Display and LCD to ARM processor.
11. Write a program to interface ARM processor with PC using Tera - Term.
12. Write a program to generate various waveforms
13. Write a program for flashing LEDs using timers and interrupts.

EC401	Electronic Instrumentation	PCC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand and estimate errors in a measurement system.
CO2	Identify the instrument suitable for specific measurements.
CO3	Estimate accurately the values of R,L and C employing suitable bridges.
CO4	Understand the basic principles of transducers for displacement, velocity, temperature and pressure.
CO5	Operate special measuring instruments such as Wave Analyzer, Harmonic Distortion Analyzer and Spectrum Analyzer.
CO6	Identify data acquisition system for a specific application

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	1
CO6	1	3										

Detailed Syllabus:

Measurement And Error: Sensitivity, Resolution, Accuracy and precision, Absolute and Relative types of errors, Statistical analysis, Probability of and Limiting errors, Linearity.

Instruments : D – Arsonval movement and basic principles of Measurement of Voltage, Current and Resistance in instruments. Analog and Digital Multimeters, Measurement of time and Frequency – Digital Frequency Meter and applications.

Impedance Measurement : Kelvin Bridge; Megger; Maxwell, Hay and Shering Bridges. Q-meter; Noise and Interference reduction techniques in Measurement Systems. Oscilloscopes: Block diagram, probes, Deflection amplifier and delay line, Trigger Generator, Coupling, Automatic Time Base and Dual Trace Oscilloscopes, Pulse Measurements, Delayed Time Base, Analog Storage, Sampling and Digital Storage Oscilloscopes. Special instruments: Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, FFT Analyzer.

Transducers (Qualitative Treatment Only): Classification and selection of Transducers, Introduction to strain, Load, force, Displacement, Velocity, Acceleration, Pressure and Temperature Measurements.

Introduction to Data Acquisition Systems (DAS): Block Diagram, Specifications and various components of DAS. General purpose Instrumentation Bus (GP-IB): Protocol, SCPI Commands and Applications to DSO and DMM.

Reading:

1. Bernard M. Oliver and John M. Cage, Electronic Measurements and Instrumentation, McGraw Hill Inc., 1971.
2. W.D.Cooper and Felbrick, Electronic Instrumentation & Measurement Techniques, 2nd Edition, PHI, 2009.
3. D.A. Bell, Electronic Instrumentation and Measurements, Reston Pub. Co., 1983.
4. H S Kalsi, Electronic Instrumentation, McGraw Hill, 3rd Edition, 2011.

EC402	Microwave Engineering	PCC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Recognize the limitations of existing vacuum tubes and solid state devices at microwave frequencies.
CO2	Study the performance of specialized microwave tubes such as klystron, reflex klystron, magnetron and Travelling wave tube.
CO3	Understand the operation of passive waveguide components.
CO4	Analyze microwave circuits using scattering parameters.
CO5	Test microwave components and circuits with standard microwave bench and vector network analyzer.

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	1	3	-	-	2	-	-	-	-	-	-	-

Introduction to microwaves, Applications of microwaves. Limitations of conventional vacuum tube at high frequencies, Limitations of solid state devices at high frequencies, Klystron amplifier, Reflex Klystron oscillator. Travelling Wave tube amplifier, Backward Wave Oscillator

Cavity magnetron, Cross Field Amplifier, Principles and applications of point contact diode, Operation and applications of PIN Diode,Gunn diode, Transit Time Devices, Elementary treatment of attenuators, terminations and twists

Diaphragms and posts , Tee Junctions, directional coupler, Magic tee, Faraday Rotation, Circulators and isolators, Cavity resonators and their applications, Stripline & Microstripline components, Matrix representation of microwave junctions.

S *matrix of transmission* lines, three port, Scattering matrix of four port microwave junctions. Power measurement: Bolometric and thermocouple methods,

Block diagram of VSWR meter, VSWR and impedance measurement, Attenuation measurement, Measurement of S parameters of 3 port and 4 port devices, Reflectometers.

Reading:

1. R.E.Collin, Foundations for Microwave Engineering, Mc Graw Hill, 2nd Edition, 2011.
2. S.Y.Liao, Microwave Devices and Circuits, Prentice Hall of India, 4th Edition, 2002.
3. G.P. Srivastava and V.L. Gupta, Microwave Devices and Circuit Design, PHI, 1st Edition 2009.

EC411	Modern Radio Communications	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the building blocks used in radio and television systems
CO2	Analyze and determine the performance of transmitter and receiver circuits
CO3	Understand the principles of Color Television operation
CO4	Compare the performance of TV standards and cameras

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	1	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-
CO3	1	-	-	-	2	1	-	-	-	-	-	-
CO4	-	-	-	-	1	3	-	-	-	-	-	-

Detailed Syllabus:

Elements of a Communication Systems, Types of Communications, Electromagnetic Spectrum, Examples of a few communication systems, issues involved, Differential Amplifier Modulator, Low Level and High Level AM, Diode AM Detector Filter SSB Modulator, Crystal Lattice Filter, Phasing SSB Modulator, Synchronous Detector, Problems based on amplitude modulation schemes, Varactor FM Modulator, Reactance FM Modulator,

VCO FM Modulator, FET Phase Modulator, Foster-Seeley FM Discriminator, Ratio Detector, Pulse Averaging Discriminator, Comparison of various FM demodulators Problems based on frequency modulation scheme, CW Transmitter, AM Transmitter, FM Transmitter, SSB Transmitter

Frequency Multipliers, Problems based on frequency modulation schemes, T RF Radio Receiver, Superheterodyne Receiver, Selectivity, Sensitivity, Fidelity, RF Section, Mixer, IF Section, Image Frequency, Dual Conversion, AGC, Squelch, SSB Transceiver, Frequency Synthesizer,

Special Features in Communication Receiver, software defined radio, Video and Television Signals, Television Broadcasting, TV Channels, Cable Channels, Picture Elements, TV Scanning Picture Qualities, Indian TV Standards. Video Signal, Frame and Field Frequencies, Horizontal and Vertical Scanning frequencies, Synchronization, Blanking Signal, 6/7 MHz TV Broadcast Channel , Construction of Composite Video signal, Blanking Time, Front and Back Porch, Video Signal Frequencies, Vertical Detail, DC Component, color Information

Basic Operation of TV Camera, Vidicon, Plumbicon, Single Tube Color Camera, Interlaced Scanning Pattern, Raster Distortions, Sync Pulses, RGB Video Signals, Color Addition, Color Matrix, I and Q Signals, Chrominance Modulation ,Negative Transmission, VSB Transmission, FM Sound Signal, Tricolor Picture Tubes, Decoding the Picture Information, Y Signal Matrix, Functional Blocks of TV Receiver ,Video Detector and Amplifier, Sound IF section , Synch Separator, Vertical Synch Integrator, Horizontal Sync, Producing Luminance Image in Colour TV Receiver, Chroma Section, Color Killer circuit,colour TV standards, Digital TV fundamentals.

Reading:

1. Louis E Frenzel, Communication Electronics: Principles and Applications, McGraw Hill Int., Singapore, 3rd Edition, 2001.
2. George Kennedy and Bernard Davis, Electronic Communication Systems, TMH, 4th Edition, 2000.
3. Bernard Grob, Basic Television and Video Systems, MGH, Singapore, 6th Edition, 2000.

EC 412	Software Defined radio	DEC	3-0-0	3 credits

Prerequisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Conceptualize the SDR and implementation details
CO2	Identify the blocks of SDR for a specific application
CO3	Recognize the challenges in the implementation of SDR
CO4	Analyze the transmitter and receiver architectures in SDR

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	2	-	-	-	-	-	-	-
CO2	1	2	-	-	2	-	-	-	-	-	-	-
CO3	-	-	-	-	3	2	1	-	-	-	-	-
CO4	-	-	-	-	3	2	1	-	-	-	-	2

Detailed Syllabus:
Introduction − Software Defined Radio – A Traditional Hardware Radio Architecture – Signal Processing Hardware History – Software Defined Radio Project Complexity.

A Basic Software Defined Radio Architecture − Introduction – 2G Radio Architectures- Hybrid Radio Architecture- Basic Software Defined Radio Block Diagram- System Level Functioning Partitioning-Digital Frequency Conversion Partitioning.

RF System Design − Introduction- Noise and Channel Capacity- Link Budget- Receiver Requirements- Multicarrier Power Amplifiers- Signal Processing Capacity Tradeoff.

Analog-to-Digital and Digital-to-Analog Conversion- Introduction – Digital Conversion Fundamentals- Sample Rate- Bandpass Sampling- Oversampling- Antialias Filtering – Quantization – ADC Techniques-Successive Approximation- Figure of Merit-DACs- DAC Noise Budget- ADC Noise Budget.

Digital Frequency Up- and Down Converters- Introduction- Frequency Converter Fundamentals- Digital NCO- Digital Mixers- Digital Filters- Halfband Filters- CIC Filters- Decimation, Interpolation, and Multirate Processing-DUCs - Cascading Digital Converters and Digital Frequency Converters.

Signal Processing Hardware Components- Introduction- SDR Requirements for Processing Power- DSPs- DSP Devices- DSP Compilers- Reconfigurable Processors- Adaptive Computing Machine- FPGAs

Software Architecture and Components − Introduction- Major Software Architecture Choices – Hardware – Specific Software Architecture- Software Standards for Software Radio-Software Design Patterns- Component Choices- Real Time Operating Systems- High Level Software Languages- Hardware Languages.

Smart Antennas for Software Radio- Introduction- 3G smart Antenna Requirements- Phased Antenna Array Theory- Applying Software Radio Principles to Antenna Systems- Smart Antenna Architectures- Optimum Combining/ Adaptive Arrays- DOA Arrays- Beam Forming for CDMA- Downlink Beam Forming.

Reading:

1. Paul Burns, Software Defined Radio for 3G, Artech House, 2002.
2. Tony J Rouphael, RF and DSP for SDR, Elsevier Newnes Press, 2008
3. Jouko Vanakka, Digital Synthesizers and Transmitter for Software Radio, Springer, 2005.
4. P Kenington, RF and Baseband Techniques for Software Defined Radio, Artech House, 2005.

EC413	Digital TV Engineering	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student must be able to:

CO1	Compare Digital TV transmission standards and performance parameters
CO2	Understand channel coding and modulation techniques for Digital TV
CO3	Analyze RF amplifiers, modules and systems for Digital TV.
CO4	Identify Transmission lines and antennas suitable for Digital TV
CO5	Test a Digital TV Transmitter and receiver

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	1	-	-	-	-	-	-
CO2	-	2	-	-	2	-	-	-	-	-	-	-
CO3	-	2	-	-	2	-	-	-	-	-	-	-
CO4	-	-	-	-	2	2	-	-	-	-	-	-
CO5	-	2	-	-	2	-	1	-	-	-	-	-

Digital Television Transmission Standards ATSC terrestrial transmission standard, vestigial sideband modulation, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2

Performance Objectives for Digital Television: System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, cochannel interference, adjacent channel interference, analog to digital TV, transmitter requirements

Channel Coding and Modulation for Digital Television: Data synchronization, randomization/scrambling, forward error correction, interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM, flexibility, bandwidth

Transmitters for Digital Television: Precorrection and equalization, up conversion, precise frequency control, RF amplifiers, solid-state transmitters, RF amplifier modules, power supplies, power combiners, Wilkinson combiner, ring combiner, starpoint combiner, cooling, automatic gain or level control, ac distribution, transmitter control, tube transmitters, tube or solid-state transmitters, performance quality, retrofit of analog transmitters for DTV

Radio-Frequency Systems for Digital Television: Constant-impedance filter, output filters, elliptic function filters, cavities, channel combiners

Transmission Line for Digital Television: Fundamental parameters, efficiency, effect of VSWR, system AERP, rigid coaxial transmission lines, dissipation, attenuation, and power handling, higher-order modes, peak power rating, frequency response, standard lengths, corrugated coaxial cables, wind load, waveguide, bandwidth, waveguide attenuation, power rating, frequency response, size trade-offs, waveguide or coax pressurization

Transmitting Antennas for Digital Television : Antenna patterns, elevation pattern, mechanical stability, null fill, azimuth pattern, slotted cylinder antennas, gain and directivity, power handling, antenna impedance, bandwidth and frequency response, multiple-channel operation, types of digital television broadcast antennas, antenna mounting

Radio-Wave Propagation : Free-space propagation, distance to the radio horizon, refraction, multipath, ground reflections, surface roughness, effect of earth's curvature, Fresnel zones, linear distortions, diffraction, fading, desired signal, field tests, Charlotte, North Carolina, Chicago, Illinois, Raleigh, North Carolina

Test and Measurement for Digital Television: Power measurements, average power measurement, calorimetry, power meters, peak power measurement, measurement uncertainty, testing digital television transmitters.

Reading:

1. R. R. Gulati, Modern Television Practice, Principles, Technology and servicing, , 2nd edition, New Age International Publishers, 2001.
2. Gerald w. Collins, Fundamentals of Digital Television Transmission', John Wiley, 2001.

EC414	Image Processing (Elective)	DEC	3–0–0	3 Credits

Course Offered: IV Year - I Semester

Prerequisites:

Course Outcomes: After the completion of the course student will be able to:

CO1	Understand the need for image transforms and their properties.
CO2	Choose appropriate technique for image enhancement both in spatial and frequency domains.
CO3	Identify causes for image degradation and apply restoration techniques.
CO4	Compare the image compression techniques in spatial and frequency domains.
CO5	Select feature extraction techniques for image analysis and recognition.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	2	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

INTRODUCTION: Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital Image Processing Systems.

DIGITAL IMAGE FUNDAMENTALS: Elements of Visual Perception, A Simple image model, Sampling and Quantization, Neighborhood of Pixels, Pixel Connectivity, Labeling of Connected Components, Distance Measures, Arithmetic and Logic Operations, Image Transformations, Perspective Transformations, Stereo Imaging.

IMAGE ENHANCEMENT: Spatial Domain Methods, Frequency Domain Methods, Point processing, Intensity Transformations, Histogram Processing, Spatial filtering, Smoothing Filters, Sharpening Filters, Enhancement in the Frequency Domain, Low Pass Filtering, High Pass Filtering, Homomorphic filtering, Pseudo-Color Image Enhancement.

IMAGE COMPRESSION: Fundamentals of Compression, Image Compression Model, Error free Compression, Lossy Predictive Coding, Transform Coding.

IMAGE SEGMENTATION: Detection of Discontinuities, Line Detection, Edge Detection, Edge Linking and Boundary Detection, Thresholding, Threshold Selection on Boundary Characteristics, Region Growing , Region Splitting and Merging, Use of motion in Segmentation.

IMAGE REPRESENTATION AND DESCRIPTION: Chain Codes, Polygonal Approximations, Signatures, Skeleton, Boundary Descriptions, Shape Numbers, Fourier descriptors, Moments, Topological Descriptors.

IMAGE RECOGNITION AND INTERPRETATION: Elements of Image Analysis, Pattern and Pattern Classes, Minimum Distance Classifier, Matching by Correlation, Baye's Classifier, Neural Network Training Algorithm, Structural methods.

Reading:

1. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, Pearson Education Asia, New Delhi, 2000.
2. B. Chanda, D. Dutta Majumder, Digital Image Processing and Analysis, PHI, New Delhi, 2000.
3. A.K. Jain, Fundamentals of Digital Image Processing, PHI, New Delhi, 2001.

EC415	Digital Switching and Multiplexing	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the characteristics of the telephone systems
CO2	Design and test telecom switching systems
CO3	Model and estimate the telecom traffic
CO4	Understand the network synchronization and management
CO5	Evaluate optical fiber based wide area networks

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	2	-	-	-	-	-	-
CO2	2	3	-	-	1	-	-	-	-	-	-	
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	1	2	-	-	-	-	-	1

Detailed Syllabus:

Introduction – Evolution of Telecommunication, Basics of switching system, step-by-step switching, Design considerations.

Principles of Crossbar switching, electronic space division switching, stored program control, software architecture, switching functions.

Digital transmission, Frequency Division multiplexing, Time Division multiplexing, Statistical Division Multiplexing, switching hierarchy, Synchronous digital hierarchy both USA and European standards.

Message switching, circuit switching & packet switching, space division switching, Time division switching. Two dimensional switching, grade of service, non-blocking, digital cross connect, concentrators, expanders and distributors, two stage networks, three stage networks, n-stage networks.

Time Division Switching – Time Division space switching, Time division time switching, time multiplexed space switching. Time multiplexed time switching, space – time combination switching, three stage combination switching, n-stage combination switching, signalling techniques.

Telecommunication Traffic – Units of Traffic, Network traffic load and parameters, Grade of service and Blocking Probability, traffic measurement, Mathematical model, Incoming traffic and service time characteristics, Blocking models and loss estimates, delay systems.

Digital Subscriber access – ISDN, High data rate digital subscriber loops, Digital Loop carrier systems, fibre in the loop, voiceband modems, digital satellite services, Broadband switching systems.

Network synchronization control and management, timing, timing inaccuracies, network synchronization, network control and management.

SONET/SDH – SONET multiplexing overview, frame formats, operation, administration and maintenance, frequency justification and payload framing, virtual tributes, DS3 payload mapping, E4 payload mapping, SONET optical standards, SONET rings & networks.

Reading :

1. Digital Telephony, John C Bellamy, 3/e, Wiley-India, 1999.

2. Telecommunication Switching Systems and Networks, T Viswanathan, PHI, 1997.

3. Telecommunications Switching, Traffic and Networks, J E Flood, Pearson, 2004.

4. Introduction to Telecommunications, Gokhale, 2/e, Cengage Learning, 2005

5. Telecommunication Transmission Systems, Robert G Winch, 2/e, Tata McGraw Hill, 2004.

EC416	Distributed Computing	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Apply a model of distributed computations to practical problems
CO2	Adopt Termination Detection Algorithms and Distributed mutual exclusion algorithms for the given problem.
CO3	Detect deadlock in distributed systems, Distributed shared memory, Check pointing and rollback recovery and Consensus and agreement algorithms.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	1

Detailed Syllabus:

A model of distributed computations, Logical and physical times and clock synchronizations, Global state and snapshot recording algorithms

Message ordering and Group Communication, Termination Detection Algorithms, Distributed mutual exclusion algorithms

Deadlock detection in distributed systems, Distributed shared memory, Check pointing and rollback recovery

Consensus and agreement algorithms, Failure detectors

Authentication in Distributed systems and self-organization

Reading:

1. Ajay D. Kshemakalyani, Mukesh Singhal, Distributed Computing, Cambridge University Press, 2008
2. Andrew S. Tanenbaum, Maarten Van Steen, Distributed Systems – Principles and Paradingms, PHI, 2004

EC417	Satellite Communication	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the orbital and functional principles of satellite communication systems
CO2	Architect, interpret, and select appropriate technologies for implementation of specified satellite communication systems
CO3	Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
CO4	Select an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link.
CO5	Specify, design, prototype and test analog and digital satellite communication systems as per given specifications.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	2	1	2	1	-	-	-	-	-
CO2	1	-	-	1	2	2	2	-	-	-	-	-
CO3	-	-	-	-	2	2	1	-	-	-	-	-
CO4	1	-	-	-	3	2	1	-	-	-	-	1
CO5	1	1	-	-	3	2	1	-	-	-	-	1

Detailed Syllabus:

Introduction: Overview of Satellite Communications, GEO, MEO and LEO satellite systems, frequency bands

Orbital Mechanics: Orbit Equations, Locating the satellite w.r.t. the earth, Orbital elements, Look Angles, Orbital perturbation, Effects of earth's oblate ness ,moon and sun , Satellite eclipse, sun transit outage, Coverage angle, slant range, satellite launching

Satellite subsystems : Attitude and Orbit Control System(AOCS), Telemetry, Tracking and Command System(TT&C), Power System, Satellite antennas, Communications subsystem, transponders

Satellite Link Design: Basic transmission theory , System noise temperature and G/T ratio, CNR, CIR, ACI, IMI, Down link design, Up link design, System design examples

Modulation and Multiplexing: FM with multiplexed telephone signals, Analog FM SCPC, PSK, QPSK,

Multiple Access Schemes: FDM/FM/FDMA, TDMA, Frame structure, frame acquisition, synchronization, TDMA in VSAT network, On-board processing, CDMA, Spread spectrum transmission and reception, DS-SS CDMA capacity, Error Control for Digital Satellite Links: Error control coding, Block codes, Convolution codes, - Implementation of error detection on satellite links.

VSAT Systems: Overview of VSAT systems, Network architectures, Access control, Multiple access selection

LEO Satellite systems: Orbits, Coverage and frequency bands, off axis scanning, delay and throughput, NGSO constellation design,

Problems:

Reading:

1. TIMOTHY PRATT, CHARLES BOSTIAN JERMEY ALLNUTT, Satellite Communications, John Wiley, Singapore, 2nd Edition, reprint 2013.
2. M. RICHHARAIA, Satellite Communication Systems, BS Publishers, 2nd Edition, 2008.
3. TRI.T. HA, Digital Satellite Communications, McGraw-Hill, 2000.

EC418	Embedded Systems (Elective)	DEC	3–0–0	3 Credits

Course Offered: IV Year - I Semester

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Identify the hardware and software components of an embedded system
CO2	Choose appropriate embedded system architecture for the given application
CO3	Write programs for optimized performance of an embedded system and validate

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	2
CO3	1	3	3	2	-	-	-	-	-	-	-	1

Detailed Syllabus:

Embedded systems Overview, Characteristics of embedded computing applications. Design Challenges, Common Design Metrics.

Processor Technology, IC Technology, Trade-offs, the development process, Requirements. Specification, Architecture Design, Designing Hardware and Software components. System Integration and Testing, Types of Hardware Platforms, Single board computers.

PC Add-on cards, custom-built hardware platforms, ARM Processor, CPU performance. CPU power consumption, Bus-based computer systems. Memory devices, I/O devices, component interfacing, designing with microprocessors, system level performance analysis. components for embedded programs,

Models of programs, Assembly, Linking, and loading, basic compilation techniques.

Software performance optimization, program level energy and Power analysis, Program validation and Testing.

Reading:

1. Wayne Wolf, Computers as Components-Principles of Embedded Computer System Design, Morgun Kaufmann Publisher, 2006.
2. David E-Simon, An Embedded software Primer, Pearson Education, 2007.

EC419	Network Security	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student must be able to:

CO1	Understand fundamentals of network security.
CO2	.Choose appropriate encryption and decryption algorithms for a given scenario
CO3	Implement authentication mechanisms through Public and Private keys
CO4	Apply cyber space laws to identify cyber crime.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction: Attacks, services and mechanisms, security attacks, security services, a model for internet work security, protection through cryptography, the role of cryptography in network security.

Conventional Encryption: Conventional encryption model, classical encryption techniques, substitution techniques and transposition techniques, block cipher principles, block cipher design principles, block cipher modes of operation.

Encryption Algorithms: The data encryption standard, triple DES, International data encryption algorithm, Blowfish, RC5, characteristics of advanced symmetric block ciphers. Principles of public-key cryptosystems, the RSA algorithm, key management.

Authentication protocols & Digital Signatures : Authentication requirements, authentication functions, message authentication codes, hash functions, security of hash functions and MAC's, Digital signatures, Digital signature standard, Authentication Protocols, MD5, message digest algorithm, secure hash algorithm, HMAC.

Mall security & IP security: Pretty good privacy, S/MIME, IP security overview, IP security architecture, Authentication header, key management. Introducers, viruses, Malware, Spyware, Spam. firewall design principles, trusted systems.Cyber crime, Cyber Law.

Text Book:
1. Cryptography and Networking Security, Principles and Practice – by William Stallings, PHI/Pearson Education Asia, 2 nd Ed. 2000.

Reference Book:
1. Network Security-Private Communication in a Public World, 2 nd ed., Kaufman, Perlman & Speciner, PHI, 2003.

EC420	Low Power VLSI Design	DEC	3–0–0	3 Credits

Prerequisites

Course Outcomes: After completion of the course student must be able to:

CO1	Identify the sources of power consumption in a given VLSI Circuit
CO2	Analyze and estimate dynamic, leakage power components in a DSM VLSI circuit
CO3	Choose SRAMs/ DRAMs for Low power applications
CO4	Design low power arithmetic circuits and systems
CO5	Decide at which level of abstraction it is advantageous to implement low power techniques in a VLSI system design

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	3	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	-	1	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Introduction, MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, The Differential Inverter, The Transmission Gate, The Tristate Inverter, Bipolar Devices (Diodes, BJT, BiCMOS).Silicon Semiconductor Technology: An overview, Basic CMOS Technology, CMOS Process Enhancements

Layout Design Rules, Latch up, Technology-related CAD Issues.Resistance Estimation, Capacitance Estimation, Inductance, Switching Characteristics, CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductor, Charge Sharing, CMOS Logic Gate Design, Basic Physical Design of Simple Logic Gates

CMOS Logic Structures, Clocking Strategies ,I/O Structures (Overall Organization, Output pads, Input pads), Low-power Design. Design Strategies, CMOS Chip Design Options (programmable logic, programmable Gate arrays,

Design Methods, Design-capture Tools, Design Verification Tools.The Need for Testing, Manufacturing Test Principles (Automatic Test Pattern Generation (ATPG)), Delay fault analysis, Design Strategies for Test

Chip Level Test Techniques, System Level Test Techniques. Data path Operations (Addition/ Subtraction, Parity Generators, Binary Counters), Boolean Operations-ALUs, Multiplication, Memory Elements, Control.

Reading:

1. Kiat Seng Yeo and Kaushik Roy, Low- Voltage, Low-Power VLSI Subsystemss, Edition 2009, Tata Mc Graw Hill
2. Soudris D, Piguet C and Goutis C, Designing CMOS Circuits for Low Power, Kluwer Academic Publishers, 2002
3. Jan Rabaey, Low Power Design Essentials, Springer

EC 421	Sensor Networks	DEC	3-0-0	3 credits

Prerequisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Identify the components of Wireless Sensor Networks
CO2	Understand the challenges in network coverage and routing for energy efficiency
CO3	Define node Architecture for specific applications
CO4	Program sensor network platforms using specialized operating system
CO5	Recognize upcoming challenges in Sensor Networks.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	-	-	-	-	-	-	-	-
CO2	-	1	-	-	2							
CO3	-	2	-	-	1	-	-	-	2	-	3	-
CO4	-	2	-	-	1	-						
CO5	-	2	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

Introduction: Constraints and Challenges, Opportunities and Challenges in Wireless Sensor Networks, Advantages of Sensor Networks (Energy Advantage and Detection Advantage), Sensor Network Applications, Smart Transportation, Collaborative Processing, Key Definitions

Sensor Network Architecture and Applications: Introduction, Functional Architecture for Sensor Networks, Sample Implementation Architectures, Classification of WSNs, Characteristics, Technical Challenges, and Design Directions, Technical Approaches, Coverage in Wireless Sensor Networks, Location in Wireless Sensor Networks, Data Gathering and Processing

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Localization Services

Sensor Network Platforms and Tools: Individual Components of SN Nodes, Sensor Network Node, WSNs as Embedded Systems, Sensor Node Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms, Node-Level Simulators, Programming beyond Individual Nodes: State-Centric Programming.

Taxonomy of Routing Techniques: Routing Protocols, Future Directions, Applications/Application Layer Protocols, Localization Protocols, Time Synchronization Protocols, Transport Layer Protocols, Network Layer Protocols, Data Link Layer Protocols

Reading:

1. F. ZHAO, C GUIBAS, Wireless Sensor Networks, Elsevier, Morgan Kaufmann, 2004.

2. MOHAMMAD ILYAS, IMAD MAHGOUB, Hand book of Sensor Networks, CRC Press, 2005.

EC422	Real Time Operating Systems	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Recognize the need for Real-Time Systems
CO2	Understand the architecture of Real-Time Operating Systems (RTOS)
CO3	Identify the use of Task Management in Real-Time Operating Systems
CO4	Outline the importance of RT Software Implementation
CO5	Evaluate System Performance Analysis of RTOS

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction to Real Time Systems, Concepts and Misconceptions- Definitions for Real-Time Systems, Usual Misconceptions, Multidisciplinary Design Challenges- Influencing Disciplines, Birth and Evolution of Real-Time Systems-Diversifying Applications, Advancements behind Modern Real-Time Systems.

Real Time Operating Systems (RTOS) Architecture , Introduction, Defining an RTOS, Board Support Package, Kernel- Monolithic kernel, Microkernel, Exokernel, The Scheduler-Schedulable Entities, Multitasking, The Context Switch, The Dispatcher, Scheduling Algorithms-Preemptive Priority-Based Scheduling, Round-Robin Scheduling, Objects, Services, Key Characteristics of an RTOS.

Task Management, Introduction to Task Management, Task Object, Defining a Task, Task States and Scheduling, Typical Task Operations, Typical Task Structure. Task synchronization-Event Objects, Semaphores-Introduction, Defining Semaphores, Typical Semaphore Operations, Typical Semaphore Use, Inter task communication -Message queues-Introduction, Defining Message Queues, Message Queue States, Message Queue Content, Message Queue Storage, Typical Message Queue Operations, Typical Message Queue Use, Pipes, Timers and system clock-Introduction, Real-Time Clocks and System Clocks, Programmable Interval Timers, Timer Interrupt Service Routines, A Model for Implementing the Soft-Timer Handling Facility.

RT Software Implementation, Qualities of Real-Time Software, Software Engineering Principles, Procedural Design Approach, Object-Oriented Design Approach.

RT System Performance Analysis, Real-Time Performance Analysis-Theoretical Preliminaries, Arguments Related to Parallelization, Execution Time Estimation from Program Code, Analysis of Polled - Loop and Coroutine Systems, Analysis of Round - Robin Systems, Analysis of Fixed - Period Systems, Input/output Performance, Analysis of Memory Requirements- Memory Utilization Analysis, Optimizing Memory Usage.

Reading:

1. Qing Li & Caroline Yao: Real-Time Concepts For Embedded Systems, 2003.
2. Phillip A. Laplante, Seppo J. Ovaska: Real-Time Systems Design And Analysis Tools for The Practitioner, 4th Edition 2012.
3. Rajkamal: Embedded Systems Architecture, Programming & Design: Architecture, Programming and Design, 2nd Edition, 2008.
4. K.V.K.K.Prasad: Embedded Real-Time Systems: Concepts, Design and Programming, Dreamtech Press, 2005.

EC403	Electronic Instrumentation Lab	PCC	0–0–3	2 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Measure displacement using capacitive and resistive transducers.
CO2	Measure temperature and strain using appropriate transducers
CO3	Build a simple data acquisition system using DMM .
CO4	Control DMM and DSO via GP-IB and perform measurements of sensor signals

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Speed measurement using:

Angular displacement measurement using capacitive pickup method

Angular displacement measurement using capacitive pickup method,

Displacement measurement using capacitive transducer.

Displacement measurement using resistive transducer, Temperature measurement using Thermistor

a) Temperature measurement using thermocouple.
b) Measurement of strain using strain gauge

Calibration and Study of DMM
Data Acquisition System

Programmable Logic Controller
Process Control Simulation
GP-IB Control of DSO and DMM

ME435	Industrial Management	OEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student must be able to:

CO1	Understand the basic principles, approaches and functions of management and apply concepts to specific situations.
CO2	Understand marketing management process and apply marketing mix in the formulation of marketing strategies during the life cycle of product.
CO3	Identify and utilize various techniques for improving productivity using work study.
CO4	Apply the concepts and tools of quality engineering in the design of products and process controls.
CO5	Understand and use appropriate methods/tools of inventory classification and control in industry.
CO6	Recognize activities with their interdependency so as to optimize time vs costs utilizing the techniques of project management/CPM.

Mapping of course outcomes with program outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	2	-	-	1	1
CO3	-	2	-	-	-	-	-	-	-	1	2	-
CO4	-	2	-	-	-	-	-	-	-	-	2	2
CO5	-	1	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	2	-	-	2	-

Detailed Syllabus:

Evolution of industry and professional management: functions of management;Design of organization structures, Hawthorn experiments. Primary groups and informal organizational structures

Leadership styles and characteristics of effective leadership, Mc Gregor's Theory X and Theory Y, Maslow's and Hertzberg's motivational theories, Japanese Management.

Marketing management process and the four Ps of marketing mix; market segmentation, targeting and positioning; product life cycle and marketing strategies in different stages of product life cycle; Productivity definition, its role in the economy, techniques for improving productivity, method study procedure

flow process chart and flow diagram, two handed process chart, principles of motion economy, work sampling, stop watch time study.control charts – X and R, p & c charts, Sampling plan – design of single sampling plan using OC curve, rectifying inspection and AOQL

Taguchi's method of total quality control, Quality function deployment, Introduction to TQM. Purposes of inventories, inventory costs, ABC classification, EOQ, P and Q systems of inventory control. Network diagrams, critical path method, total slack and free slack, crashing of activities and resource leveling, PERT

Reading:

1. Donald J Clough. "Concepts in Management Science", Prentice Hall of India.
2. Philip Kotler, "Marketing Management", Prentice Hall of India, New Delhi, 2000
3. Hajra Choudhury S.A., Nirjar Roy and Hajra Choudhury A.R., "Production Management", Media Promoters and Pub. Pvt. Ltd., Bombay, 1990.

EC451	Optical Fiber Communication	PCC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Identify and characterize different components of an Optical Fiber Communication link.
CO2	Analyze optical source, Fiber and Detector operational parameters
CO3	Compute optical fiber link design parameters
CO4	Understand WDM, Optical Amplifiers, Optical Switching and networking technology concepts.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	1	-	-	-	-	-	-	-
CO2	1	-	-	-	2	1	-	-	-	-	-	-
CO3	1	-	-	-	2	2	-	-	-	-	-	-
CO4	1	-	-	-	-	-	2	-	-	-	-	-

Detailed Syllabus:

Motivation for optical communications, advantages of optical fibers, optical bands, telecom signal multiplexing, optical multiplexing standard, key elements of optical fiber communication link.

Optical windows, standards, few exercise problems. Linear polarization, optical laws, polarizer, fiber types, rays and modes, ray optics, Numerical aperture, optical fiber modes, evanescent tails, mode cutoff condition, wave equation in SI fibers, modes in SI fibers, LP modes, Single mode fibers, graded index fibers.

Fiber materials, fiber fabrication, Fiber optic cables, exercise problems. Attenuation in fibers, absorption and scattering losses, bending losses, chromatic dispersion, modal delay, group delay, material dispersion, signal distortion in SM fibers, cutoff wavelength, mode field diameter, specialty fibers, exercise problems.

Energy bands, pn junction, LED structures, light source materials, quantum efficiency and LED power, modulation of LED, exercise problems.

Laser diode, structure, modes and threshold conditions, single mode lasers, modulation of laser diodes, external modulation, linearity, exercise problems.

Source to fiber power launching, lensing schemes, fiber to fiber joints, fiber splicing, fiber connectors, exercise problems. Photo diode principles, Avalanche photodiode, photodetector noise, detector response time, structures for APD, exercise problems.

Optical receiver operation, error sources, digital receiver performance, receiver sensitivity, eye pattern features, coherent detection, heterodyne detection, BER comparisons, analog receivers, exercise problems.

Digital links, point to point links, link power budget, error control, Analog links, CNR, photodetector and preamplifier noise, multichannel AM, multichannel FM, RF over fiber, exercise problems,

WDM overviews, operational principles, WDM standards, optical coupler, star coupler, optical isolator, fiber Bragg grating, tunable optical filters, optical add/drop multiplexers, exercise problems. Optical amplifiers, basic operation, amplifier gain, Erbium doped fiber amplifiers, amplification mechanism, EDFA architecture, optical network concepts, topologies, SONET/SDH transmission formats and speeds, optical cross connect switches,

Reading:

1. GERD KEISER, Optical Fiber Communications, TMH India, 4th edition, 2010.
2. SENIOR JOHN M., Optical Fiber Communications, Pearson Education India, 3rd edition, 2009.

EC461	Cellular and Mobile Communications	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the evolution of cellular communication systems upto and beyond 3G
CO2	Design a cellular link and estimate the power budget.
CO3	Choose proper multiple accessing methods depending on channel model
CO4	Identify traffic channels for call processing
CO5	Calculate key performance metrics of a cellular communication system.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	2	2	-	-	-	-	-
CO2	2	-	-	-	2	2	1	-	-	-	-	2
CO3	2	-	-	-	2	2	1	-	-	-	-	-
CO4	1	-	-	-	2	-	2	-	-	-	-	-
CO5	2	-	-	-	3	2	2	-	-	-	-	2

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

An Overview of Wireless Systems - Introduction - Everything moves - Mobility versus portability - Mobile devices – Wireless communication and the layer model - First- and Second- Generation Cellular Systems - Cellular Communications from 1G to 3G - Road Map for Higher Data Rate Capability in 3G - Wireless 4G Systems - Future Wireless Networks – Standardization Activities for Cellular Systems.

Cellular System design concepts and fundamentals - Frequency Reuse – Channel Assignment - Handoff Strategies – Interference and System Capacity – Trunking and Grade of service – Improving Coverage and Capacity in cellular systems. Mobile Radio Wave propagation - I - Large scale path loss and propagation models – Reflection – Diffraction – Scattering – Practical link budget design – Outdoor propagation models – Indoor propagation models.

Mobile Radio Wave propagation – II - Small- Scale fading and multipath propagation, Rayleigh and Ricean Distributions. Multiple Access Techniques for Wireless Communications -I – FDMA – TDMA –Spread Spectrum multiple access – FHMA, CDMA – SDMA.

Multiple Access Techniques for Wireless Communications – II - Packet radio – Pure ALOHA, Slotted ALOHA, CSMA, Reservation ALOHA, PRMA - Capacity of Cellular Systems. Wireless systems and standards – I – AMPS and ETACS – IS 54 and IS 136 – GSM features – Architecture – Radio subsystems – Traffic channels – call processing.

Wireless systems and standards – II – CDMA features – Architecture – IS 95 – Forward and reverse channels – power constrol - system capacity.Wireless Networking – WLAN – PAN – Mobile network layer – Mobile Transport layer – Wireless data services, Common channel signalling. Wireless Networking – Satellite data communication - cellular data communications, third generation UMTS system features – WiMAX - RFID.

Reading:

1. William C Y Lee, "Mobile Cellular Telecommunications, McGraw Hill.(Main Book)
2. Stallings, *Wireless Communications and Networks*, Prentice Hall.
3. Schwartz, *Mobile Wireless Communications*, Cambridge University Press.(Main Book)
4. Theodore S Rappaport, "Wireless Communications Principles and Practice", Prentice Hall.

EC462	Radar Engineering	DEC	3–0–0	3 Credits

Course Offered: IV Year - II Semester

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Understand the basic operation of pulse and CW radar systems.
CO2	Evaluate the radar performance based on pulse width, peak power and beam width.
CO3	Choose suitable tracking radar for a given problem.
CO4	Select appropriate criterion for detecting a target.
CO5	Understand the working of phased array radars and navigational aids

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	1	-	-	-	-	-	-
CO4	2	-	-	-	1	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Radar and Radar Equation: Introduction, Radar block diagram and operation, frequencies, applications, types of displays, derivation of radar equation, minimum detectable signal, probability of false alarm and threshold detection, radar cross-section, system losses.

CW Radar – Doppler Effect, CW Radar, applications, FM – CW radar, altimeter, Multiple Frequency Radar. Pulse Radar – MTI, Delay Line Canceller, Multiple Frequencies, Range-gated Doppler Filters, Non-coherent MTI, Pulse Doppler Radar,

Tracking Radar- Sequential lobing, conical scanning, monopulse, phase comparison monopulse, tracking in range, comparison of trackers.

Detection – Introduction, Matched Filter, Detection Criteria, Detector characteristics.

Phased Arrays – Basic concepts, feeds, phase shifters, frequency scan arrays, multiple beams, applications, advantages and limitations. Navigational Aids: Direction Finder, VOR, ILS and Loran

Reading:

1. M.I. Skolnik, Introduction Radar Systems, 2nd Edn,Mc Graw Hill Book Co.,1981
2. F.E. Terman, Radio Engineering, Mc Graw Hill Book Co. (for Chapter 7 only), 4Th Edn. 1955
3. Simon Kingsley and Shaun Quegan, Understanding RADAR Systems, McGraw Hill Book Co., 1993

EC463	FPGA Design	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Distinguish between DSP and FPGA based filter architectures
CO2	Compare the architectures of general purpose processors and DSP processors
CO3	Design simple IP cores for FPGA applications
CO4	Use the CAD tools to model an FPGA design
CO5	Model and design a heterogeneous FPGA based embedded system

Mapping of course outcomes with program outcomes:

Detailed Syllabus:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-
CO4	-	2	3	-	-	-	-	-	-	-	-	1
CO5	-	3	3	-	-	-	-	-	-	-	-	2

Introduction to Field-programmable Gate Arrays: Programmability and DSP. A Short History of the Microchip, Challenges of FPGAs, DSP System Basics, DSP System Definitions, DSP Transforms, Filter Structures, Adaptive Filtering , Basics of Adaptive Filtering

Arithmetic Basics: Number Systems, Fixed-point and Floating-point, Arithmetic Operations, Fixed-point versus Floating-point, Technology Review: Introduction, Architecture and Programmability, DSP Functionality Characteristics .Processor Classification, Microprocessors, DSP processors
.
Current FPGA Technologies: Introduction, Toward FPGA, Altera FPGATechnologies, Xilinx FPGA Technologies , Detailed FPGA Implementation Issues: Introduction, Various Forms of the LUT ,Memory Availability , Fixed Coefficient Design Techniques, Distributed Arithmetic, Reduced Coefficient Multiplier, Rapid DSP System Design Tools and Processes for FPGA: Introduction, Design Methodology Requirements for FPGA DSP, IP Core Generation Tools for FPGA, System-level Design Tools for FPGA,

The IRIS Behavioural Synthesis**:** Introduction of Behavioural Synthesis Tools, Hierarchical Design Methodology, Hardware Sharing Implementation (Scheduling Algorithm) for IRIS.DECISION ANALYSIS AND SUPPORT: Decision Making., Modeling throughout System Development, Modeling for Decision

Complex DSP Core Design for FPGA: Motivation for Design for Reuse ,Intellectual Property (IP) Cores, Evolution of IP Cores. Model-based Design for Heterogeneous FPGA: Dataflow Modelling and Rapid Implementation for FPGA DSP Systems, Rapid Synthesis and Optimization of Embedded Software from DFGs, System-level Modelling for Heterogeneous Embedded DSP Systems, System-level Design and Exploration of Dedicated Hardware Network, Adaptive Beamformer Example, Low Power FPGA Implementation.

Reading:

2. Roger Woods, John McAllister, Gaye Light body, Ying Yi, FPGA-based Implementation of Signal Processing Systems, Wiley, 2008

EC464	System Engineering	DEC	3–0–0	3 Credits

Prerequisites: Basics of Complex systems and systems engineering Management

Course Outcomes: After completion of the course student must be able to:

CO 1	Understand the structure of complex systems
CO2	Evaluate system development process in terms of system life cycle
CO3	Classify a systems engineering project in terms of the balance of demands, choice and constraints
CO4	Evaluate the differences between a generic model of systems engineering and a software specific model

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	1	-	-	-	-	-	-	-	-	2	-	-
CO3	1	-	-	-	-	-	-	-	-	-	3	-
CO4	1	-	-	-	-	-	-	-	-	-	2	-

Detailed Syllabus:

SYSTEMS ENGINEERING AND THE WORLD OF MODERN SYSTEMS: What Is Systems Engineering, Origins of Systems Engineering, Examples of Systems Requiring Systems Engineering, Systems Engineering as a Profession, Systems Engineer Career Development Model, The Power of Systems Engineering.

SYSTEMS ENGINEERING LANDSCAPE: Systems Engineering Viewpoint, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, Systems Engineering Approaches, Systems Engineering Activities and Products

STRUCTURE OF COMPLEX SYSTEMS: System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interaction.

THE SYSTEM DEVELOPMENT PROCESS : Systems Engineering through the System Life Cycle, Evolutionary Characteristics of the Development Process ,The Systems Engineering Method, Testing throughout System Development
.
SYSTEMS ENGINEERING MANAGEMENT: Managing System Development and Risks, WBS, SEMP, Risk Management, Organization of Systems Engineering.

NEEDS ANALYSIS: Originating a New System, Operations Analysis, Functional Analysis, Feasibility Definition.

CONCEPT EXPLORATION: Developing the System Requirements, Operational Requirements Analysis, Performance Requirements Formulation, Implementation of Concept Exploration, Performance Requirements Validation

CONCEPT DEFINITION: Selecting the System Concept, Performance Requirements Analysis, Functional Analysis and Formulation, Functional Allocation, Concept Selection, Concept Validation, System Development Planning, Systems Architecting.

DECISION ANALYSIS AND SUPPORT: Decision Making, Modeling throughout System Development, Modeling for Decision.

ADVANCED DEVELOPMENT: Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction.

SOFTWARE SYSTEMS ENGINEERING: Coping with Complexity and Abstraction, Nature of Software Development, Software Development Life Cycle Models, Software Concept Development: Analysis and Design, Software Engineering Development: Coding and Unit Test, Software Integration and Test, Software Engineering Management

Reading:

1. Alexander Kossiakoff William N. Sweet, Sam Seymour, Steven M. Biemer, SYSTEMS ENGINEERING PRINCIPLES AND PRACTICE, Wiley, 2nd Edition, 2011.

EC465	Advanced Digital Signal Processing	DEC	3-0-0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Compare the performance of LMS and RLS algorithms in terms of speed of convergence for a given application.
CO2	Choose an appropriate transform for the given signal
CO3	Choose appropriate decimation and interpolation factors for high performance filters
CO4	Model and design an AR system
CO5	Implement filter algorithms on a given DSP processor platform.

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-	2
CO5	2	1	3	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

1. Adaptive Filter theory: Stochastic gradient based algorithms – LMS algorithm, stability analysis, Mean-squared error behavior. Convergence analysis, Normalized LMS algorithm, Gradient adaptive lattice algorithm. Prediction, filtering and smoothing, adaptive equalization, noise cancellation, blind deconvolution, adaptive IIR filters, RLS algorithms-GRLS, Gauss- Newton and RML.
2. Transform techniques: Discrete cosine transforms(DCTs), Discrete sine transforms(DSTs), KL transforms, Hadamard transforms, Walsh transforms and Wavelet transforms, Applications of DCTs and Wavelets.
3. Multirate signal processing: Decimation, Interpolation, Applications.
4. Linear Prediction and Optimum linear filters: Innovations representation of a stationary random process, Gram-Schmidt Orthogonality, signal models – AR,MA and ARMA models; Forward and backward linear prediction, solution of the normal equations, - Levinson – Durbin Algorithm, Schur algorithm, properties of linear- prediction error filters, AR lattice and ARMA Lattice – Ladder filters, Wiener filters for filtering and prediction state-space(Kalman) filters, practical aspects, Kalman filter design methodology, Wiener filter design, Least Square methods for system modeling & Filter Design.
5. Digital Signal Processors: Programmable DSP architectures, multiport memory, Special addressing modes, on chip peripherals, Architecture of TMS 320 C5X/6X,Bus structure, Programme controller, CALU, IDEX, ARCER, ALU, BMAR, on-chip memory,TMS320C5X Assembly language, Instruction pipelining in C5X,Applications programs in C5X.
6. Signal analysis with higher order spectra.

Reading:

1. Simon Haykin, Adaptive Filter Theory, Prentice Hall, 2^{nd} Edition, 2001.
2. Janes V.Candy, Signal Processing, The Model Based Approach, McGraw-Hill Book Company, 1987
3. Monson H. Hayes, Statistical Digital Signal Processing and modeling, John Wiley & Sons, 1996
4. Handouts on DSP Processors.
5. S.K.MITRA, Digital Signal Processing – A computer Based Approach, MGH, 2^{nd} Edition, 2001.
6. Reference Manuals of Texas TMS 320X and Analog Devices 21XX Processors.

EC466	PC based Instrumentation	DEC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Identify hardware and software components of a Personal Computer
CO2	Interface PC ports with the given device and develop handshaking protocol
CO3	Develop a device driver routine for a given I/O module
CO4	Interface a given instrument to the PC via standard buses

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	1	3	3	-	-	-	-	-	-	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	1

Detailed Syllabus:

INTRODUCTION: PC in automated measurement and control systems; its relevance, advantages and disadvantages.
HARDWARE OVERVIEW: Evolution of PC family, various essential and desirable sub-systems of PC; self test and initialization of various sub-systems (Eg. POST etc.)
OPERATING SYSTEM: Essential features of OS for PC based Instrumentation, Overview of the features of additional software modules needed for optimization of system performance, Booting process and Command processor.
MOTHER BOARD: Functional units of Mother Board and their inter communication; details of "CPU Nucleus logic, DMA, Bus arbitration, NMI, Interrupt handling, co-processor, data address and control bus logic"; I/O Slot signals; New generation mother boards.
BUS STANDARDS: Essential features of a bus; bus design considerations; Study of standard buses; ISA, EISA, PCI, SCSI, GPIB and UXI.
STUDY OF STANDARD I/O CONTROLLER CARDS: I/O Ports; Serial and Parallel Ports; Bus slots; Key board, mouse and VDU Controller cards/ logic.
ADDITIONAL HARDWARE: Add-on card design considerations, Considerations of external hardware design to be used with PC, usage of ports for additional hardware; Usage of IRQ for additional hardware; Power requirements and physical dimensions of Add-on cards. Need for device drivers, installable device drivers; Executable device drivers; Device driver development and implementation considerations; A case study.

Reading:

1. Dexter Arthur L.,The Microcomputer Bus Structures and Interface Design, Marcel Dekker, 1986.
2. N. Mathivanan: PC Based Instrumentation Concepts and Practice, PHI Learning Pvt. Ltd., 2009.
3. Michel H. Toolay: PC Based Instrumentation and Control, 3rd Edition, CRC Press, 2005.
4. Tom Shanley, Don Anderson: PCI System Architecture, 3rd Edition, Adison Wesley Pub. Co., 1999.

EC452	Microwave and Optical Communication Lab	PCC	0–0–3	2 Credits

Prerequisites:

Course Outcomes: After completion of the course student will be able to:

CO1	Measure performance of simple microwave circuits and devices.
CO2	Perform microwave measurements with sophisticated instruments such as vector network analyzer and spectrum analyzer
CO3	Assess the performance of optical devices: light sources, fibers and detectors.
CO4	Plot the loss characteristics of optical fibers.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	1	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-

List of Experiments:

Antenna Demonstration

Mode characteristics of Reflex Klystron

Gunn oscillator characteristics and power measurement

Measurement of VSWR & impedance

Measurement of radiation pattern and gain of an antenna

Properties of circulators & Directional coupler

Properties of the Magic Tee Junction

Vector Network Analyser Demonstration

Measurement of Numerical Aperture

Integrated Voice and Data Optical Communication System

Study of Optical Sources, Detectors and Fiber Characteristics

CE390	Environmental Impact Analysis	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Identify the environmental attributes to be considered for the EIA study.
CO2	Formulate objectives of the EIA studies.
CO3	Identify the suitable methodology and prepare Rapid EIA.
CO4	Prepare EIA reports and environmental management plans.
CO5	Plan the methodology to monitor and review the relief and rehabilitation works.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	3	1	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	2
CO3	-	-	-	-	-	-	-	1	3	-	-	-
CO4	-	-	-	-	-	-	-	-	3	2	1	-
CO5	-	-	-	-	-	-	-	-	3	-	-	2

Detailed Syllabus:

Introduction: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies**:** Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.

Reviewing the EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System,Integrated Impact Assessment.

Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Reading:

1. Jain, R.K., Urban, L.V., Stracy, G.S., *Environmental Impact Analysis*, Van Nostrand Reinhold Co., New York, 1991.
2. Barthwal, R. R., *Environmental Impact Assessment*, New Age International Publishers, 2002
3. Rau, J.G. and Wooten, D.C., *Environmental Impact Assessment,* McGraw Hill Pub. Co., New York, 1996.
4. Anjaneyulu.Y., and Manickam. V., Environmental Imapact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
5. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

EE390	LINEAR CONTROL SYSTEMS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Analyze electromechanical systems using mathematical modelling
CO2	Determine Transient and Steady State behavior of systems using standard test signals
CO3	Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability
CO4	Design a stable control system satisfying requirements of stability and reduced steady state error

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-	1

Detailed syllabus:

Introduction - control system, types, feedback and its effects-linearization

Mathematical Modelling of Physical Systems. Block diagram Concept and use of Transfer function. Signal Flow Graphs- signal flow graph, Mason's gain formula.

Time Domain Analysis of Control Systems - BIBO stability, absolute stability, Routh-Hurwitz Criterion.

P, PI and PID controllers. Root Locus Techniques - Root loci theory, Application to system stability studies.

Frequency Domain Analysis of Control Systems - polar plots, Nyquist stability criterion, Bode plots, application of Bode plots.

Reading:

1. B.C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 2009.
2. I.J. Nagarath and M. Gopal: Control Systems Engineering, 2nd Edition, New Age Pub. Co. 2008.

ME390	AUTOMOTIVE MECHANICS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Analyze operation and performance indicators of transmission systems, internal combustion engines and after treatment devices.
CO2	Understand operation of engine cooling system, lubrication system, electrical system and ignition system.
CO3	Understand fuel supply systems in an diesel and petrol vehicles
CO4	Analyze current and projected future environmental legislation and its impact on design, operation and performance of automotive power train systems.
CO5	Understand operation and performance of suspension, steering and braking system.
CO6	Understand layout of automotive electrical system

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	-	-	3
CO2	-	-	-	-	-	-	-	-	2	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	2	-	2	3
CO5	-	2	-	-	-	-	-	-	-	-	-	3
CO6	-	3	-	-	-	-	-	-	-	-	-	-

Detailed syllabus:

Introduction: Layout of an automotive chassis, engine classification.

Cooling Systems: Air cooling, air cleaners, Water cooling: Thermosyphon and pump circulation systems, Components of water cooling systems- Radiator, thermostat etc.

Engine Lubrication: Petroils system, Splash system, Pressure lubrication and dry sump system

Ignition System: Battery, Magneto and Electronic, Engine Starting drives

Fuel supply system: Components in fuel supply system, types of feed pumps, air cleaners, fuel and oil filters, pressure and dry sump systems.

Engine testing and Performance: Performance parameters, constant and variable speed test, heat balance test, performance characteristics. Engine Emissions: SI and CI engine emissions, emission control methods

Automotive electrical and electronics: Electrical layout of an automobile, ECU, sensors, windscreen wiper, Electric horn.

Transmission: Clutch**-** Single and multiplate clutch, semi & centrifugal clutch and fluid flywheel, Gear box: Sliding mesh, constant mesh and synchromesh gear box, selector mechanism, over drive, Propeller shaft and Differential.

Suspension System: Front and rear suspension, shock absorbers, Rear Axles mountings, Front Axle. Steering Mechanism: Manual and power steering systems, Braking System: Mechanical, Hydraulic and Air braking systems.

Engine service: Engine service procedure.

Reading:

1. S. Srinivasan, Automotive Mechanics, Tata McGraw-Hill, 2004.
2. K.M.Gupta, Automobile Engineering, Vol.1 and Vol.2, Umesh Publications, 2002
3. Kirpal Singh, Automobile Engineering, Vol.1 and Vol.2, Standard Publishers, 2003.
4. William H.Crouse and Donald L. Anglin, Automotive Mechanics, Tata McGraw-Hill, 2004
5. Joseph Heitner, Automotive Mechanics, East-West Press, 2000.

ME391	ROBUST DESIGN	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Understand stages in engineering design and concept of robust design.
CO2	Develop quality loss functions and S/N ratios for S, N and L type objective functions.
CO3	Identify control and noise factors for a given product or process.
CO4	Conduct experiments using DOE concepts to decide the optimal setting of parameters
CO5	Apply quality loss function approach for fixing the component tolerances.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	2	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	2	1	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3

Detailed syllabus:

Introduction: Taguchi's quality philosophy, causes of performance variation, concept of robust design, stages in product/process design, need for experimentation, QFD, process flow analysis, cause and effect diagram.

Design of Experiments**:** Principles of experimentation, Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & Anova, Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

Parameter Design**:** Loss function, average quality loss, S/N ratios, objective functions, selection of control & noise factors and their levels, strategy for systematic sampling of noise, classification of control factors, inner-array and outer-array design, data analysis, selection of optimum levels/values for parameters.

Tolerance Design: Experiments, selection of tolerances to be tightened, fixing the final tolerances.

Reading:

1. Taguchi G, Chowdhury S and Taguchi S, Robust Engineering, TMH, 2000.
2. Ross PJ, Taguchi Techniques for Quality Engineering, TMH, 2005.

ME392	ENTREPRENEURSHIP DEVELOPMENT	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Understand entrepreneurship and entrepreneurial process and its significance in economic development.
CO2	Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.
CO3	Identify entrepreneurial opportunities, support and resource requirements to launch a new venture within legal and formal frame work.
CO4	Develop a framework for technical, economic and financial feasibility.
CO5	Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.
CO6	Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	2	-
CO2	-	-	-	-	-	-	-	-	2	-	3	-
CO3	-	-	-	-	-	-	-	-	-	2	3	-
CO4	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	-	3	3	-
CO6	-	-	-	-	-	-	-	-	-	-	3	2

Detailed syllabus:

Entrepreneur and Entrepreneurship: Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies and motivation; Institutional Interface for Small Scale Industry/Enterprises.

Establishing Small Scale Enterprise: Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site.

Planning a Small Scale Enterprsies**:** Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership.

Operational Issues in SSE**:** Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.

Performance appraisal and growth strategies**:** Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth.

Reading:

1. G.G. Meredith, R.E.Nelson and P.A. Neek, The Practice of Entrepreneurship, ILO, 1982.
2. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.
3. A Handbook for New Entrepreneurs, Entrepreneurship Development Institute of India, Ahmedabad, 1988.
4. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.

EC390	COMMUNICATION SYSTEMS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Understand different modulation and demodulation schemes for analog communications.
CO2	Design analog communication systems to meet desired application requirements
CO3	Evaluate fundamental communication system parameters, such as bandwidth, power, signal to quantization noise ratio etc.
CO4	Elucidate design tradeoffs and performance of communications systems.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	2	-	-	-	-	-	-
CO2	-	3	-	-	3	2	-	-	-	-	-	-
CO3	2	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	-	-	-	-	-	-

Detailed syllabus:

Signal Analysis**:** Communication Process, Sources of Information, Communication Channels, Modulation Process, Types of Communication, Random Process, Gaussian Process, Correlation Function, Power Spectral Density, Transmission of Random Process through an LTI Filter.

Noise Analysis: External Noise, Internal Noise, White Noise, Narrow Band Noise, Representation of Narrow Band noise In phase and Quadrature Components, Noise Figure, Noise Bandwidth, Noise Temperature.

Amplitude (Linear) Modulation: Linear Modulation Schemes, Generation of AM, Envelope Detector, DSB-SC Product Modulator, Switching Modulator, Ring Modulator, Coherent Detection, Costas receiver, SSB Signal Representation, Filtering Method, Phase Shift Method, Coherent Demodulation, VSB Modulator and Demodulator, Carrier Acquisition using Squaring Loop and Costas Loop, Receiver Model, SNR, Noise in SSB and DSB receivers using coherent detection, Noise in AM Receiver using Envelope detection, Threshold Effect.

Angle (Exponential) Modulation: Types of Angle Modulation, Relation between FM and PM, Narrow Band FM, Wideband FM, Transmission Bandwidth of FM Signals, Generation of FM using Direct and Indirect methods, FM Demodulation using Slope Circuit, Frequency Discriminator, Interference in Angle Modulation, Noise in FM Receiver, FM Threshold Effect, Pre-emphasis and De-emphasis in FM, Model of PLL for FM Demodulation.

Pulse Modulation: Sampling Process, PAM, PWM, PPM, Quantization, PCM, TDM, Digital Multiplexer Hierarchy, DM, DSM, Linear Prediction, DPCM, ADPCM, Noise in PCM System, Companding, Comparison of the Noise Performance of AM,FM,PCM and DM.

Information Theory: Uncertainty, Information, Entropy, Source Coding Theorem, Data Compaction, Mutual information, Channel Capacity, BSC Channel, Information Capacity Theorem, Bandwidth - Power Tradeoff, Huffman Coding.

Reading:

1. S. Haykin, Communication Systems, 4th Edn, John Wiley & Sons, Singapore, 2001.
2. B.P. Lathi, Modern Digital & Analog Communication Systems, 3rd Edn, Oxford University Press, Chennai, 1998.
3. Leon W.Couch II., Digital and Analog Communication Systems, 6th Edn, Pearson Education inc., New Delhi, 2001.
4. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems, 4th Edn, MGH, New York, 2002.

EC391	MICROPROCESSOR SYSTEMS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Develop basic understanding of microprocessor architecture.
CO2	Design Microprocessor and Microcontroller based systems.
CO3	Understand C, C++ and assembly language programming
CO4	Understand concept of interfacing of peripheral devices and their applications

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	2	-	-	-
CO3	-	-	3	-	-	-	-	-	2	-	-	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-

Detailed syllabus:

Microcomputer Organization: CPU, Memory, I/O, Operating System, Multiprogramming, Multithreading, MS Windows

80386 Micro Processors : Review of 8086,salient features of 80386,Architecture and Signal Description of 80386,Register Organization of 80386,Addressing Modes,80386 Memory management, Protected mode, Segmentation, Paging, Virtual 8086 Mode, Enhanced Instruction set of 80386, the Co- Processor 80387

Pentium & Pentium-pro Microprocessor: Salient features of Pentium microprocessor, Pentium architecture, Special Pentium registers, Instruction Translation look aside buffer and branch Prediction, Rapid Execution module, Memory management, hyper-threading technology, Extended Instruction set in advanced Pentium Processors

Microcontrollers: Overview of micro controllers-8051 family microcontrollers, 80196 microcontrollers family architecture, instruction set, pin out, memory interfacing.

ARM Processor Fundamentals: Registers, current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table, Architecture Revisions, ARM Processor families, ARM instruction set, Thumb Instruction set-Exceptions Handing, Interrupts, Interrupt Handling schemes, firmware, Embedded operating systems, Caches-cache architecture, Cache policy, Introduction to DSP on the ARM, DSP on the ARM7TDMI,ARM9TDMI.

Case study-Industry Application of Microcontrollers

Reading:

1. Barry B.Brey: Intel Microprocessor Architecture, Programming and Interfacing-8086/8088,80186,80286,80386 and 80486, PHI,1995.
2. Muhammad Ali Mazidi and Mazidi: The 8051 Microcontrollers and Embedded systems, PHI, 2008
3. Intel and ARM Data Books on Microcontrollers.

CH390	Nanotechnology and Applications	OPC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the properties of Nano-materials and applications
CO2	Apply chemical engineering principles to Nano-particle production
CO3	Solve the quantum confinement equations.
CO4	Characterize Nano-materials.
CO5	Scale up the production Nanoparticles for Electronics and Chemical industries.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	-	-	-	-	-	-	2	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	2	-	-	3
CO5	-	-	-	-	-	-	-	-		-	2	3

Detailed Syllabus:

Introduction to Nanotechnology: Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano-sizes and properties comparison with the bulk materials, Different shapes and sizes and morphology.

Fabrication of Nanomaterials: Top Down Approach Grinding, Planetory milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Microemulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Kinetics at Nanoscale: Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance, Layers of surface charges, Zeta Potential and pH.

Carbon Nanomaterials: Synthesis of carbon bucky-balls, List of stable carbon allotropes extended, fullerenes, metallofullerenes, solid C_{60}, bucky onions, nanotubes, nanocones.

Quantum mechanics: Quantum dots and its Importance, Pauli exclusion principle, Schrödinger's equation, Application of quantum Dots: quantum well, wire, dot, characteristics of quantum dots, Synthesis of quantum dots Semi-conductor quantum dots

Nanomaterials characterization: Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential, Electronic band structure Electron statistics

Application: Optical transitions in solids, photonic crystals, Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy.
Applications: Self-assembly and molecular manufacturing, Surfactant based system Colloidal system applications, Functional materials Applications, commercial processes of synthesis of nanomaterials, Nano inroganic materials of $CaCO_3$ synthesis, Hybrid Waste Water Treatments systems, Electronic Nanodevices.

Nanobiology: Biological synthesis of nanoparticles and applications in drug delivery, Nanocontainers and Responsive Release of active agents, Layer by Layer assembly for nanospheres, Safety and health Issues of nano materials, Environmental Impacts, Case Study for Environmental and Societal Impacts.

Reading:

1. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007
2. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.
4. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press
5. Davies, J.H. ‘The Physics of Low Dimensional Semiconductors: An Introduction’, Cambridge University Press, 1998.

CH391	Industrial Safety and Hazards	OPC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Analyze the effects of release of toxic substances.
CO2	Select the methods of prevention of fires and explosions.
CO3	Understand the methods of hazard identification and preventive measures.
CO4	Assess the risks using fault tree diagram.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	-	3

Detailed syllabus:

Introduction-Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk , Public Perceptions ,The Nature of the Accident Process ,Inherent Safety.

Industrial Hygiene- Anticipation and Identification, Hygiene Evaluation, Hygiene Control.

Toxic Release and Dispersion Models- Parameters Affecting Dispersion, Neutrally Buoyant Dispersion Models, Dense Gas Dispersion, Toxic Effect Criteria, Effect of Release Momentum and Buoyancy, Release Mitigation.

Fires and Explosions- The Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram

Hazards Identification- Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews.

Risk Assessment- Review of Probability Theory, Event Trees, Fault Trees.

Safety Procedures: Process Safety Hierarchy, Managing Safety, Best Practices, Procedures—Operating, Procedures—Permits, Procedures—Safety Reviews and Accident Investigations.

Reading:

1. D. A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

CS390	OBJECT ORIENTED PROGRAMMING	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand fundamental concepts in object oriented approach.
CO2	Analyze design issues in developing OOP applications.
CO3	Write computer programs to solve real world problems in Java.
CO4	Analyze source code API documentations.
CO5	Create GUI based applications.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	2	-	-	3
CO3	-	-	-	-	-	-	-	-	2	2	-	3
CO4	-	-	-	-	-	-	-	-	-	3	-	3
CO5	-	-	-	-	-	-	-	-	-	-	2	3

Detailed Syllabus:

Object- oriented thinking, History of object-oriented programming, overview of java, Object-oriented design, Structure of java program. Types and modifiers, Classes, declaring objects in classes, Methods, constructors, garbage collection, Method overloading, passing objects as parameters, Inheritance, various forms and types of inheritance, Multilevel hierarchy, use of super, method overriding, Applications of method overriding, abstract classes, Packages with examples

Interfaces and implementation, Exception handling, types, throwing, creating own exceptions, Multithreading and concepts, its usage and examples, Input/output streams, String operations and examples, Collection classes-array, stack collection, bitset collection, Utility classes-string tokenizer, bitset, date, Applets- methods, creation, designing and examples, Event handling- event classes, Event listener interfaces, AWT classes, working with frames, AWT controls-layout manager, user interface components, Graphics programming

Reading:

1. Timothy Budd, “Understanding object-oriented programming with Java”, Pearson,
2. Herbert Schildt, “ The complete reference Java 2”, TMH,

BT390	GREEN TECHNOLOGY	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Address smart energy and green infrastructure
CO2	Build models that simulate sustainable and renewable green technology systems
CO3	Understand the history, global, environmental and economical impacts of green technology
CO4	Address non-renewable energy challenges

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	2	-	-	3
CO3	2	-	-	-	-	-	-	-	-	-	2	3
CO4	2	-	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

Biomass Energy, basic concepts, sources of biomass energy, uses of biomass energy, science and engineering aspects of biomass energy, production of biomass electricity, transmission of biomass electricity, storage of biomass electricity.

Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies, Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity.

First and second laws of thermodynamics and their applications – Thermodynamic processes - Irreversibility of energy – Entropy. Properties of steam and classification of steam engines. Carnot cycle - Rankine cycle, Current energy requirements, growth in future energy requirements, Review of conventional energy resources- Coal, gas and oil reserves and resources, Tar sands and Oil, Shale, Nuclear energy Option.

Biomass fuels, market barriers of biomass fuels, biomass fuel standerdization, biomass fuel life cycle, Sustainability of biomass fuels, economics of biomass fuels, Fuel stoichiometry and analysis: Fuel stoichiometry relations; Estimation of air required for complete combustion; Estimation of minimum amount of air required for a fuel of known composition; Estimation of dry flue gases for known fuel composition; Calculation of the composition of fuel & excess air supplied, from exhaust gas analysis; Dew point of products; Flue gas analysis (O_2, CO_2, CO, NOx, SOx).

Biomass as a major source of energy in India: Fuel-wood use in rural households. Consequences for ecosystems. Future energy scenario in rural areas. Utilization of biomass in industrial and semi-industrial settings. Future utilization of biomass in India. Future of landscape management: optimal management.

Reading:

1. Ayhan Demirbas, Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs, 1st Edition, Springer, 2009.
2. Jay Cheng, Biomass to Renewable Energy Processes, 1st Edition, CRC press, 2009.
3. Samir K. Khanal, Rao Y. Surampally, 1st edition, American Society of Civil Engineers, 2010.

SM390	MARKETING MANAGEMENT	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand concepts and scope of marketing and market oriented strategic planning
CO2	Analyze macro level environment
CO3	Identify factors influencing consumer behavior in competitive global business environment
CO4	Identify tools and techniques for marketing management through integrated marketing communication systems.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	-	-	-	-	-	-	-	-	-	-	3	1
CO3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	-	-	-	-	-	-	-	-	3	2

Detailed Syllabus:

Importance of Marketing, Scope of Marketing, Core Marketing concepts company orientation towards market place-production concept, Product concept, selling concept and Marketing concept.

Market oriented Strategic planning – Defining corporate Mission and Vision Statement at Corporate level and at Business unit level. Assigning resources to Strategic Business units through B.C.G Matrix and G.E Model.

Analyzing Macro environment-Demographic environment. Economic Environment, Technical Environment, Social-Cultural Environment and political – Legal Environment.

Components of Marketing information systems- Internal Records, Marketing intelligence, Marketing research and Marketing Decision support system.

Consumer Behavior- Buying Decision process and the factors influencing consumer Behavior-Psychological factors, social factors, cultural factors and personal factors.

Importance of Market segmentation, Target market selection and positioning.

Importance of new product development process and the various stages involved.

The concept of product lifecycle and the various strategies used by the marketer in each stage.

Product characteristics and classification, Product mix and product line decisions Branding Decisions, Building Brand Equity.

Importance of Pricing, Factors influencing pricing decisions. Various pricing methods-cost based and demand based methods.

Role of Marketing channels-Channel functions and channel levels channel Design and channel Management Decisions, Managing Retailing. Wholesaling and logistics. Importance of Electronic channels.

Importance of integrated Marketing communication. Advantages and Disadvantages of Various promotional tools- Advertising, Sales promotion, personal selling, publicity and public Relations and Direct marketing.

Reading:

1. Philip Kotler, Marketing Management, PHI, 14th Edition, 2013.
2. William Stonton & Etzel, Marketing Management, TMH, 13th Edition, 2013.
3. Rama Swamy & Namakumari, Marketing Management, McMillan, 2013.

MA390	NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Solve nonlinear differential equations by numerical methods.
CO2	Determine the convergence region for a finite difference method.
CO3	Solve elliptic PDE by finite difference method
CO4	Solve a parabolic PDE by finite difference method
CO5	Solve a hyperbolic PDE by finite difference method

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Ordinary Differential Equations: Multistep (explicit and implicit) methods for initial value problems, Stability and Convergence analysis, Linear and nonlinear boundary value problems, Quasi-linearization, Shooting methods

Finite difference methods: Finite difference approximations for derivatives, boundary value problems with explicit boundary conditions, implicit boundary conditions, error analysis, stability analysis, convergence analysis.

Partial Differential Equations: Classification of partial differential equations, finite difference approximations for partial derivatives and finite difference schemes for Parabolic equations, Schmidt's two level, multilevel explicit methods, Crank-Nicolson's two level, multilevel implicit methods, Dirichlet's problem, Neumann problem, mixed boundary value problem, stability analysis.

Hyperbolic Equations: Explicit methods, implicit methods, one space dimension, two space dimensions, ADI methods.

Elliptic equations: Laplace equation, Poisson equation, iterative schemes, Dirichlet's problem, Neumann problem, mixed boundary value problem, ADI methods.

Reading:

1. M.K. Jain, Numerical Solution of Differential Equations, Wiley Eastern, 1984.
2. G.D. Smith, Numerical Solution of Partial Differential Equations, Oxford Univ. Press, 2004.
3. M.K.Jain, S.R.K. Iyengar and R.K. Jain, Computational Methods for Partial Differential Equations, Wiley Eastern, 2005.

MA391	FUZZY MATHEMATICS AND APPLICATIONS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply operations on Fuzzy sets
CO2	Solve problems related to Propositional Logic.
CO3	Apply Fuzzy relations to cylindric extensions.
CO4	Apply logic of Boolean Algebra to switching circuits.
CO5	Develop Fuzzy logic controllers

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	2	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	2	-	-	2

Detailed Syllabus:

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets.

Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

Propositional Logic (PL1): Introduction, Syntax of PL1, Semantics of PL1, certain properties satisfied by connectives, inference rules, Derivation, Resolution.

Predicate Logic (PL2): Introduction, Syntax of PL2, Semantics of PL2, certain properties satisfied by connectives and quantifiers, inference rules, Derivation, Resolution

Fuzzy Relations (FR): Introduction, Operations on FR, □-cuts of FR, Composition of FR, Projections of FR, Cylindric extensions, Cylindric closure, FR on a domain.

Fuzzy Logic (FL): Introduction, Three-valued logics, N-valued logics and infinite valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Fuzzy rules and their interpretations in terms of FR, fuzzy inference, More on fuzzy inference, Generalizations of FL.

Switching functions (SF) and Switching circuits (SC): Introduction, SF, Disjunctive normal form, SC, Relation between SF and SC, Equivalence and simplification of circuits, Introduction of Boolean Algebra BA, Identification, Complete Disjunctive normal form.

Applications: Introduction to fuzzy logic controller (FLC), Fuzzy expert systems, classical control theory versus fuzzy control, examples, working of FLC through examples, Details of FLC, Mathematical formulation of FLC, Introduction of fuzzy methods in decision making.

Reading:

1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G.J. Klir and B.Yuan, Fuzzy sets and Fuzzy Logic–Theory and Applications, PHI, 1997.
3. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1995.

PH390	MEDICAL INSTRUMENTATION	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the origin of bio-potentials and their physical significance.
CO2	Understand anatomy and functioning of human heart and its common problems.
CO3	Analyze ECG, ENG and EMG signals and instrumentation.
CO4	Compare different techniques of measuring blood pressure, blood flow and volume.
CO5	Interpret the principle and operation of therapeutic and prosthetic devices.
CO6	Differentiate between the various techniques for measurement of parameters.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-
C05	3	-	-	-	-	-	-	-	-	-	-	2
CO6	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

General Introduction: The cell, body fluids, Musculoskeletal system, respiratory system, gastrointestinal system, Nervous system, endocrine system and circulatory system.

Origin of Bio potentials: electrical activity of Excitable cells: the resting state, The active state, Volume conductor fields, Functional organization of the peripheral nervous system: Reflex are & Junctional transmission.

The Electroneurogram (ENG): The H-Reflex, The Electromyogram (EMG), The Electrocardiogram (ECG), heart and the circulatory system, Electro conduction system of the heart and heart problems, ECG waveform and Physical significance of its wave features, Electrical behavior of cardiac cells, The standard lead system, The ECG preamplifier, DC ECG Amplier, Defibrillator protection circuit, Electro surgery Unit filtering, Functional blocks of ECG system, Multichannel physiological monitoring system, Common problems encountered and remedial techniques.

Blood Pressure: indirect measurement of blood pressure, korotkoff sounds, auscultatory method using sphygmo manometer, Oscillometric and ultrasonic non invasive pressure measurement, Direct measurement of blood pressure H2O manometers, electronic manometry, Pressure transducers,. Pressure amplifier designs, Systolic, diastolic mean detector circuits

Blood flow and Volume Measurement: indicator dilution methods, Transit time flow meter, DC flow meter, Electromagnetic flow meter AC electromagnetic flow meter, Quadrature suppression flow meter, Ultrasonic flow meter, Continuous-wave Doppler flow meter, Electric impedance plethysmography, chamber plethysmography, Photo plethysmography.

Pulse Oximetr: Principles of Operation, Absorption Spectrum, Sensor design, Pulse oximeter, Therapeutic and Prosthetic Devices.

Cardiac Pacemakers: Lead wires and electrodes, Synchronous Pacemakers, rate responsive pacemaking, Defibrillators, cardioverters, Electrosurgical unit, Therapeutic applications of laser, Lithotripsy Haemodialysis.

Reading:

1. John G Webster, Medical Instrumentation: Application and Design , John Wiley,3rd Ed. 2012.
2. Joseph J. Carr & John M. Brown , Introduction to biomedical Equipment Technology, 4th Ed., Prentice Hall India, 2001

MM390	METALLURGY FOR NON-METALLURGISTS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Understand the characteristics and usefulness of metals and alloys.
CO2	Differentiate metals and alloys and their fabrication techniques.
CO3	Correlate the microstructure, properties, processing and performance of materials.
CO4	Select metal/alloy for engineering applications.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	2	-	-	3

Detailed Syllabus:

Introduction to Metallurgy:

Structure of Metals and Alloys: Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals

Mechanical Properties: Plastic Deformation Mechanisms, Tensile, Creep, Fatigue, Fracture

Strengthening Mechanisms: Strain Hardening, Grain Size Refinement, Solid Solution Strengthening, Precipitation Hardening

Discovering Metals: Overview of Metals, Modern Alloy Production

Fabrication and Finishing of metal products: Metal Working and Machining

Testing of Metals: Both Destructive and Non-Destructive, Inspection and Quality Control of Metals

Engineering Alloys: Steel Products and Properties, Cast Irons, Tool Steels and High Speed Steels, Stainless Steels, Nonferrous Metals

Heat Treatment: Annealing, Normalizing, Hardening, Tempering

Corrosion and its Prevention: Electro chemical considerations, Corrosion Rates, Passivity, Environmental Effects, Forms of Corrosion, Corrosion Environments, Oxidation; Durability of Metals and Alloys

The material selection processes: Case studies

Reading:

1. M. F. Ashby: Engineering Metals, 4th Edition, Elsevier, 2005.
2. R. Balasubramaniam (Adapted): Calister's Materials Science and Engineering, 7th Edition, Wiley India (P) Ltd, 2007.
3. Reza Abbaschian, Lara Abbaschian, R E Reed-Hill: Physical Metallurgy Principles, Affiliated East-West Press, 2009.
4. V Raghavan: Elements of Materials Science and Engineering- A First Course, 5th Edition, PHI, 2006

PH391	ADVANCED MATERIALS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the synthesis and properties of nanomaterials
CO2	Evaluate the usefulness of nanomaterials in medicine, biology and sensing
CO3	Understand modeling of composite materials by finite element analysis
CO4	Differentiate superconducting materials
CO5	Understand the characteristics and uses of functional materials

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3
CO4	2	-	-	-	-	-	-	-	-	-	-	3
CO5	2	-	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

Nano Materials: Origin of nano technology, Classification of nano materials, Physical, chemical, electrical, mechanical properties of nano materials. Preparation of nano materials by plasma arcing, physical vapour deposition, chemical vapour deposition (CVD), Sol-Gel, electro deposition, ball milling, carbon nano tubes(CNT).Synthesis, preparation of nanotubes, nano sensors, Quantum dots, nano wires,nano biology, nano medidcines.

Biomaterials: Overview of biomaterials. Biomaterials, bioceramics, biopolymers, tissue grafts, soft tissue applications, cardiovascular implants, biomaterials in ophthalmology, orthopeadiac implants, dental materials.

Composites: General characteristics of composites , composites classes, PMCs, MMCs, CMCs, CCCs, IMCs, hybrid composites, fibers and matrices, different types of fibers, whiskers, different matrices materials, polymers, metal, ceramic matrices, toughening mechanism, interfaces, blending and adhesion, composite modeling, finite element analysis and design.

Optical materials: Mechanisms of optical absorption in metals, semiconductors and insulators. Nonlinear optical materials, optical modulators, optical fibers. Display devices and materials photo-emissive, photovoltaic cells, charge coupled devices(CCD), laser materials.

Super conducting materials: Types of super conductors, an account of mechanism of superconductors, effects of magnetic field currents, thermal energy, energy gap, acoustic attenuation, penetration depth, BCS theory, DC and AC Josephson effects, high Tc superconductors, potential applications of superconductivity, electrical switching element, superconductor power transmission and transformers, magnetic mirror, bearings, superconductor motors, generators, SQUIDS etc.

Smart materials: An introduction, principles of smart materials, input – output decision ability, devices based on conductivity changes, devices based on changes in optical response, biological systems smart materials. Devices based on magnetization, artificial structures, surfaces, hetero structures, polycrystalline, amorphous, liquid crystalline materials.

Surface Acoustic Wave (SAW) Materials and Electrets: Delay lines, frequency filters, resonators, Pressure and temperature sensors, Sonar transducers. Comparison of electrets with permanent magnets, Preparation of electrets, Application of electrets..

Reading:

1. T.Pradeep, Nano: The Essentials; TaTa McGraw-Hill,2008.
2. B.S. Murthy et al., Textbook of Nano science and Nanotechnology, University press
3. Krishan K Chawla, Composite Materials; 2nd Ed., Springer 2006.

CY390	INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Characterize materials using ultraviolet and visible absorption and fluorescence techniques
CO2	Analyze materials, minerals and trace samples using atomic absorption, emission and X-ray fluorescence techniques
CO3	Analyze environmental, industrial, production-line materials by liquid, gas and size-exclusion chromatographic techniques.
CO4	Characterize interfaces and traces of surface adsorbed materials using electro-analytical techniques
CO5	Understand principles of thermo gravimetry and differential thermal analyses.
CO6	Characterize chemical, inorganic and engineering materials using analytical techniques

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	-	2
CO2	1	-	-	-	-	-	-	-	3	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	-	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	2	-	-	2

Detailed Syllabus:

UV-Visible Spectrophotometry and Fluorescence Beer-Lambert's law, limitations, Molecular fluorescence, influencing factors, basic instruments, standardization, quantitative methods, applications.

Atomic spectrometry, atomic absorption, X-ray fluorescence methods Flame atomic emission and absorption, flame emission photometer, flame absorption spectrometer, spectral interferences, quantitative aspects, X-ray fluorescence principle, Instrumentation, quantitative analysis.

Separation techniques Solvent extraction, Principle, Extraction of solutes, Soxhlet extraction
Chromatography methods Gas chromatography, High performance liquid chromatography, Size exclusion chromatography, Principle, Basic instrumentation, Capillary Electrophoresis: Principle and application.

Thermoanalytical methods Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications, Quantitative determinations.

Electroanalytical methods Coulometric methods, Polarography, Pulse voltammetric methods, Amperometry, Principles, Applications, Electrochemical sensors, Ion selective, Potentiometric and amperometric sensors, Applications.

Spectroscopic methods Molecular absorption, Woodward rules, applications, Infra red absorption, functional group analysis, qualitative analysis, 1H- and 13C-NMR spectroscopy, Principle, Basic instrumentation, terminology, Interpretation of data, Quantitative applications.

Mass spectrometry Principles, Instrumentation, Ionization techniques, Characterization and applications.

Reading:

1. Mendham, Denny, Barnesand Thomas, Vogel: Text book of Quantitative Chemical Analysis, Pearson Education, 6th Edition, 2007.
2. Skoog, Holler and Kouch, Thomson, Instrumental methods of chemical analysis, 2007.
3. Willard, Meritt and Dean, Instrumental methods of chemical analysis, PHI, 2005.

CY391	CHEMICAL ASPECTS OF ENERGY SYSTEMS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand traditional and alternative forms of energy
CO2	Understand energy production, storage, distribution and utilization.
CO3	Model environmental impacts of energy generation and conservation
CO4	Apply concepts of engineering design to energy challenges

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Energy as the Key of Civilisation; Thermochemistry of Energy Sources and Kinteics of Energy Tapping; Conventional and Finite Energy Sources; Coal Based Energy Sources and Coal Carbonisation; Petroleum and Natural Gas; Biomass and Gobar Gas; Primary and Secondary Batteries, Reserve Batteries, Solid State and Molten Solvent Batteries, Lithium Ion Batteries;, Solar Energy Harnessing, Photogalvanic and Photovoltaic Energy Storage; Fuel Cells; Hydrogen as Future Fuel; Photochemical Water Cleavage; Green Energies.

Reading:

1. Tokio Ohta, Energy Systems, Elsevier Science, 2000.
2. R. Narayan and B. Viswanathan, Chemical and Electrochemical Energy Systems, Universities Press, 1998

HS390	SOFT SKILLS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand corporate communication culture
CO2	Prepare business reports and proposals expected of a corporate professional
CO3	Employ appropriate speech in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Acquire corporate email, mobile and telephone etiquette

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	2	2
CO3	-	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	-	-	-	-	-	2	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

Detailed Syllabus:

English Language Enhancement: Verbs and tenses, Phrasal verbs, Synonyms, Antonyms, Homonyms - Descriptive Words, Combining Sentences, Business Idioms, Indianisms in English.

Art of Communication, Communication process- Non-verbal Communication- Effective Listening.

Interpersonal and Intra Personal Communication Skills- Self-Awareness- Self-Esteem and Confidence- Assertiveness and Confidence- Dealing with Emotions-Team Concept- Elements of Teamwork- Stages of Team Formation- Effective Team-Team Player Styles-Leadership.

Campus to Company- Dressing and Grooming- The Corporate Fit- Business Etiquette- Communication; media etiquette- Group Discussions, Interviews, and Presentation Skills.

Interview Handling skills- Effective Resume-- Common Interview Mistakes- Body-language- Content Aid, Visual Aids- Entrepreneurial Skills Development.

Reading:

1. Robert M. Sherfield, Developing Soft Skills, Montgomery and Moody Fourth Edn. Pearson, 2009.
2. K.Alex, Soft Skills: Know Yourself & Know The world, S. Chand; 2009.
3. Robert Bramson, Coping with Difficult People, Dell, 2009

CE440	BUILDING TECHNOLOGY	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Apply basic principles to develop stable, sustainable and cost-effective building plans.
CO2	Identify effective measures for fire proofing, damp proofing, and thermal insulation.
CO3	Adopt standard building provisions for natural ventilation and lighting.
CO4	Identify different materials, quality and methods of fabrication & construction.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	2	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	3	-

Detailed Syllabus:

Overview of the course, basic definitions, Buildings – Types, components, economy and design, Principles of planning of buildings and their importance.

Definitions and importance of Grouping and circulation; Lighting and ventilation; How to consider these aspects during planning of building

Termite proofing: Inspection, control measures and precautions, Lighting protection of buildings: General principles of design of openings, Various types of fire protection measures to be considered while planning a building.

General requirements and extra requirements for safety against fire, special precautions, Vertical transportation in building – types of vertical transportation, Stairs, different forms of stairs, planning of stair cases, Other modes of vertical transportation – lifts, ramps, escalators.

Prefabrication systems in residential buildings – walls, openings, cupboards, shelves etc., planning and modules and sizes of components in prefabrication.

Planning and designing of residential buildings against the earthquake forces, Principles, Seismic forces and their effect on buildings.

Air conditioning – process and classification of air conditioning, Dehumidification. Systems of air-conditioning, ventilation, functional requirements of ventilation.

Acoustics, effect of noise, properties of noise and its measurements, Principles of acoustics of building. Sound insulation – importance and measures.

Plumbing services – water supply system, maintenance of building pipe line, Sanitary fittings, principles governing design of building drainage.

Reading:

1. Building Construction - Varghese, PHI Learning Private Limited, 2008

2. Building Construction - Punmia, B C, Jain, A J and Jain A J, Laxmi Publications, 2005.

3. Building Construction by S.P. Arora and S.P. Bindra – Dhanpatrai and Sons, New Delhi, 1996.

4. Building Construction – Technical Teachers Training Institute, Madras, Tata McGraw Hill, 1992.

5. National Building code of India, Bureau of Indian Standards, 2005.

EE 440	NEW VENTURE CREATION	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the process and practice of entrepreneurship and new venture creation
CO2	Understand conceptual frameworks for identifying entrepreneurial opportunities and for preparation of business plan
CO3	Explore opportunities for launching a new venture
CO4	Identify functional management issues of running a new venture

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	-	-	-	-	-	-	-	-	3	-

Detailed syllabus:

ENTREPRENEUR AND ENTREPRENEURSHIP:
Entrepreneurship and Small Scale Enterprises (SSE) – Role in Economic Development, Entrepreneurial Competencies, Institution Interface for SSE.

ESTABLISHING THE SMALL SCALE ENTERPRISE:
Opportunity Scanning and Identification, Market Assessment for SSE, Choice of Technology and Selection of Site, Financing the New/Small Enterprises, Preparation of the Business Plan, Ownership Structures and Organizational Framework.

OPERATING THE SMALL SCALE ENTERPRISES:
Financial Management Issues in SSE, Operational Management Issues in SSE, Marketing Management Issues in SSE, Organizational Relations in SSE.

Reading:

1. Kuratko: New Venture Management : The Entrepreneur's Roadmap, Pearson Education India, 2008.
2. Holt, "Entrepreneurship: New Venture Creation", PHI(P), Ltd.,2001.
3. Lisa K. Gundry, Jill R. Kickul: Entrepreneurship Strategy: Changing Patterns in New Venture Creation, Growth, and Reinvention, Sage Publications, 2007.

ME440	ALTERNATIVE SOURCES OF ENERGY	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify renewable energy sources and their utilization.
CO2	Understand basic concepts of solar radiation and analyze solar thermal systems for its utilization.
CO3	Understand working of solar cells and its modern manufacturing technologies.
CO4	Understand concepts of Fuel cells and their applications
CO5	Identify methods of energy storage.
CO6	Compare energy utilization from wind energy, geothermal energy, biomass, biogas and hydrogen.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	2	3
CO4	-	-	-	-	-	-	-	-	2	-	-	3
CO5	2	-	-	-	-	-	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	2	-	-	3

Detailed Syllabus:

Introduction: Overview of the course; Examination and Evaluation patterns; Global warming; Introduction to Renewable Energy Technologies

Energy Storage: Introduction; Necessity of Energy Storage; Energy Storage Methods

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data

Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems

Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems

Fuel cells: Overview; Classification of fuel cells; operating principles; Fuel cell thermodynamics

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles

Reading:

1. Sukhatme S.P. and J.K.Nayak, Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.
2. Khan B.H., Non-Conventional Energy Resources,Tata McGraw Hill, New Delhi, 2006.
3. J.A. Duffie and W.A. Beckman, Solar Energy - Thermal Pro

EC440	ELECTRONIC MEASUREMENTS AND INSTRUMENTAION	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, student will be able to:

CO1	Apply knowledge of instruments for effective use
CO2	Select suitable instruments for typical measurements.
CO3	Identify various transducers to measure strain, temperature and displacement.
CO4	Understand data acquisition system and general purpose interfacing bus.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	2	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	2	-	-	-	-	-

Detailed syllabus:

Measurement And Error: Sensitivity, Resolution, Accuracy and precision, Absolute and Relative types of errors, Statistical analysis, Probability of and Limiting errors, Linearity.

Instruments: D'Arsonval movement and basic principles of Measurement of Voltage, Current and Resistance in instruments. Analog and Digital Multimeters, Measurement of time and Frequency – Digital Frequency Meter and applications.

Impedance Measurement: Kelvin Bridge; Megger; Maxwell, Hay and Shering Bridges. Q-meter; Noise and Interference reduction techniques in Measurement Systems.

Oscilloscopes: Block diagram, probes, Deflection amplifier and delay line, Trigger Generator, Coupling, Automatic Time Base and Dual Trace Oscilloscopes, Pulse Measurements, Delayed Time Base, Analog Storage, Sampling and Digital Storage Oscilloscopes.

Special instruments: Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, FFT Analyzer.

Transducers (Qualitative Treatment Only): Classification and selection of Transducers, Introduction to strain, Load, force, Displacement, Velocity, Acceleration, Pressure and Temperature Measurements.

Introduction to Data Acquisition Systems (DAS): Block Diagram, Specifications and various components of DAS.

General purpose Instrumentation Bus (GP-IB): Protocol, SCPI Commands and Applications to DSO and DMM.

Reading:

1. Oliver and Cage, Electronic Measurements and Instrumentation, McGraw Hill, 2009
2. Helfrick Albert D. and Cooper William D., Electronic Instrumentation & Measurement Techniques, PHI, 2008.
3. D.A. Bell, Electronic Instrumentation and Measurements, 3/e, Oxford, 2013.

MM440	MATERIALS FOR ENGINEERING APPLICATIONS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Correlate processing, microstructure and properties of materials.
CO2	Understand behaviour of materials under various conditions.
CO3	Characterize modes of failure of engineering materials and design new materials with better properties and cost effective processes.
CO4	Identify suitable materials for engineering applications.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	2	-	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Materials Science and Engineering Materials, Classification of Materials and Properties: Mechanical, Dielectric, Magnetic and Thermal

Metallurgical Aspects of Materials: Structure of Metals and Alloys, Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals, Significance of microstructural features

Heat Treatment: effect of cooling and heating rates and ageing materials for mechanical load bearing applications

Corrosion Resistant Materials: Some important Metals, Alloys, Ceramics and Polymers

Materials for Electrical Applications: Conductors, Dielectrics, insulators

Materials for Civil Engineering Applications

Materials for Biomedical applications: Steels, Ti and its alloys, Ni-Ti alloys, bioceramics, porous ceramics, bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products.

Reading:

1. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
2. M.F. Ashby: Materials Selection in Mechanical Design, B H, 2005.
3. ASM Publication Vol. 20, Materials Selection and Design, ASM, 1997
4. Pat L. Mangonon: The Principles of Materials Selection and Design, PHI, 1999.

CH440	INDUSTRIAL POLLUTION CONTROL	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Analyze the effects of pollutants on the environment.
CO2	Understand meteorological aspects of air pollution
CO3	Understand air pollution control methods
CO4	Select treatment technologies for water/wastewater/solid waste.
CO5	Design unit operations for pollution control.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	3	-	-	2
CO5	-	2	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

Introduction: Biosphere, hydrological cycle, nutrient cycle, consequences of population growth, pollution of air, water and soil.

Air pollution sources & effects: Classification and properties of air pollutants, emission sources, behavior and fate of air pollutants, effect of air pollution.

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, wind velocity and turbulence, plume behavior, dispersion of air pollutants, estimation of plume rise.

Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, stack sampling, analysis of air pollutants.

Air pollution control methods & equipment: Control methods, source correction methods, cleaning of gaseous effluents, particulate emission control, selection of a particulate collector, control of gaseous emissions, design methods for control equipment.

Water pollution: Water resources, origin of wastewater, types of water pollutants and there effects.

Waste water sampling, Analysis and Treatment: Sampling, methods of analysis, determination of organic matter, determination of inorganic substances, physical characteristics, bacteriological measurement, basic processes of water treatment, primary treatment, secondary treatment, advanced wastewater treatment, recovery of materials from process effluents.

Solid Waste Management: Sources and classification, public health aspects, methods of collection, disposal Methods, potential methods of disposal.

Hazardous Waste Management: Definition and sources, hazardous waste classification, treatment methods, disposal methods.

Reading:

1. Rao C.S. – Environmental Pollution Control Engineering- Wiley Eastern Limited, India, 1993.
2. Noel de Nevers- Air Pollution and Control Engineering- McGraw Hill, 2000.
3. Glynn Henry J. and Gary W. Heinke - Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
4. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
5. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.

CH441	FUEL CELL TECHNOLOGY	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand fuel cell fundamentals.
CO2	Analyze the performance of fuel cell systems.
CO3	Understand construction and operation of fuel cell stack and fuel cell system.
CO4	Apply the modeling techniques for fuel cell systems

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	-	-	-	-	-	-	3	-	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-	3

Detailed syllabus:

Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others.

Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO_2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal , Using renewable fuels for SOFCs

Reading:

1. Gregor Hoogers, Fuel Cell Technology Hand Book, CRC Press, 2003.
2. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.
3. F. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 2013.
4. Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications

CS440	Management Information Systems	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Determine key terminologies and concepts including IT, marketing, management, economics, accounting, finance in the major areas of business.
CO2	Design, develop and implement Information Technology solutions for business problems.
CO3	Analysis of computing systems and telecommunication networks for business information systems.
CO4	Understand ethical issues that occur in business, evaluate alternative courses of actions and evaluate the implications of those actions.
CO5	Plan projects, work in team settings and deliver project outcomes in time.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	2	-	-	3	-
CO5	-	-	-	-	-	-	-	-	3	-	3	-

Detailed syllabus:

Organization and Information Systems, Foundation Concepts, Information Systems in Business, The Components of Information Systems, Competing with Information Technology, Fundamentals of Strategic Advantage, Using Information Technology for Strategic Advantage.

Changing Environment and its impact on Business, Kinds of Information Systems.

Computer Fundamentals, Computer Hardware, Computer Systems: End User and Enterprise Computing, Computer Peripherals: Input, Output, and Storage Technologies, Computer Software, Application Software, System Software, Computer System Management, Data Resource Management, Technical Foundations of Database Management, Managing Data Resources

Telecommunication and Networks, Telecommunications and Networks, The Networked Enterprise, Telecommunications Network Alternatives

System Analysis and Development and Models, Developing Business/IT Strategies, Planning Fundamentals, Implementation Challenges, Developing Business/IT Solutions, Developing Business Systems, Implementing Business Systems

Manufacturing and Service Systems Information systems for Accounting, Finance, Production and Manufacturing, Marketing and HRM functions, Enterprise Resources Planning (ERP), Choice of IT, Nature of IT decision, Managing Information Technology, Managing Global IT,

Security and Ethical Challenges, Security and Ethical Challenges, Security and Ethical, and Societal Challenges of IT, Security Management of Information Technology, Enterprise and Global Management of Information Technology

Reading:

1. Kenneth J Laudon, Jane P. Laudon, *Management Information Systems*, 10th Edition, Pearson/PHI, 2007.
2. W. S. Jawadekar, *Management Information Systems*, 3rd Edition, TMH, 2004.

BT440	BIOSENSORS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand biosensing and transducing techniques
CO2	Understand principles of linking cell components and biological pathways with energy transduction, sensing and detection
CO3	Demonstrate appreciation for the technical limits of performance of biosensor
CO4	Apply principles of engineering to develop bioanalytical devices and design of biosensors

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

General principles: A historical perspective; Signal transduction; Physico-chemical and biological transducers; Sensor types and technologies, Definitions and Concepts Terminology and working vocabulary; Main technical definitions: calibration, selectivity, sensitivity, reproducibility, detection limits, response time.

Physico-chemical transducers: Electrochemical transducers (amperometric, potentiometric, conductimetric); optical transducers (absorption, fluorescence, SPR); Thermal transducers; Piezoelectric transducers.

Biorecognition systems: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Limitations & problems. Immobilization of biomolecules.

Biosensor Engineering: Methods for biosensors fabrication: self-assembled monolayers, screen printing, photolithography, micro-contact printing, MEMS. Engineering concepts for mass production.

Application of modern sensor technologies: Clinical chemistry; Test-strips for glucose monitoring; Urea determination; Implantable sensors for long-term monitoring; Environmental monitoring; Technological process control; Food quality control; Forensic science benefits; Problems & limitations.

Reading:

1. Donald G. Buerk, Biosensors: Theory and Applications, 1st Edition, CRC Press, 2009.
2. Alice Cunningham, Introduction to Bioanalytical Sensors, John Wiley& Sons, 1998.
3. Brian R. Eggins, Chemical Sensors and Biosensors, John Wiley& Sons, 2003.
4.

SM440	HUMAN RESOURCE MANAGEMENT	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand principles, processes and practices of human resource management.
CO2	Apply HR concepts and techniques in strategic planning to improve organizational performance.
CO3	Understand tools to manage HR systems and procedures.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	3	-	2	3	-
CO2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	-	-	-	-	-	-	-	-	-	2	3	-

Detailed Syllabus:

Introduction to Human Resource Management, Objectives, Scope and Significance of HRM, Functions of HRM, Problems and Prospects in HRM, Environmental scanning.

Human Resource Planning, Demand Forecasting Techniques, Supply Forecasting Techniques, Analyzing work and designing jobs, Recruitment and Selection, Interviewing Candidates.

Human Resource Development, Orientation, Training and Development, Management Development, Performance Appraisal and Employee Compensation, Factors Influencing Employee Remuneration and Challenges of Remuneration.

Industrial Relations, Industrial Disputes and Discipline, Managing Ethical Issues in Human Resource Management, Workers Participation in Management, Employee safety and health, Managing Global Human Resources and Trade Unions

International HRM, Future of HRM and Human Resource Information Systems

Reading:

1. Aswathappa, Human Resource Management — TMH., 2010.
2. Garry Dessler and Biju Varkkey ,Human Resource Management, PEA., 2011.
3. Noe & Raymond ,HRM: Gaining a Competitive Advantage, TMH, 2008.
4. Bohlander George W, Snell Scott A, Human Resource Management, Cengage Learning, 2009.

MA440	OPTIMIZATION TECHNIQUES	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Formulate and solve linear Programming Problems
CO2	Determine the optimum solution to constrained and unconstrained
CO3	Apply dynamic programming principle to Linear programming problems.
CO4	Determine the integer solutions to Linear Programming Problems.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Linear Programming: Introduction and formulation of models, Convexity, Simplex method, Big-M method, Two-phase method, Degeneracy, non-existent and unbounded solutions, revised simplex method, duality in LPP, dual simplex method, sensitivity analysis, transportation and assignment problems, traveling salesman problem .

Nonlinear Programming: Introduction and formulation of models, Classical optimization methods, equality and inequality constraints, Lagrange multipliers and Kuhn-Tucker conditions, quadratic forms, quadratic programming problem, Wolfe's method.

Dynamic Programming: Principle of optimality, recursive relations, solution of LPP.

Integer Linear Programming: Gomory's cutting plane method, Branch and bound algorithm, Knapsack problem, linear 0-1 problem.

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S.Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.
3. N.S.Kambo, Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

MA441	OPERATIONS RESEARCH	OPC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Formulate and solve linear programming problems
CO2	Determine optimum solution to transportation problem
CO3	Determine average queue length and waiting times of queuing models.
CO4	Determine optimum inventory and cost in inventory models.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

Detailed Syllabus:

Linear Programming: Formulation and graphical solution of LPP's. The general LPP, slack, surplus and artificial variables. Reduction of a LPP to the standard form. Simplex computational procedure, Big-M method, Two-phase method. Solution in case of unrestricted variables. Dual linear programming problem. Solution of the primal problem from the solution of the dual problems.

Transportation Problems : Balanced and unbalanced Transportation problems. Initial basic feasible solution using N-W corner rule, row minimum method, column minimum, least cost entry method and Vogel's approximation method. Optimal solutions. Degenracy in Transportation problems.

Queueing Theory : Poisson process and exponential distribution. Poisson queues - Model (M/M/1):(∞/FIFO) and its characteristics.

Elements of Inventory Control : Economic lot size problems - Fundamental problems of EOQ. The problem of EOQ with finite rate of replenishment. Problems of EOQ with shortages - production instantaneous, replenishment of the inventory with finite rate. Stochastic problems with uniform demand (discrete case only).

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S. Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.
   N.S.Kambo : Mathematical Programming Tec

PH440	NANOMATERIALS AND TECHNOLOGY	OPC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand synthesis and properties of nanostructured materials.
CO2	Analyze magnetic and electronic properties of quantum dots
CO3	Understand structure, properties and applications of Fullerenes and Carbon nanotubes.
CO4	Understand applications of nanoparticles in nanobiology and nanomedicine

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

General properties of Nano materials : Origin of nanotechnology. Classification of nanomaterials. Fullerene,carbon, Nanotubes (CNT's), Nanoparticles. Physical, Chemical, Electrical, Optical, Magnetic and mechanical properties of nanomaterials.

Fullerenes and Carbon Nanotubes (CNT's): Introduction: Synthesis and purification. Preparation of fullerenes in the condensed phase,Transport, mechanical, physical properties of CNT's.

Investigation and manipulating materials in the Nanoscale: Electron microscope, scanning probe microscopes, optical microscopes for Nanoscience and Technology, X-Ray Diffraction.

SAMs and clusters: Growth process. Patterning monolayers. Types of clusters. Bonding and properties of clusters.

Semi conducting Quantum Dots: Introduction: Synthesis of Quantum Dots. Electronic structure of Nanocrystals, properties.

Nanobiology: Interaction between Biomolecules and Nanoparticle surgaces. Different types of Inorganic materials used for the synthesis of Hybrid Nano-bio assemblies. Nanoprobes for Analytical Applications.

Nanosensors: Nanosensors based on optical properties. Nanosensors based on quantum size effects. Nanobiosensors.

Nanomedicines: Developments of nanomedicines. Nanotechnology in Diagnostic Applications, materials for use in Diagnostic and therapeutic Applications.

Reading:

1. T. Pradeep, Nano: The Essentials; Tata McGraw-Hill, 2008.
2. W.R. Fahrner, Nanotechnology and Nanoelectronics; Springer,2006.
3. Rechard Booker and Earl Boysen, Nanotechnology, Willey, 2006.

PH441	BIOMATERIALS AND TECHNOLOGY	OPC	3–0–0	3 Credits

Prerequisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the structure and properties of biomaterials
CO2	Classify implant biomaterials
CO3	Evaluate biocompatibility of implants
CO4	Identify appropriate biomaterials for specific medical applications

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	3

Detailed Syllabus:

Overview of biomaterials: Historical developments, impact of biomaterials, interfacial phenomena, tissue responses to implants.

Structure and properties of biomaterials: Crystal structure of solids, phase changes, imperfections in solids, non-crystalline solids, surface properties of solids, mechanical properties, surface improvements.

Types of biomaterials: Metallic implant materials, ceramic implant materials, polymeric implant materials composites as biomaterials.

Characterization of materials: Electric properties, optical properties, X-ray absorption, acoustic and ultrasonic properties.

Bio implantation materials: Materials in ophthalmology, orthopedic implants, dental materials and cardiovascular implant materials.

Tissue response to implants : Normal wound healing processes, body response to implants, blood compatibility, structure – property relationship of tissues.

Reading:

1. Joon Park, R.S. Lakes , Biomaterials an introduction; 3rd Ed., Springer, 2007
2. Sujatha V Bhat , Biomaterials; 2nd Ed., Narosa Publishing House, 2006.

CY440	CORROSION SCIENCE	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the electrochemical Principles of Corrosion.
CO2	Apply eight forms of corrosion to industrial problems.
CO3	Evaluate corrosion rates for industrial problems
CO4	Evaluate the corrosion rates of steel in RCC under corrosive environments.
CO5	Perform case studies using microbially induced corrosion of metals.
CO6	Perform case studies using appropriate methods of corrosion control of metals and alloys

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	2	-	-	-
CO5	2	-	-	-	-	-	-	-	3	-	-	-
CO6	2	-	-	-	-	-	-	-	2	-	-	-

Detailed Syllabus:

Understanding Corrosion:

Types of corrosion: uniform corrosion, Galvanic corrosion, pitting corrosion, stress corrosion cracking, corrosion fatigue, stray current corrosion, selective leaching, microbial corrosion Pourbaix potential-pH diagrams for iron, for aluminium, limitations of Pourbaix diagram Passivity-characteristics of passivation and the Flade potential, Theories of passivity, passive-active cells, critical pitting potential, Anodic protection and transpassivity.

Methods of corrosion monitoring:

Polarisation and corrosion rates, polarisation diagrams of corroding metals, calculation of corrosion rates from polarization data. Electrochemical impedance spectroscopy: Nyquist plots, Bode plots, simple equivalent circuits for fitting the impedance data, calculation of corrosion parameters from impedance measurements. Electrochemical cell assembly for polarization and impedance studies. Gravimetric method of determination of corrosion rates.

Measurement of corrosion rates of carbon steel in reinforced cement concrete, Corrosion rates of metals due to micriobially induced corrosion .

Methods of corrosion prevention and control:

Cathodic protection; By impressed current, By the use of sacrificial anodes, combined use with coatings, Advances in cathodic protection.

Metallic coatings: Methods of application, Electroplating, Electroless plating, specific metal platings like Cu, Ni and Cr.

Inhibitors and passivators: Picking inhibitors, vapour phase inhibitors, Inhibitors for cooling water systems, understanding of action of inhibitors through polarization and impedance.

Corrosion prevention and control strategies in different industries – case studies

Reading:

1. R. Winston Revie, Herbert H. Uhlig, Corrosion and Corrosion control, 4th edition, Wiley-Interscience, 2007
2. Mc Cafferty and Edward, Introduction to Corrosion Science, 1st Edition, Springer, 2010.
3. Mars G. Fontana, Corrosion Engineering, 3rd edition, Tata McGraw- Hill, New Delhi, 2008.

CY441	CHEMISTRY OF NANOMATERIALS	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the state of art synthesis of nano materials
CO2	Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
CO3	Analyze nanoscale structure in metals, polymers and ceramics
CO4	Analyze structure-property relationship in coarser scale structures
CO5	Understand structures of carbon nano tubes.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	-	-	-	-	-	2	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	2

Detailed Syllabus:

Introduction: Scope of Nano science and nanotechnology, Nano science in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods: Chemical Routes (Bottom-Up approach):- Sol-gel synthesis, micro emulsions or reverse micelles, solvothermal synthesis, microwave heating synthesis and sonochemical synthesis. Physical methods (Top-Down approach):- Inert gas condensation, plasma arc technique, ion sputtering, Laser ablation, laser pyrolysis, and chemical vapour deposition method.

Techniques for characterization:

Diffraction Technique: - Powder X-ray diffraction for particle size analysis.

Spectroscopy Techniques: - Operational principle and applications of spectroscopy techniques for the analysis of nanomaterials, UV-VIS spectrophotometers and its application for band gap measurement.

Electron Microscopy Techniques:- Scanning electron microscopy (SEM) and EDAX analysis, transmission electron microscopy (TEM), scanning probe microscopy (SPM).

BET method for surface area determination.

Dynamic light scattering technique for particle size analysis.

Reading:

1. T. Pradeep, NANO: The Essentials: McGraw-Hill, 2007.
2. B. S. Murty, P. Shankar, Baldev Rai, BB Rath and James Murday, Textbook of Nanoscience and nanotechnology: Univ. Press, 2012.

3. Guozhong Cao, Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Imperial College Press, 2007.
4. M.A. Shah and Tokeer Ahmad, Principles of Nanoscience and Nanotechnology: Narosa Pub., 2010.
5. Manasi Karkare, Nanotechnology: Fundamentals and Applications: IK International, 2008.
6. C. N. R. Rao, Achim Muller, K.Cheetham, Nanomaterials Chemistry, Wiley-VCH, 2007

HS440	CORPORATE COMMUNICATION	OPC	3–0–0	3 Credits

Pre-requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand corporate communication culture
CO2	Prepare business letters, memos and reports
CO3	Communicate effectively in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Practice corporate email, mobile and telephone etiquette
CO6	Develop good listening skills and leadership qualities

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	-	3	-	-
CO3	-	-	-	-	-	-	-	2	-	3	-	-
CO4	-	-	-	-	-	-	-	3	-	2	-	-
CO5	-	-	-	-	-	-	-	2	-	3	-	-
CO6	-	-	-	-	-	-	-	2	-	3	-	-

Detailed Syllabus:

Importance of Corporate communication - Introduction to and definition of corporates – Communication, process, patterns and channels of communication- Barriers to communication and strategies to overcome them- Evolution of corporate culture- Role and contribution of individual group and organization - Role of psychology in communication.

Oral Communication- Techniques for improving oral fluency-Speech mechanics-Group Dynamics and Group Discussion – Debate and oral presentations.

Written Communication- Types and purposes- Writing business reports, and business proposals- Memos, minutes of meetings- Circulars, persuasive letters- Letters of complaint- ; language and formats used for drafting different forms of communication. Internal and external communication.

Corporate responsibility- Circulating to employees vision and mission statements- ethical practices- Human rights -Labour rights-Environment- governance- Moral and ethical debates surrounding - Public Relations - Building trust with stakeholders.

Corporate Ethics and Business Etiquette- Integrity in communication-Harmful practices and communication breakdown- Teaching how to deal with tough clients through soft skills. Body language- Grooming- Introducing oneself- Use of polite language- Avoiding grapevine and card pushing – Etiquette in e-mail, mobile and telephone.

Listening Skills - Listening- for information and content- Kinds of listening- Factors affecting listening and techniques to overcome them- retention of facts, data and figures- Role of speaker in listening.

Leadership Communication Styles - Business leadership -Aspects of leadership-qualities of leader-training for leadership-delegation of powers and ways to do it-humour-commitment.

Reading:

1. Raymond V. Lesikar, John D. Pettit, Marie E. Flatley Lesikar's Basic Business Communication - 7th Edition: Irwin, 1993
3. Krishna Mohanand Meera Banerji, Developing Communication Skills: Macmillan Publishers India, 2000
4. R.C. Sharma & Krishna Mohan Business Correspondence and Report Writing: – 3rd Edition Tata McGraw-Hill, 2008
4. Antony Jay & Ross Jay, Effective Presentation, University Press, 1999.
5. Shirley Taylor, Communication for Business, Longman, 1999