Bachelor of Technology

(Electronics & Communication Engineering)

Scheme & Syllabus
(I Sem. to VIII Sem.)
w.e.f. 2018-19

Department of Electronics & Communication Engg.
Guru Jambheshwar University of Sc. & Tech.
HISAR- 125001 (HARYANA)

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Chairperson, ECE

Guru Jambheshwar University of Science and Technology
Curriculum for First Year
Undergraduate Degree Courses in Engineering & Technology
(w. e. f. session 2018-19)

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:-

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical(Lab)/week	1 credit

B. Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Structure of Undergraduate Engineering program:-

For all semesters

S. No.	Category	Suggested Breakup of Credits(Total 160)
1	Humanities and Social Sciences including Management courses	12*
2	Basic Science courses	25*
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	24*
4	Professional core courses	48*
5	Professional Elective courses relevant to chosen specialization/branch	18*
6	Open subjects – Electives from other technical and /or emerging subjects	18*
7	Project work, seminar and internship in industry or elsewhere	15*
8	Mandatory Courses [Induction training, Environmental Sciences, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
	Total	160*

**Minor variation is allowed as per need of the respective disciplines.*

For First year

S. No.	Category	Credits
1	Humanities and Social Sciences courses	03
2	Basic Science courses	19
3	Engineering Science courses	16
4	Mandatory Courses	00
	Total	38

D. Credit distribution in the First year of Undergraduate Engineering Program:

	Lecture (L)	**Tutorial (T)**	**Laboratory/Practical (P)**	**Total credits (C)**
Physics	3	1	3	5.5
Chemistry	3	1	3	5.5
Maths-I	3	1	0	4
Maths -II	3	1	0	4
Programming for Problem solving	3	0	4	5
English	2	0	2	3
Engineering Graphics & Design	1	0	4	3
Workshop/Manufacturing Practices	1	0	4	3
Basic Electrical Engg.	3	1	2	5
Total				38

E. Course code and definition:-

Course code	**Definitions**
L	Lecture
T	Tutorial
P	Practical
C	credits
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
MC	Mandatory courses

F. Category of Courses:-

BASIC SCIENCE COURSES

(FIRST YEAR)

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
2	BSC101	Physics	3	1	3	5.5
1	BSC102	Chemistry	3	1	3	5.5
3	BSC103/105	Maths –I	3	1	0	4
4	BSC104/106	Maths –II	3	1	0	4

ENGINEERING SCIENCE COURSES

(FIRST YEAR)

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	ESC101	Basic Electrical Engineering	3	1	2	5
2	ESC102	Engineering Graphics & Design	1	0	4	3
3	ESC103	Programming for Problem Solving	3	0	4	5
4	ESC104	Workshop/Manufacturing Practices	1	0	4	3

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

(FIRST YEAR)

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	HSMC101	English	2	0	2	3

MANDATORY COURSES

(FIRST YEAR)

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	MC 101	Induction Training	0	0	3	0.0
2	MC102	Environmental Sciences	3	0	0	0.0
3	MC103	Indian Constitution	3	0	0	0.0

G. Structure of curriculum

Mandatory Induction Training

(3 weeks duration)

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Scheme (First year)

Common to all branches of UG Engineering & Technology

Semester I

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses	BSC101	Physics (Group A)	3	1	3	5.5
		BSC 102	Chemistry (Group B)	3	1	3	
2	Basic Science Courses	BSC103 BSC105	Maths –I Maths –I (for CSE/IT)	3	1	0	4.0
3	Engineering Science Courses	ESC101	Basic Electrical Engineering (Group A)	3	1	2	5.0
		ESC103	Programming for Problem Solving (Group B)	3	0	4	
4	Engineering Science Courses	ESC104	Workshop/Manufacturing Practices (Group A)	1	0	4	3.0
		ESC102	Engineering Graphics & Design (Group B)	1	0	4	
5	Mandatory Courses	MC 101	Induction Training (Group A & B)	3 weeks			0.0
Total							17.5

Semester II

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses	BSC101	Physics (Group B)	3	1	3	5.5
		BSC 102	Chemistry (Group A)	3	1	3	
2	Basic Science Courses	BSC104 BSC106	Maths –II Maths –II (for CSE/IT)	3	1	0	4.0
3	Engineering Science Courses	ESC101	Basic Electrical Engineering(Group B)	3	1	2	5.0
		ESC103	Programming for Problem Solving(Group A)	3	0	4	
4	Engineering Science Courses	ESC104	Workshop/Manufacturing Practices (Group B)	1	0	4	3.0
		ESC102	Engineering Graphics & Design (Group A)	1	0	4	
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3.0
6	Mandatory Courses	MC102	Environmental Sciences (Group A)	3	0	0	0.0
		MC103	Indian Constitution (Group B)	3	0	0	
Total							20.5

Group	Disciplines
A	• Electronics and Communication Engineering • Electrical Engineering • Electrical and Electronics Engineering • Printing Technology • Packaging Technology • Printing and Packaging Technology • Mechanical Engineering • Agricultural Engineering • Aeronautical Engineering • Automobile Engineering
B	• Computer Science and Engineering • Information Technology • Biomedical Engineering • Food Technology • Civil Engineering

Note:

1. *The following disciplines have been shifted **from Group B to Group A** w.e.f. session 2018-19*
   - *Electrical Engineering*
   - *Electrical and Electronics Engineering*
2. *The following mandatory courses (non-credit) will be offered in semesters as shown below :*

Induction Training	*1st Semester (Group A & Group B)*
Environmental Sciences	*2nd Semester (Group A)* *3rd Semester (Group B)*
Indian Constitution	*2nd Semester (Group B)* *3rd Semester (Group A)*
Essence of Indian Traditional Knowledge	*4th Semester (Group A)* *5th Semester (Group B)*

Curriculum Contents (First year)

Course code		BSC102				
Category		Basic Science Course				
Course title		**Chemistry (Theory & Lab.)** **Contents** (i) Chemistry (Concepts in chemistry for engineering) (ii) Chemistry Laboratory				
Scheme and Credits		**L**	**T**	**P**	**Credits**	
		3	**1**	**3**	**5.5**	
Pre-requisites (if any)		-				
Course Assessment Methods (Internal: 30; External: 70)	**Theory**	Internal Examination: • Two minor tests each of 20 marks • Class Performance measured through percentage of lectures attended (4 marks) • Assignments, quiz etc. (6 marks) End semester examination: • Nine questions are to be set by the examiner. • Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. • Rest of the eight questions is to be set with a fair weightage of all the units. • All questions will carry equal marks. • The Students will be required to attempt 05 questions in all.				
Course Assessment Methods (Internal: 30; External: 70)	**Lab.**	• Internal practical evaluation is to be done by the course coordinator. • The end semester practical examination will be conducted jointly by external and internal examiners.				

(i)Chemistry (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

Detailed contents

(i) Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and

its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibrium (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The

course will enable the student to:

- Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalize bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalize periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

(ii)Chemistry Laboratory [L : 0; T:0 ; P : 3 (1.5 credits)]

Choice of 10-12 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg .

Laboratory Outcomes

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

<table>
<tr><td colspan="2">Course code</td><td colspan="5">BSC101</td></tr>
<tr><td colspan="2">Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td colspan="2">Course title</td><td colspan="5">Physics (Theory & Lab.)</td></tr>
<tr><td colspan="2" rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>3</td><td>5.5</td></tr>
<tr><td colspan="2"></td><td colspan="5"><u>Course contents in Physics</u>
(i) Introduction to Electromagnetic Theory (for Mechanical Engineering, Agricultural Engineering, Aeronautical Engineering, Automobile Engineering)
(ii) Introduction to Mechanics (for Civil Engineering, Food Technology)
(iii) Introduction to Quantum Mechanics for Engineers
(iv) Oscillation, Waves and Optics (for Electrical Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering, Printing Technology, Packaging Technology)
(v) Semiconductor Physics (for Commuter Science and Engineering, Information Technology)</td></tr>
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(i)Introduction to Electromagnetic Theory[L : 3; T:1; P : 0 (4 credits)]

Pre-requisites (if any)	Mathematics course with vector calculus

Detailed contents:

Module 1: Electrostatics in vacuum (8 lectures)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal

conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module 2: Electrostatics in a linear dielectric medium (4 lectures)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magnetostatics (6 lectures)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module 4: Magnetostatics in a linear magnetic medium (3 lectures)

Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and feromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module 5: Faraday's law (4 lectures)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (5 lectures)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module 7: Electromagnetic waves (8 lectures)

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Suggested Text Books

(i) David Griffiths, Introduction to Electrodynamics

Suggested Reference Books:

(i) Halliday and Resnick, Physics

(ii) W. Saslow, Electricity, magnetism and light

Course Outcomes

- Solve and formulate various problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media with simple geometries using separation of variables and the method of images.
- derive expressions for the energy both for the electrostatic and magnetostatic fields, and derive Poyntings theorem from Maxwells equations and interpret the terms in the theorem physically
- Describe and make calculations of plane electromagnetic waves in homogeneous media, including reflection of such waves in plane boundaries between homogeneous media.

❖ **Laboratory - Introduction to Electromagnetic Theory[L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- LC circuit and LCR circuit;
- Resonance phenomena in LCR circuits
- Magnetic field from Helmholtz coil
- Measurement of Lorentz force in a vacuum tube
- To determine the Wavelength of a given laser by Diffraction Grating.
- To find the frequency of A.C. mains by using sonometer.
- To find the low resistance by carey - Foster's bridge.
- To study the characteristics of a solar cell.
- To find the value of e/m for electrons by Helical method.
- To find the value of co-efficient of self-inductance by using a Rayleigh bridge.
- To find the value of Hall Co-efficient of semi-conductor.
- To study the V-I characteristics of a p-n diode.
- To find the band gap of intrinsic semi-conductor using four probe method.
- To calculate the hysteresis loss by tracing a B-H curve.
- Electron Spin Resonance Spectrometer

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(ii)Introduction to Mechanics[L : 3; T:1; P : 0 (4 credits)]

Pre-requisites (if any)	High-school education

Detailed contents:

Module 1: (8 lectures)

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

Module 2: (7 lectures)

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

Module 3: (5 lectures)

Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

Module 4: (6 lectures)

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Module 5: (5 lectures)

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

Module 6: (7 lectures)

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Suggested Reference Books

(i) Engineering Mechanics, 2nd ed. — MK Harbola
(ii) Introduction to Mechanics — MK Verma
(iii) An Introduction to Mechanics — D Kleppner & R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Griffiths

(v)Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii)Mechanical Vibrations — JP Den Hartog
(viii)Theory of Vibrations with Applications — WT Thomson

Course Outcomes

- Know about Forces in nature and constraints. Afterwards they would be able to solve simple mechanics problems related to laws of motion and co-ordination system.
- Derive expression for potential energy, central forces and harmonic oscillator (Damped and Un-damped) along with idea of planetary motion given by Kepler.
- Describe rigid body motion in one dimension to three dimensions with various examples of rigid body motion as well as numerical problem related to rigid body rotation.

❖ **Laboratory - Introduction to Mechanics [L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- Experiments on an air-track;
- Experiment on moment of inertia measurement,
- Experiments with gyroscope;
- Resonance phenomena in mechanical oscillators.
- To find the wavelength of sodium light by Newton' ring
- To determine the specific rotation of a cane sugar solution with the help of Polarimeter.
- To determine the height of an Object/Line with the help of a sextant..
- To study the moment of inertia of fly wheel
- To find the frequency of A.C. mains by using sonometer.
- To study the characteristics of a solar cell
- To study the characteristics of (Cu-Fe, Cu-Constant) thermo couple.
- To study the V-I characteristics of a p-n diode.
- To calculate the hysteresis loss by tracing a B-H curve.
- Measurement of Susceptibility of Solids by Gouy's Method
- To Determine the Variation of Magnetic Field Along the Axis of a Circular Coil Carrying Current and Calculate the Radius of the coil.
- To Study The Gaussian Beam Pattern Spot Size and The Angle of Divergence of Laser Beam.

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(iii)Introduction to Quantum Mechanics for Engineers [L : 3; T:1; P : 0 (4 credits)]

Pre-requisites (if any)	Mathematics course on differential equations and linear algebra

Detailed contents :

Module 1: Wave nature of particles and the Schrodinger equation (8 lectures)
Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wavefunction, Born interpretation, probability current, Expectation values, Free-particle wavefunction and wave-packets, Uncertainty principle.

Module 2: Mathematical Preliminaries for quantum mechanics (4 lectures)
Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators, Hermite polynomials, Legendre's equation, spherical harmonics.

Module 3: Applying the Schrodinger equation (15 lectures)
Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator.Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials Scattering from a potential barrier and tunneling; related examples like alpha-decay, field-ionization and scanning tunneling microscope
Three-dimensional problems: particle in three dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field, spin Numerical solution stationary-state radial Schrodinger equation for spherically symmetric potentials.

Module 4: Introduction to molecular bonding (4 lectures)
Particle in double delta-function potential, Molecules (hydrogen molecule, valence bond and molecular orbitals picture), singlet/triplet states, chemical bonding, hybridization

Module 5: Introduction to solids (7 lectures)
Free electron theory of metals, Fermi level, density of states, Application to white dwarfs and neutron stars, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands
Numerical solution for energy in one-dimensional periodic lattice by mixing plane waves.

Suggested Text Books
(ii) Eisberg and Resnick, Introduction to Quantum Physics

Suggested Reference Books
(i) D. J. Griffiths, Quantum mechanics
(ii) Richard Robinett, Quantum Mechanics
(iii) Daniel McQuarrie, Quantum Chemistry

Course Outcomes
- Develop an informed appreciation of the paradigm shift already in evidence in technologies behind modern services and products

- solve one-dimensional problems involving transmission, reflection and tunnelling of quantum probability amplitudes;
- demonstrate an understanding of the significance of operators and eigenvalue problems in quantum mechanics
- Pursue PG courses, research programs and industrial R & D programs in nanotechnologies
- Pursue simulation and modeling of systems encountered in nanotechnologies having basic knowledge of physics.

❖ **Laboratory - Introduction to Quantum Mechanics for Engineers [L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- To find the value of Plank's constant by using a photoelectric cell.
- To determine the Wavelength of a given laser by Diffraction Grating.
- To study the Photoelectric effect
- Study of Zener Diode characteristics
- Dispersive Power of Material of Prism
- Atomic Spectra of Two Electron Systems
- To study the characteristics of a solar cell
- To find the value of e/m for electrons by Helical method.
- To find the ionisation potential of Argon/Mercury using a thyratron tube.
- To find the value of Hall Co-efficient of semi-conductor.
- To study the V-I characteristics of a p-n diode.
- To study two probe method.
- Electron spin Resonance
- To find the band gap of intrinsic semi-conductor using four probe method.
- To find the ionisation potential of Argon/Mercury using a thyratron tube.
- Measurement of Lande 'g' factor by Electron Spin Resonance Spectrometer

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(iv) Oscillations, waves and optics[L : 3; T:1; P : 0 (4 credits)]

Pre-requisites (if any)	(i) Mathematics course on Differential equations (ii) Introduction to Electromagnetic theory

Detailed contents:

Module 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7 lectures)

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Module 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion (7 lectures)

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module 3: The propagation of light and geometric optics (10 lectures)

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

Module 4: Wave optics (6 lectures)

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 5: Lasers (8)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Reference Books

(i) Ian G. Main, Oscillations and waves in physics
(ii) H.J. Pain, The physics of vibrations and waves
(iii)E. Hecht, Optics
(iv)A. Ghatak, Optics
(v)O. Svelto, Principles of Lasers

Course Outcomes

- Analyse oscillations and waves mathematically.
- Solve simple problems of geometric optics.
- Predict diffraction and interference patterns.
- Operate small telescopes and record images.
- Different type of laser and lasing action with application of laser in various fields

❖ **Laboratory - Oscillations, waves and optics [L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- To find the wavelength of sodium light by Newton' ring
- To find the resolving power of telescope.
- Find the velocity of ultrasonic waves in non-conducting medium by piezo-electric method.
- To study the moment of inertia of fly wheel
- Bending of beam by Koening method
- Maxwell Needle Apparatus
- Strokes law experiment
- Electron Spin Resonance Spectrometer.
- Finding frequency of A.C. mains by using sonometer
- To determine the specific rotation of a cane sugar solution with the help of Polarimeter
- To determine the wave length of He-Ne Laser with the help of a single slit.
- To determine the Wavelength of a given laser by Diffraction Grating.
- To Study The Gaussian Beam Pattern Spot Size and The Angle of Divergence of Laser Beam
- To Study Faraday Effect and Calculate the Verdict Constant of given sample.
- Measurement of Dependence of Hall Coefficient on Temperatures

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(V) Semiconductor Physics [L : 3; T:1; P : 0 (4 credits)]

Pre-requisites (if any)	Introduction to Quantum Mechanics

Module 1: Electronic materials **(8)**
Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.

Module 2: Semiconductors **(10)**
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

Module 3: Light-semiconductor interaction **(6)**
Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

Module 4: Measurements **(6)**
Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.

Module 5: Engineered semiconductor materials **(6)**
Density of states in 2D, 1d and 0D (qualitatively). Practical examples of low-dimensional systems such as quantum wells, wires, and dots: design, fabrication, and characterization techniques. Heterojunctions and associated band-diagrams

References:
1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
7. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL

❖ **Laboratory - Semiconductor Physics [L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- To find the value of Plank's constant by using a photoelectric cell.
- To determine the Wavelength of a given laser by Diffraction Grating.
- Two Probe Method for Measurement of Resistivity of Insulators at Different Temperatures.
- Measurement of Susceptibility of Solids by Gouy's Method
- To compare the capacitances of two capacitors by De'sauty bridge and hence to find the dielectric constant of a medium.
- To find the frequency of A.C. mains by using sonometer.
- To find the low resistance by carey - Foster's bridge.
- To study the characteristics of a solar cell.
- To find the value of Hall Co-efficient of a semi-conductor.
- To study the V-I characteristics of a p-n diode.
- To find the band gap of intrinsic semi-conductor using four probe method.
- To calculate the hysteresis loss by tracing a B-H curve.
- Measurement of Magnetoresistance of Semiconductors
- Study of Dielectric Constant and Curie Temperature of Ferroelectric Ceramic.
- To Determine the Variation of Magnetic Field Along the Axis of a Circular Coil Carrying Current and Calculate the Radius of the coil.
- To Study The Gaussian Beam Pattern Spot Size and The Angle of Divergence of Laser Beam
- To Study Faraday Effect and Calculate the Verdict Constant of given sample

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Course code	BSC103				
Category	Basic Science Course				
Course title	**Maths -I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Pre-requisites (if any)	-				
Course Assessment Methods (Internal: 30; External: 70)	Internal examination: • Two minor tests each of 20 marks • Class Performance measured through percentage of lectures attended (4 marks) • Assignments, quiz etc. (6 marks) End semester examination: • Nine questions are to be set by the examiner. • Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. • Rest of the eight questions is to be set with a fair weightage of all the units. • All questions will carry equal marks. • The Students will be required to attempt 05 questions in all.				

(i)Calculus and Linear Algebra

Detailed contents:

Module 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric,

skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(iii) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
(iv) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
(v) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
(vi) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
(vii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

The students will learn:

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

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Course code	**BSC104**				
Category	**Basic Science Course**				
Course title	**Maths-II** **(Calculus, Ordinary Differential Equations and Complex Variable)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Pre-requisites (if any)	-				
Course Assessment Methods (Internal: 30; External: 70)	Internal examination: • Two minor tests each of 20 marks • Class Performance measured through percentage of lectures attended (4 marks) • Assignments, quiz etc. (6 marks) End semester examination: • Nine questions are to be set by the examiner. • Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. • Rest of the eight questions is to be set with a fair weightage of all the units. • All questions will carry equal marks. • The Students will be required to attempt 05 questions in all.				

Calculus, Ordinary Differential Equations and Complex Variable

Detailed contents

Module 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding

harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(iii) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

(iv) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

(v) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

(vi) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

(vii) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

(viii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

(ix) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

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Course code	**BSC105**				
Category	**Basic Science Course**				
Course title	**Maths-I (for Computer Science & Engg. /Information Technology students)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Pre-requisites (if any)	**-**				
Course Assessment Methods (Internal: 30; External: 70)	Internal examination: • Two minor tests each of 20 marks • Class Performance measured through percentage of lectures attended (4 marks) • Assignments, quiz etc. (6 marks) End semester examination: • Nine questions are to be set by the examiner. • Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. • Rest of the eight questions is to be set with a fair weightage of all the units. • All questions will carry equal marks. • The Students will be required to attempt 05 questions in all.				

Paper-I Calculus and Linear Algebra

Detailed contents :

Module 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 lectures)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Matrices (in case vector spaces is to be taught) (8 lectures)

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

Module 4: Vector spaces (Prerequisite Module 3-Matrices) (10 hours)

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.

Module 5: Vector spaces (Prerequisite Module 3 –Matrices & Module-4 Vector spaces) (10 lectures)

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

(ii) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(iii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

(iv) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

(v) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

(vi) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

(vii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

(viii) V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

The students will learn:

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from various applications, they will have a basic understanding of Beta and Gamma functions.
- The essential tools of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.

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Course code	**BSC106**				
Category	**Basic Science Course**				
Course title	**Maths-II (for Computer Science & Engg./Information Technology Students)** **Probability and Statistics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Pre-requisites (if any)	-				
Course Assessment Methods (Internal: 30; External: 70)	Internal examination: • Two minor tests each of 20 marks • Class Performance measured through percentage of lectures attended (4 marks) • Assignments, quiz etc. (6 marks) End semester examination: • Nine questions are to be set by the examiner. • Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. • Rest of the eight questions is to be set with a fair weightage of all the units. • All questions will carry equal marks. • The Students will be required to attempt 05 questions in all.				

Paper -II: Probability and Statistics

Detailed contents

Module 1: Basic Probability: *(12 lectures)*
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions: *(4 lectures)*
Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: *(4 lectures)*
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics: (8 lectures)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Module 5: Applied Statistics: (8 lectures)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Module 6: Small samples: (4 lectures)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Suggested Text/Reference Books

(i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(ii) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

(iii) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

(iv) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

(v) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

(vi) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

(vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

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<table>
<tr><td colspan="2">Course code</td><td colspan="5">ESC103</td></tr>
<tr><td colspan="2">Category</td><td colspan="5">Engineering Science Course</td></tr>
<tr><td colspan="2">Course title</td><td colspan="5">Programming for Problem Solving (Theory & Lab.)</td></tr>
<tr><td colspan="2" rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">The lab component should have one hour of tutorial followed or preceded by laboratory assignments.</td></tr>
<tr><td>3</td><td>0</td><td>4</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisites (if any)</td><td colspan="5">-</td></tr>
<tr><td>Course Assessment Methods (Internal: 30; External: 70)</td><td>Theory</td><td colspan="5">Internal Examination:
Two minor tests each of 20 marks
Class Performance measured through percentage of lectures attended (4 marks)
Assignments, quiz etc. (6 marks)
End semester examination:
Nine questions are to be set by the examiner.
Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.
Rest of the eight questions is to be set with a fair weightage of all the units.
All questions will carry equal marks.
The Students will be required to attempt 05 questions in all.</td></tr>
<tr><td>Course Assessment Methods (Internal: 30; External: 70)</td><td>Lab.</td><td colspan="5">Internal practical evaluation is to be done by the course coordinator.
The end semester practical examination will be conducted jointly by external and internal examiners.</td></tr>
</table>

(i)Programming for Problem Solving **([L : 3; T:0; P : 0 (3 credits)] [contact hrs : 40]**

Detailed contents

Unit 1

Introduction to Programming **(4 lectures)**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Unit 2

Arithmetic expressions and precedence **(2 lectures)**

Conditional Branching and Loops **(6 lectures)**

Writing and evaluation of conditionals and consequent branching **(3 lectures)**

Iteration and loops **(3 lectures)**

Unit 3
Arrays **(6 lectures)**
Arrays (1-D, 2-D), Character arrays and Strings

Unit 4
Basic Algorithms **(6 lectures)**
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit 5
Function **(5 lectures)**
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Unit 6
Recursion **(4 -5 lectures)**
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7
Structure **(4 lectures)**
Structures, Defining structures and Array of Structures

Unit 8
Pointers **(2 lectures)**
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9
File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books
(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books
(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes
The student will learn
- To formulate simple algorithms for arithmetic and logical problems.

- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

(ii) Laboratory - Programming for Problem Solving [L : 0; T:0 ; P : 4 (2credits)]

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self referential structures.
- To be able to create, read and write to and from simple text files.

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Course code	**HSMC 101**				
Category	**Humanities and Social Sciences including Management courses**				
Course title	**English**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	2	**0**	**2**	**3**	
Pre-requisites (if any)	**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Internal examination:** • **Two minor tests each of 20 marks** • **Class Performance measured through percentage of lectures attended (4 marks)** • **Assignments, quiz etc. (6 marks)** **End semester examination:** • **Nine questions are to be set by the examiner.** • **Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.** • **Rest of the eight questions is to be set with a fair weightage of all the units.** • **All questions will carry equal marks.** • **The Students will be required to attempt 05 questions in all.**				

English **([L : 2; T:0; P : 2 (3 credits)]**

Detailed contents

1. Vocabulary Building

The concept of Word Formation
Root words from foreign languages and their use in English
Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
Synonyms, antonyms, and standard abbreviations.

2. Basic Writing Skills

Sentence Structures
Use of phrases and clauses in sentences
Importance of proper punctuation
Creating coherence
Organizing principles of paragraphs in documents
Techniques for writing precisely

3. Identifying Common Errors in Writing

Subject-verb agreement
Noun-pronoun agreement
Misplaced modifiers
Articles
Prepositions

Redundancies
Clichés

4. Nature and Style of sensible Writing

Describing
Defining
Classifying
Providing examples or evidence
Writing introduction and conclusion

5. Writing Practices

Comprehension
Précis Writing
Essay Writing

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:

(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. Macmillan.2007
(iii)*On Writing Well.* William Zinsser. Harper Resource Book. 2001
(iv)*Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) *Communication Skills.* Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(vi)*Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

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Course code		**ESC 102**				
Category		**Engineering Science Courses**				
Course title		**Engineering Graphics & Design (Lab.)**				
Scheme and Credits		**L**	**T**	**P**	**Credits**	***Only end semester practical examination will be conducted for this course.***
		1	**0**	**4**	**3**	
Pre-requisites (if any)		**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Lab.**	• **Internal practical evaluation is to be done by the course coordinator.** • **The end semester practical examination will be conducted jointly by external and internal examiners by taking viva-voce and written Examination on drawing sheet. Question paper for written examination will be based on the entire syllabus and to be set by external and internal examiners both.**				

Engineering Graphics & Design [A total of 10 lecture hours & 60 hours of lab.]

[[L : 1; T:0; P : 4 (3 credits)]

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module 1: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections covering,

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids covering,

those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower,

etc.

Module 4:Sections and Sectional Views of Right Angular Solids covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Module 5: Isometric Projections **covering,**
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphics covering,
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customization & CAD Drawing
Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Annotations, layering & other functions covering
Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Module 9: Demonstration of a simple team design project *that illustrates*
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling;

Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

(iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

(iv) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

(v) (Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes

All phases of manufacturing or construction require the conversion of new ideas and design concepts

into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

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Course code		**ESC 104**				
Category		**Engineering Science Courses**				
Course title		**Workshop/Manufacturing Practices (Theory & Lab.)**				
Scheme and Credits		**L**	**T**	**P**	**Credits**	
		1	**0**	**4**	**3**	
Pre-requisites (if any)		**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Theory**	**Internal Examination:** • **Two minor tests each of 20 marks** • **Class Performance measured through percentage of lectures attended (4 marks)** • **Assignments, quiz etc. (6 marks)** **End semester examination:** • **Nine questions are to be set by the examiner.** • **Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.** • **Rest of the eight questions is to be set with a fair weightage of all the units.** • **All questions will carry equal marks.** • **The Students will be required to attempt 05 questions in all.**				
Course Assessment Methods (Internal: 30; External: 70)	**Lab.**	• **Internal practical evaluation is to be done by the course coordinator.** • **The end semester practical examination will be conducted jointly by external and internal examiners.** • ***01 hour of the lab will be for delivering course contents through lectures & videos***				

Workshop/Manufacturing Practices **[L : 1; T:0; P : 0 (1 credit)]**

Lectures & videos: (10 hours)

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Electrical & Electronics **(1 lecture)**
5. Carpentry **(1 lecture)**
6. Plastic moulding, glass cutting **(1 lecture)**
7. Metal casting **(1 lecture)**
8. Welding (arc welding & gas welding), brazing **(1 lecture)**

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers

private limited, Mumbai.
(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
(iii) Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
(iv) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
(v) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:(60 hours) [L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop **(10 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(6 hours)**
4. Electrical & Electronics**(8 hours)**
5. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**
6. Casting **(8 hours)**
7. Smithy **(6 hours)**
8. Plastic moulding & Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

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Course code		**ESC 101**				
Category		**Engineering Science Course**				
Course title		**Basic Electrical Engineering (Theory & Lab.)**				
Scheme and Credits		**L**	**T**	**P**	**Credits**	
		3	**1**	**2**	**5**	
Pre-requisites (if any)		**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Theory**	**Internal Examination:** • **Two minor tests each of 20 marks** • **Class Performance measured through percentage of lectures attended (4 marks)** • **Assignments, quiz etc. (6 marks)** **End semester examination:** • **Nine questions are to be set by the examiner.** • **Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.** • **Rest of the eight questions is to be set with a fair weightage of all the units.** • **All questions will carry equal marks.** • **The Students will be required to attempt 05 questions in all.**				
Course Assessment Methods (Internal: 30; External: 70)	**Lab.**	• **Internal practical evaluation is to be done by the course coordinator.** • **The end semester practical examination will be conducted jointly by external and internal examiners.**				

(i)Basic Electrical Engineering [L : 3; T:1; P : 0 (4 credits)]

Detailed contents :

Module 1 : DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

(i) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
(ii) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
(iii) L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press,2011.
(iv) E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
(v) V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

(ii)Basic Electrical Engineering Laboratory [L : 0; T:0 ; P : 2 (1 credit)]

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.

- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters.

MANDATORY COURSES

offered for

B. Tech. Programmes (2018 – Scheme)

Approved by faculty (Engg & Tech) for implementation w.e.f 2018 batch onwards
18/7/19

Course code	**MC102**				
Category	**Mandatory Courses**				
Course title	**Environmental Sciences**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**0**	**0**	**0.0**	
Pre-requisites (if any)	**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Internal examination:** • **Two minor tests each of 20 marks** • **Class Performance measured through percentage of lectures attended (4 marks)** • **Assignments, quiz etc. (6 marks)** **End semester examination:** • **Nine questions are to be set by the examiner.** • **Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.** • **Rest of the eight questions is to be set with a fair weightage of all the units.** • **All questions will carry equal marks.** • **The Students will be required to attempt 05 questions in all.**				

Course Outcomes

1. Students will be able to enhance and analyze human impacts on the environment.
2. Integrate concepts & methods from multiple discipline and apply to environmental problems.
3. Design and evaluate strategic terminologies and methods for subs table management of environmental systems.
4. Field studies would provide students first-hand knowledge on various local environment aspects which forms an irreplaceable tool in the entire learning process.

Course Contents

UNIT-I

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem ,Ecological succession ,Food chains, Food webs and ecological pyramids; Introduction, types, characteristics features, structure and function of Forest ecosystem, Grassland ecosystem ,Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries); Biodiversity: Introduction, Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values; Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-II

Renewable and non-renewable resources, Natural resources and associated problems ,Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their

effects on forests and tribal people; Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, main induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

UNIT-III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies; different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness

UNIT-IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problem and concern, case studies; Environment ethics: Issues and possible solutions; Wasteland reclamation; Consumerism and waste products; Human Population growth, variation among nation, Population explosion- Family Welfare Programme, Environment and human health , Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Books:

1. Fundamental concepts in Environmental studies by Dr. D.D. Mishra. S. Chand publications.
2. Essentials of Ecology and Environmental Science by Dr. S .V .S. Rana, PHI Learning Pvt. Ltd, Delhi
3. Environmental Chemistry by Anil Kumar De, Wiley Eastern Limited.
4. Environmental Science by T.G. Miller, Wadsworth Publishing Co, 13th edition.
5. Ecology and Environment by P. D. Sharma, Rastogi publications

Course code	**MC103**				
Category	**Mandatory Courses**				
Course title	**Indian Constitution**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**0**	**0**	**0.0**	
Pre-requisites (if any)	**-**				
Course Assessment Methods (Internal: 30; External: 70)	**Internal examination:** • **Two minor tests each of 20 marks** • **Class Performance measured through percentage of lectures attended (4 marks)** • **Assignments, quiz etc. (6 marks)** **End semester examination:** • **Nine questions are to be set by the examiner.** • **Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions.** • **Rest of the eight questions is to be set with a fair weightage of all the units.** • **All questions will carry equal marks.** • **The Students will be required to attempt 05 questions in all.**				

Course Contents- Basic features and fundamental principles

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Group A *(ECE, EE, EEE, PT, PKG, P&P, ME, Agri, Aero, Auto)* : 4th Semester
Group B *(CSE, IT, BME, FT, Civil)* : 5th Semester

General Course Information	
Course Code: MC301-T Course Credit: 0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 2/week, (L-T-P:2-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

About the Course: This course is designed to acquaint students with Indian knowledge traditions It introduces students to Vedic period, Post Vedic period, Sufi and Bhakti Movement in India, the ancient scientists of India and social reform movements of 19th century in India.

Course Outcomes: By the end of the course students will be able to:

- **CO1. Recognize** the forms and sources of Indian traditional knowledge. **(LOTS: Level 1: Remember)**
- CO2. **Identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. **(LOTS: Level 2: Understand)**
- CO3. **Apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society. **(LOTS: Level 3: Apply)**
- **CO4. Differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. **(LOTS: Level 4: Evaluate)**
- **CO5. Suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. **(LOTS: Level 6: Create)**

UNIT-I

Introduction to Indian Tradition Knowledge: Defining traditional knowledge, forms, sources and dissemination of traditional knowledge. **Vedic Period:** Vedas and Upanishads, Yogsutras of Patanjali **Post Vedic Period:** Budhism, Janism and Indian Materialism: Bhartiya Darshan

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UNIT-II

Sufi and Bhakti Movement (14th to 17th century): सगुण-निर्गुण भक्ति, Sufism and Sufi saints, Kabir, Dadu, Soordas, Tulsidas, Nanak and Guru Jambheshwar ji Maharaj etc., Composite Culture of Indian sub-continent.

UNIT-III

Jyotirao Phule, Savitri Bai Phule, Arvind, Vivekanand and other 18th & 19th Century Social Reform Movements; India's cultural heritage.

UNIT-IV

India's Contribution to the world of knowledge:प्राचीन भारत के महान वैज्ञानिक: बौधायन, चरक, कौमारभृत्यजीवन, सुश्रुत, आर्यभट, बराहमिहिर, ब्रह्मगुप्त, नागार्जुन, वाग्भट; Astrology and Astronomy, Myths and Reality

Text and Reference Books:

1. A. L. Bhansam, The *Wonder That was India, A Survey of the Culture of the, Indian Sub-Continent before, the Coming of the Muslims*, Vol 1, Groove Press, New York, 1959.
2. S. A. A. Rizvi, *Wonder That was India, A Survey of the History and Culture of the Indian Sub-Continent from the Coming of the Muslims to the British Conquest 1*200-1700, Vol 2, Rupa and Co. 2001.
3. Jambhvani Mool Sanjivini Vyakhya
4. *प्रतियोगितादर्पणअतिरिक्तांकसीरीज–5*भारतीयकलाएवंसंस्कृति,
5. गुणाकरमूले, *प्राचीनभारतकेमहानवैज्ञानिक,* ज्ञानविज्ञानप्रकाशन, नईदिल्ली, 1990.
6. B. V. Subbarayappa, *A Historical Perspective of Science in India*, Rupa Publications, New Delhi, 2013.
7. KR Bishnoi, NR Bishnoi, Religion and Environment, Vol 1,2 & 3
8. ThichNhat Hanh, Nguyen Thi Hop, MobiHo ,*Old Path White Clouds: Walking in the Footsteps of the Buddha*, Parallax Press, 1991.
9. Hermann Hesse, *Siddhartha*, Simon & Brown, 2017.
10. सावित्रीचंद्रशोभा, *हिन्दीभक्तिसाहित्यमेंसामाजिकमूल्यएवंसहिष्णुतावाद,* नेशनलबुकट्रस्ट, इंडिया, 2007.
11. Rosalind O' Hanlon, *Caste Conflict and Ideology, Mahatma JyotiraoPhule and low caste protest in nineteen century*, Western India, Camridge University Press, 2009.
12. Melanie P. Kumar, SavitribaiPhule: *Forgotten liberator*, Infochange, 2009.
13. Leah Verghese, Ranjna, and MedhaSundar, *Savitribai, Journey of a Trailblazer*, Azim Prem Ji University, 2014.

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CO-PO Articulation Matrix Essence of Indian Traditional Knowledge (MC301-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Recognise** the forms and sources of Indian traditional knowledge. (LOTS: Level 1: Remember)	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2. **Identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. (LOTS: Level 2: Understand)	-	2	1	-	-	3	-	-	-	-	-	1	-	-	-
CO3. **Apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society. (LOTS: Level 3: Apply)	-	3	3	2	-	3	-	-	-	-	-	3	-	-	-
CO4. **Differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. (LOTS: Level 4: Evaluate)	-	2	3	3	-	3	1	-	-	-	-	3	-	-	-
CO5. **Suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. (LOTS: Level 6: Create)	-	3	3	3	-	3	-	-	-	-	-	3	-	-	-
Level of Attainments MC301-T															

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

Group A *(ECE, EE, EEE, PT, PKG, P&P, ME, Agri, Aero, Auto)* **: 5th Semester**
Group B *(CSE, IT, BME, FT, Civil)* **: 6th Semester**

General Course Information	
Course Code: HSMC302-T Course Credit: 2	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 2/week, (L-T-P:2-0-0)	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and
Mode: Lectures Examination Duration: 3 Hours	based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** fundamental concepts of management **(LOTS: Level 1: Remember)**
CO2. **Explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership. **(LOTS: Level 2: Understand)**
CO3. Apply the managerial skills to solve real world management problems. **(LOTS: Level 3: Apply)**
CO4. **Identify** leadership roles in various scenarios. **(HOTS: Level 4: Analyse)**
CO5. Evaluate a business model based on principles of management. **(HOTS: Level 5: Evaluate)**
CO6. Prepare a plan for a start up in IT sector. **(HOTS: Level 6: Create)**

Course Content

UNIT-I

Management Definition:Scope and process of management, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management, Evolution of Management, Scientific and Administrative Management, The Behavioural approach, The Quantitative approach, The Systems Approach, Contingency Approach, IT Approach.

UNIT-II

Planning and Decision Making: General Framework for Planning, Planning Process, Types of plans, Management by objectives, Development of business strategy.

Decision making and Problem Solving: Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making, Bounded Rationality and Influences on Decision Making, Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT-III

OrganizationHRM and Controls: Organizational Design & Organizational Structures, Delegation, Empowerment, Centralization, Decentralization, Organizational culture, Organizational climate and Organizational change, Talent management, Talent management Models and strategic human Resource planning; Recruitment and selection; Training and development, Performance Appraisal. Types of controls and controlling Techniques.

UNIT-IV

Leading and Motivation: Leadership, Power and authority, Leadership styles; Behavioural leadership, Situational leadership, Leadership skills, Leader as mentor and coach, Leadership during adversity and crisis; Handling employee and customer complaints, Team leadership. Motivation: Types of motivation, Relationship between motivation, performance and engagement, Content motivational theories.

Text and Reference Books:

1. Robert N Lussier, *Management Fundamentals*, 5th edition, Cengage Learning, 2013.
2. Stephen P. Robbins, *Fundamentals of Management*, Pearson Education, 2009.
3. WeihrichKoontz, *Essentials of Management*, fifth edition, Tata Mc Graw Hill, 1990.
4. DubrinAndrew, *Management Essentials*, 9th edition, Cengage Learning, 2012.

CO-PO Articulation Matrix Fundamentals of Management for Engineers Course (HSMC302-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** fundamental concepts of management (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO2. **Explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO3. **Apply** the managerial skills to solve real world management problems. (LOTS: Level 3: Apply)	2		1	–	–	–	–	–	–	–	–	–	–	–	–
CO4. **Identify** leadership roles in various scenarios. (HOTS: Level 4: Analyse).	–	–	–	–	–	–	–	3	3	–	–	–	–	–	–
CO5. **Evaluate** business model based on principles of management.	2	3	2		–	–	–	–	–	–	–	2	–	–	–
CO6. **Prepare** a plan for start-up in IT sector	3	3	3	2	–	3	–	–	–	3	3	–	–	–	–

ECONOMICS FOR ENGINEERS

Group A *(ECE, EE, EEE, PT, PKG, P&P, ME, Agri, Aero, Auto)* **: 6th Semester**
Group B *(CSE, IT, BME, FT, Civil)* **: 5th Semester**

General Course Information	
Course Code: HSMC301-T Course Credit: 2	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 2/week, (L-T-P:2-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

About the Course: This course is designed to provide the elementary and essential knowledge of economics relevant to their profession as engineers. The graduating engineers will learn about the basic principles of economics and cost benefit analysis for various economic alternatives. The course also gives an initial exposure to issues and challenges for sustainable development.

Course Outcomes: By the end of the course students will be able to:

- **CO1.** Outline the principles of economics in general and economics in Indian context. **(LOTS: Level 1: Remember)**
- CO2. Discuss concepts related to economics in general and particularly relevant to Indian scenario. **(LOTS: Level 2: Understand)**
- **CO3.** Apply the principles of economics for solving problems related to Engineering sector. **(LOTS: Level 3: Apply)**
- **CO4.** Carry out cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives. **(HOTS: Level 4: Analyse)**
- **CO5.** Judge the issues and challenges of sustainable development. **(HOTS: Level 5: Evaluate)**

UNIT-I

Definition of Economics- various definitions, Nature of economic problem, Production possibility curve, Economics laws and their nature. Relation betweenScience, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical applications and importance.

UNIT-II

Meaning of Demand, Individual and Market demand schedules, Law of demand, shape of demand curve, Elasticity of Demand, measurement of elasticity of demand, factors affecting elasticity of demand, practical importance and applications of the concept of elasticity of demand.

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

UNIT-III

Various concepts of cost- Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run both.

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets) Issues, Strategies and challenges for sustainable development for developing economies

UNIT-IV

Elements of Business/Managerial Economics and forms of organizations, Cost & Cost ControlTechniques, Types of Costs, Lifecycle Costs, Budgets, Break Even Analysis, Capital Budgeting, Application of linear Programming. Investment Analysis- NPV, ROI, IRR, Payback Period, Depreciation, Time Value of Money (present and future worth of cash flows).

Business Forecasting- Elementary techniques. Statements- Cash Flows, Financial. Case Study Method. Nature and Characteristics of Indian Economy (brief and elementary introduction). Privatization - meaning, merits, and demerits. Globalisation of Indian economy- merits and demerits. WTO and TRIPs agreements.

Text and Reference Books:

1. Alfred William Stonier, D. C. Hague, *A text book of Economic Theory*, 5th edition, Longman Higher Education, 1980.
2. K. K. Dewett, M. H. Navalur, *ModemEconornicTheory*, S. Chand, 2006.
3. H. L. Ahuja, *Modern Microeconomic: Theory and Applications*, S. Chand, 2017.
4. N. Gregory Mankiw, *Principlesof Economics*, 7th edition, South-Western College Publishing, 2013.
5. RuddarDutt& K.P.M. Sundhram, *IndianEconomy*, S. Chand, 2004.
6. V. Mote, S. Paul, G. Gupta, Managerial Economics, McGraw Hill Education, 2017.
7. SarojPareek,TextbookofBusiness Economics, Neha Publishers and Distributors, 2013.
8. William McDonough and Michael Braungart, *Cradle to Cradle Remaking the Way We Make Things*, North Point Press, New York, 2002.
9. Sustainable Development Challenges, World Economic and Social Survey, United Nations Publication, 2013.

CO-PO Articulation Matrix Economics for Engineers (HSMC301-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. Outline the principles of economics in general and economics in Indian context particularly for public sector agencies and private sector businesses. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2. Discuss concepts related to economics in general and particularly relevant to Indian scenario. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3. Apply the principles of economics for solving problems related to Engineering sector. (LOTS: Level 3: Apply)	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4. carry out benefit/cost, life cycle and breakeven analyses on one or more economic alternatives. (HOTS: Level 4: Analyse)	3	2	2	3	3	-	-	-	2	-	-	3	-	-	-
CO5. Judge the issues and challenges of sustainable development. (HOTS: Level 4: Evaluate)	3	-	3	3	-	-	3	-		3	3	3	-	-	-

Bachelor of Technology

(Electronics & Communication Engineering)

Scheme & Syllabus

(2nd year to 4th year)

w.e.f.

2018-19

Department of Electronics & Communication Engg.
Guru Jambheshwar University of Sc. & Tech.
HISAR- 125001
HARYANA

Semester wise credit Assigned									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total Credits**
HSMC	9.5	9.5	3						22
BSC		3			2	2			7
ESC	8	8	7		6				29
PCC			12	17	10	12	13		64
PEC					3	3	3		9
OEC						3	4	10	17
PROJ							4	6	10
INT					1		1		2
MC									
Total Credits	17.5	20.5	22	17	22	20	25	16	160

Subject Area	Abbreviation
Humanities and Social Sciences including Management courses	HSMC
Basic Science Courses	BSC
Engineering Science Courses	ESC
Professional Core Courses	PCC
Professional Elective Courses	PEC
Open Elective Courses	OEC
Project Work	PROJ
Pratical Training	INT
Mandatory Courses	MC

B.Tech., ECE - Total Credits	
Semester	Credits
1	17.5
2	20.5
3	22
4	17
5	22
6	20
7	25
8	16
Total	160

B.Tech. , ECE, Semester-3							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
BSC201-T	Mathematics-III	3	0	0	3	3	3
PCC-ECE201-T	Signals & Systems	3	0	0	3	3	3
PCC-ECE203-T	Digital Electronics	3	0	0	3	3	3
PCC-ECE205-T	Analog Electronics- I	3	0	0	3	3	3
ESC-ECE207-T	Network Analysis and Synthesis	3	0	0	3	3	3
ESC-ME202-T	Elements of Mechanical Engineering	3	0	0	3	3	3
PCC-ECE203-P	Digital Electronics Lab	0	0	2	2	1	3
PCC-ECE205-P	Analog Electronics- I Lab	0	0	4	4	2	3
ESC-ECE207-P	Network Analysis and Synthesis Lab	0	0	2	2	1	3
*MC103-T	Indian Constitution	3	0	0	3	0	3
Total		21	0	8	29	22	

*MC-Mandatory Course, which will be a non-credit course and the student has to get pass marks in order to qualify for the award of degree.

Note: Students will be allowed to use the scientific calculator only.

B.Tech. , ECE, Semester-4							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
PCC-ECE202-T	Electronic Measurements & Instrumentation	3	0	0	3	3	3
PCC-ECE204-T	Analog and Digital Communication	3	0	0	3	3	3
PCC-ECE206-T	Analog Electronics II	3	0	0	3	3	3
PCC-ECE208-T	Electromagnetic Theory	3	0	0	3	3	3
PCC-ECE202-P	Electronic Measurements & Instrumentation Lab	0	0	4	4	2	3
PCC-ECE204-P	Analog & Digital Communication Lab	0	0	2	2	1	3
PCC-ECE206-P	Analog Electronics -II Lab	0	0	4	4	2	3
*MC104-T	Essence of Indian Traditional knowledge	3	0	0	3	0	3
Total		15	0	10	25	17	

Note: The students will have to undergo Practical Training -I of 4 to 6 weeks duration during summer vacations which will be evaluated in 5th sem.

*MC-Mandatory Course which will be a non-credit course and the student has to get pass marks in order to qualify for the award of degree.

Note: Students will be allowed to use the scientific calculator only.

B.Tech. , ECE, Semester-5							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
HSMC302-T	Fundamentals of Management for Engineers	2	0	0	2	2	3
PCC-ECE301-T	Microwave Engg.	3	0	0	3	3	3
PCC-ECE303-T	Embedded System Design	3	0	0	3	3	3
ESC-ECE307-T	Data Structure & Applications	3	0	0	3	3	3
ESC-ECE309-T	Control System Engg.	3	0	0	3	3	3
Open Elective Course-I		3	0	0	3	3	3
PCC-ECE301-P	Microwave Engg. Lab	0	0	2	2	1	3
PCC-ECE303-P	Embedded System Design Lab	0	0	4	4	2	3
PCC-ECE305-P	Skills & Innovation Lab	0	0	2	2	1	3
*INT-ECE311-P	Practical Training-I Presentation	0	0	2	2	1	3
Total		17	0	10	27	22	

*Assessment of Practical Training-I will be based on presentation/seminar, viva-voce, report and certificate for the practical training taken at the end of 4th semester.

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Open Elective Course-I is to be offered by Departments other than ECE.

Note: Students will be allowed to use the scientific calculator only.

B.Tech. , ECE, Semester-6							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
HSMC301-T	Economics for Engineers	2	0	0	2	2	3
PCC-ECE302-T	Computer Networks and IOT	3	0	0	3	3	3
PCC-ECE304-T	VLSI Design	3	0	0	3	3	3
PCC-ECE306-T	Linear Integrated Circuits & Applications	3	0	0	3	3	3
Program Elective Course-I		3	0	0	3	3	3
Open Elective Course-II		3	0	0	3	3	3
PCC-ECE302-P	Computer Networks and IOT Lab	0	0	2	2	1	3
PCC-ECE304-P	VLSI Design LAB	0	0	2	2	1	3
PCC-ECE306-P	Linear Integrated Circuits & Applications Lab	0	0	2	2	1	3
Total		17	0	6	23	20	

Note: The students will have to undergo Practical Training -II of 4 to 6 weeks duration during summer vacations which will be evaluated in 7th sem.

Open Elective Course-II is to be offered by Departments other than ECE.

Note: Students will be allowed to use the scientific calculator only.

B.Tech. , ECE, Semester-7							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
PCC-ECE401-T	Digital Signal Processing	3	0	0	3	3	3
PCC-ECE403-T	Wireless communication	3	0	0	3	3	3
PCC-ECE405-T	Digital System Design	3	0	0	3	3	3
Open Elective Course-III		3	0	0	3	3	3
Program Elective Course-II		3	0	0	3	3	3
PCC-ECE401-P	Digital Signal Processing Lab	0	0	4	4	2	3
PCC-ECE405-P	Digital System Design lab	0	0	4	4	2	3
Program Elective Course-II Lab		0	0	2	2	1	3
*PROJ-ECE413-P	Minor Project	0	0	8	8	4	3
**INT-ECE415-P	Practical Training-II Presentation	0	0	2	2	1	3
***MC-ECE417-P	General Proficiency	0	0	0	0	0	3
Total		15	0	20	35	25	

Open Elective Course-III is to be offered by Departments other than ECE.

* The minor project will be completed and evaluated at the end of the 7th semester on the basis of its implementation, presentation, viva-voce and report.

** Assessment of Practical Training-II will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of 6th sem.

*** A viva of the students will be taken by external examiner and Chairperson of the Department(Internal Examiner) at the end of the semester.

***MC-Mandatory Course which will be a non-credit course and the student has to get pass marks in order to qualify for the award of degree.

Note: Students will be allowed to use the scientific calculator only.

B.Tech. , ECE, Semester-8							
Course Code	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
		L	**T**	**P**			
Program Elective Course-III		3	0	0	3	3	3
Program Elective Course-IV		3	0	0	3	3	3
Program Elective Course-V		3	0	0	3	3	3
Program Elective Course-IV Lab		0	0	2	2	1	3
*PROJ-ECE428-P	Major Project	0	0	12	12	6	3
Total		9	0	14	23	16	

* The major project will be completed and evaluated at the end of the 8th semester on the basis of its implementation, presentation, viva-voce and report.

Note: Students will be allowed to use the scientific calculator only.

Program Elective Courses

(The detailed syllabus of program elective subjects in appended in the end)

B.Tech. , ECE, Program Elective Course-1	
Course Code	**Course Name**
PEC-ECE308-T	Consumer & Industrial Electronics
PEC-ECE310-T	Information Theory & Coding
PEC-ECE312-T	Advanced Instrumentation and Control
PEC-ECE314-T	Satellite Communication
PEC-ECE316-T	Computer Architecture & Organization
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

B.Tech. , ECE, Program Elective Course-2	
Course Code	**Course Name**
PEC-ECE407-T	FPGA Design
PEC-ECE409-T	Antenna & Wave Propagation
PEC-ECE411-T	Artifical Intelligence & Machine Learning
PEC-ECE407-P	FPGA Design Lab
PEC-ECE409-P	Antenna & Wave Propagation Lab
PEC-ECE411-P	Artifical Intelligence & Machine Learning Lab

B.Tech. , ECE, Program Elective Course-3	
Course Code	**Course Name**
PEC-ECE402-T	Power Electronics
PEC-ECE404-T	Database Management System
PEC-ECE406-T	Probability Theory & Stochastic Design
PEC-ECE408-T	Audio & Speech Processing
PEC-ECE410-T	RADAR & SONAR Engg.
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

B.Tech. , ECE, Program Elective Course-4	
Course Code	**Course Name**
PEC-ECE412-T	Robotics
PEC-ECE414-T	Optical communication
PEC-ECE416-T	Operating systems
PEC-ECE412-P	Robotics Lab
PEC-ECE414-P	Optical communication lab
PEC-ECE416-P	Operating systems Lab

B.Tech. , ECE, Program Elective Course-5	
Course Code	**Course Name**
PEC-ECE418-T	Recent Trends in Comm. System
PEC-ECE420-T	VLSI Tech. & Application
PEC-ECE422-T	ARM
PEC-ECE424-T	MEMS & its Application
PEC-ECE426-T	Digital Image processing
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

*The MOOC/SWAYAM/equivalent course proposed/shortlisted by the students will be reviewed and finalised by the departmental committee consisting of Chairperson, Class co-ordinator/Incharge and Subject teacher concerned (to be appointed by Chairperson). The committee will ensure that the course content of this course should not overlap (more than 10%) with subjects already covered in the scheme and syllabus.

Detailed Syllabus
of
B.Tech.(ECE)
3rd Semester

MATHEMATICS-III

General Course Information	
Course Code: BSC201-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** concepts and terminology of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing. **(LOTS: Level 1: Remember)**

CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. **(LOTS: Level 3: Apply)**

CO3. **Apply** mathematical principles to solve computational problems.**(LOTS: Level 3: Apply)**

CO4. **Compare** various probability distributions **(HOTS: Level 4: Analyse)**.

CO5. **Select** suitable hypothesis testing methods for given problems and interpret the respective outcomes. **(HOTS: Level 4: Evaluate)**

CO6. **Integrate** the knowledge of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing for solving real world problems. **(HOTS: Level 6: Create)**

UNIT- I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series.

UNIT-II

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

UNIT-III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity. Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

UNIT-IV

Complex integral, Cauchy Gaursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

Text and Reference Books:

1. F.Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R.K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, Narosa Publishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*,2nd edition, Pearson Education, 2002.
5. Johnson and Miller*Probability and statistics for Engineers*, 8th edition,Pearson Education India, 2015.

CO-PO Articulation Matrix Mathematics-III (BSC201-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** concepts and terminology of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing. (LOTS: Level 1: Remember)	1	--	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO3. **Apply** mathematical principles to solve computational problems. (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2	3
CO4. **Compare** various probability distributions (HOTS: Level 4: Analyse).	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO5. **Select** suitable hypothesis testing methods for given problems and interpret the respective outcomes. (HOTS: Level 4: Evaluate)	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO6. **Integrate** the knowledge of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing for solving real world problems. (HOTS: Level 6: Create)	3	3	2	3	-	-	-	-	-	-	-	-	2	2	3

SIGNALS & SYSTEM
PCC-ECE201-T

Course Credits: 3 Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration: 03 Hours	Course Assessment Methods **(**Internal**:** 30; External**:** 70**)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Physics**,** Maths.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe various signals and their behaviour involved in processing**.**	L1
CO 2	To classify different systems used for signal processing and operation.	L2
CO 3	To demonstrate the conversion of signals in analog domain to digital domain.	L3
CO 4	To formulate any required system according to different types of applications.	H3

Course Contents

UNIT-1

INTRODUCTION TO SIGNALS: Signal definition, classification of signals, basic/singularity continuous and discrete-time signals, basic operations: time shifting, time reversal, time scaling on signals, signal representation in terms of singular functions, correlation of signals and its properties, representation of a continuous-time signal by its samples: the sampling theorem, reconstruction, aliasing.

UNIT-II

SYSTEM & ITS PROPERTIES: system, classification of systems: linear & nonlinear systems; static & dynamic systems, causal & non-causal system, invertible & noninvertible, stable & unstable system, time variant & time invariant systems with examples, linear time-invariant systems: definition and properties, impulse response, convolution sum/integral and its properties, representation of lti systems using differential and difference equations.

UNIT –III

FOURIER SERIES & FOURIER TRANSFORM: Introduction to Frequency domain Representation, Fourier Series Representation of Periodic Signals, Convergence of Fourier Series, Properties of Fourier Series, Fourier Transform for periodic and Aperiodic signals, Convergence of Fourier Transform, Properties of Fourier Transform, Applications of Fourier Transform.

DISCRETE-TIME FOURIER TRANSFORM: Fourier Transform representation for Discrete –Time Aperiodic & Periodic Signals, Properties of Discrete-Time Fourier Transform, Basic Fourier Transform Pairs.

UNIT-IV

Z-TRANSFORM: Introduction to Z-Transform, Region of Convergence (ROC) for Z-Transform, Z-Transform Properties, Inverse Z-Transform, Analysis of LTI Systems Using Z-Transform, Application of z transform, Introduction to Hilbert Transform.

TEXT BOOKS:

1. A. V. Oppenheim, A. S. Willsky, with S. Nawab "Signals & Systems", Prentice –Hall India.
2. Tarun K. Rawat, "Signal & Systems", Oxford University Press.
3. Farooq Husain, "Signals & Systems", Umesh Publications.

REFERENCE BOOKS:

1. S. Salivahanan, A. Vallavraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw Hill.
2. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing, Principles, Algorithms, & Applications", Prentice-Hall India.
3. B. Kumar, "Signals and Systems", New Age International Publishers.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	1	-	-	1	-	1	3	2	2
CO2	3	3	2	1	1	1	2	1	1	1	-	1	3	2	2
CO3	3	3	2	1	1	1	1	1	2	2	-	1	3	3	2
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	3

DIGITAL ELECTRONICS
PCC-ECE203-T

General Information of course

Course Credits: 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes: At the end of the semester, students will be able to:	RBT Level
CO 1	Define the fundamental concepts and techniques used in digital electronics.	L1
CO 2	Understand the minimization techniques to simplify the hardware requirements of digital circuits, implement it, design and apply for real time digital systems.	L2
CO 3	Demonstrate the working mechanism and design guidelines of different combinational, sequential circuits & logic families and their role in the digital system design.	L3
CO 4	Develop the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.	H3

Course Contents

UNIT-I

FUNDAMENTALS OF DIGITAL TECHNIQUES: Digital signal, logic gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Boolean algebra. Review of Number systems.
BINARY CODES: BCD, Excess-3, Gray, EBCDIC, ASCII, Binary arithmetic, Error detection and correction codes.
DIGITAL LOGIC FAMILIES: Switching mode operation of p-n junction, bipolar and MOS devices. Bipolar logic families: RTL, DTL, DCTL, HTL, TTL, ECL, MOS, and CMOS logic families, Tristate logic.

UNIT-II

COMBINATIONAL CIRCUIT DESIGN USING GATES: Circuit design using gates, adder, subtractor, comparator,BCD to seven segment, code converters, Karnaugh map and Quine Mcluskey methods of simplification.
COMBINATIONAL DESIGN USING MSI DEVICES: Multiplexers and Demultiplexers and their use as logic elements, Decoders, Encoders, Adders / Subtractors, BCD arithmetic circuits.

UNIT-III

SEQUENTIAL CIRCUITS: S-R, J-K, T, D, master-slave, edge triggered, flip flop conversions. Shift registers, bidirectional shift register, sequence generators, Ring counters and Johnson Counter, Design of Asynchronous and Synchronous Counters.

FINITE STATE MACHINES: Timing diagrams (synchronous FSMs), Moore versus Mealy, FSM design procedure- State diagram, State-transition table, State minimization, State encoding, Next-state logic minimization, Implement the design.

UNIT-IV

ADC AND DAC: Weighted resistor and R -2 R ladder D/A Converters, specifications for D/A converters. A/D converters: Quantization, parallel -comparator, successive approximation, counting type,dual-slope ADC, specifications of ADCs.

MEMORIES AND PLD'S: ROM, PLA, PAL, FPGA and CPLDs, Implementation of combinational circuits using ROM, PLA and PAL.

TEXT BOOKS:

1. Modern Digital Electronics(Edition III) : R. P. Jain; TMH
2. Digital Fundamentals : Thomas L Floyd, Pearson.
3. Digital circuits and design : S. Salivahanan, Oxford University Press.

REFERENCE BOOKS:

1. Digital Integrated Electronics : Taub & Schilling; MGH
2. Digital Principles and Applications : Malvino & Leach; McGraw Hill.
3. Digital Design : Morris Mano; PHI.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	-	2	1	-	1	3	2	3
CO2	3	3	2	1	1	1	2	-	2	1	-	1	3	2	2
CO3	3	3	2	1	1	1	1	1	2	1	-	1	2	3	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	2	3

ANALOG ELECTRONICS-I
PCC-ECE205-T

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** :Two Minor Tests Each of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Physics

Course Outcomes

Sr. No.	At the end of the semester, students will be able:	RBT Level
CO 1	To describe the characteristics of intrinsic and extrinsic semiconductors.	L1
CO 2	To explain the construction and operation of semiconductor devices.	L2
CO 3	To illustrate the use of semiconductor devices in electronic circuits.	L3
CO 4	To examine the analog circuit parameters and defend the usage of various semiconductor devices in it.	H1

Course Contents

UNIT-1

CONDUCTION IN SEMICONDUCTOR: Conductivity of a semiconductor, Carrier concentration in an intrinsic semiconductor, Fermi level in a Intrinsic and extrinsic semiconductor, Carrier lifetime, Continuity equation, Hall effect.
PN JUNCTIONS: Qualitative theory of PN junctions, PN junction as diode, zener diode, voltage doubler, band structure of an open circuited p-n junction, current components in a PN diode, PN diode Switching times, tunnel diode, rectifier with filter circuits, clippers, clampers.

UNIT-II

BJT : Review of BJT : construction – operation - characteristics, Ebers moll model, BJT as an amplifier and switch, limits of operation, thermal runaway, stability factor, bias stability of self bias-emitter bias- collector to base bias , bias compensation: thermistor and sensistor compensation, Ac and dc load line for a CE amplifier, Transistor hybrid model, h-parameter (CE, CB, CC), analysis of transistor amplifier circuit using h-parameter, simplified CE hybrid model, frequency response of RC coupled amplifier.

UNIT –III

MOSFET: Review of device structure- operation and V-I characteristics of JFETs and MOSFET (depletion and enhancement), MOSFET as a switch and amplifier, FET small signal model, common source amplifier, source follower, biasing the FET, FET as a voltage variable resistor.

UNIT-IV

SPECIAL SEMICONDUCTOR DEVICES: Gun diode, P-I-N diode, Schottky diodes, varactor diode, tunnel diode, photodiode, power diodes, photoconductive cell, IR emitters and receivers, LCD.

REGULATED POWER SUPPLIES: Series and shunt voltage regulators, three terminal fixed IC voltage regulator (78xx/79xx), adjustable voltage regulator (LM 317), SMPS.

TEXT BOOKS:

1. Electronics devices and Circuits(4e): Millman, Halkias and Jit ; McGrawHill
2. Electronics Devices & Circuits: Boylestad & Nashelsky ; Pearson
3. Electronic circuit analysis and design (Second edition): D.A.Neamen; TMH.

REFERENCE BOOKS:

1. Electronics Principles: Malvino ; McGrawHill
2. Electronics Circuits: Donald L. Schilling & Charles Belove ; McGrawHill
3. Microelectronics Circuits, theory and applications:Sedra & Smith;OXFORD

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	2	1	-	1	3	2	3
CO2	3	3	2	1	1	1	2	1	2	2	-	1	3	2	3
CO3	3	3	2	1	1	1	1	1	2	1	-	1	3	2	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	2	3

NETWORK ANALYSIS & SYNTHESIS
ESC-ECE207-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Mathematics, Physics, Electrical Technology

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To relate time domain linear network with equivalent network in frequency domain using transformation technique.	L1
CO 2	To explain graph theory concepts for solving electrical networks.	L2
CO 3	To examine behaviour of electrical network on the basis of its transfer function.	H1
CO 4	To design two port networks for given transfer function.	H3

Course Contents

UNIT I

LAPLACE TRANSFORM: Introduction to Laplace transform & its properties, Laplace transform of special signal waveforms, Inverse Laplace transform, Use of Laplace Transform in solving electrical networks.
TRANSIENT RESPONSE: Initial Conditions of resistive, inductive & capacitive Elements, Time domain analysis of simple linear circuits: Transient & Steady state Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.

UNIT II

NETWORK FUNCTIONS: Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero Locations for driving point functions and transfer functions, Time domain behaviour from the pole-zero plot.
PARAMETERS OF TWO PORT NETWORKS: Relationship of two-port variables, short-circuit Admittance parameters, open circuit impedance parameters, Transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two port networks.

UNIT III

NETWORK SYNTHESIS: Concept & significance of Positive real functions, concept ofnetwork synthesis, driving point immittance function structure of LC network, LC network synthesis using foster and cauer form, driving point immittance function structure of RC & RL network, RC & RL network synthesis by Foster and Cauer form.

UNIT IV

NETWORK GRAPH THEORY: Concept of network graph , terminology used in network graph, relation between Twigs and Links, properties of tree in a graph, formation of incidence Matrix[Ai], number of trees in a graph, Graph matrices: cut-set matrix, tie set matrix, formulation of network equilibrium equations, network analysis using graph theory.
FILTERS: Introduction to filters, Characteristics of filters, Filter Classification, Passive Filters: Analysis & Design of prototype HPF, LPF, BPF, & BSF, introduction to m-derived filters, Active Filters: Introduction of active filters.

TEXT BOOKS:

1. Engineering Network Analysis & Filter Design: G.G Bhise, P.R Chadha, D.C Kulshreshtha;Umesh Publication.
2. Circuit Theory: A Chakrabarty; Dhanpat Rai Publication.
3. Network Analysis: Van Valkenburg; PHI.

REFERENCE BOOKS:

1. Network Analysis & Synthesis: S.P Ghosh; McGraw Hill.
2. Network Analysis & Synthesis: K.M. Soni;S.kKataria& Sons Publication.
3. Network Analysis & Synthesis:F.F.Kuo; John Wiley & Sons Inc.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	1	-	-	1	-	1	3	2	2
CO2	3	3	2	1	1	1	2	1	1	2	-	1	2	3	2
CO3	3	3	2	1	1	1	1	1	2	1	-	1	2	3	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	3

ELEMENTS OF MECHANICAL ENGINEERING
ESC-ME202-T

General Course Information

Course Credits: 3.0 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Sr. No.	Course Outcome At the end of the semester students will be able:	RBT Level
CO1	To define and tell about basic mechanical engineering devices/machines.	**L1**
CO2	To classify and explain elements of mechanical engineering.	**L2**
CO3	To demonstrate the working operations of various basic mechanical engineering devices/machines.	**L3**
CO4	To examine the performance of various basic mechanical engineering devices/machines.	**H1**

Course Contents

UNIT-I

Properties of Steam & Boilers: Introduction, Formation of steam at constant pressure, Thermodynamics properties of steam, Steam boilers, Requirements of a good boiler, Classification of boilers, Constructional and operational details of Cochran and Babcock and Wilcox boilers, Comparison of water and fire tube boilers, mounting and accessories with their functions.

Steam Turbines and Condensers: Working principle of steam turbine, Classification of steam turbines, Comparison of impulse and reaction turbines, Compounding of impulse turbine, Steam condensers: Elements of steam condensing plant, Types of steam condensers, Cooling ponds and cooling towers.

UNIT-II

I.C. Engines: Introduction, Classification, I.C. Engines basic terminology, engine parts and their functions, Constructional details and working of two-stroke and four-stroke diesel and petrol engines, Otto and Diesel cycles, comparison of petrol and diesel engines.

Water Turbines and Pumps: Introduction, Classification of hydraulic turbines, Construction details and working of Pelton, Francis and Kaplan turbines, Classification of water pumps, constructional and working of centrifugal and reciprocating pumps.

UNIT-III

Simple Lifting Machines: Introduction, Basic concepts and definition, reversible and irreversible machines, Laws of machines, Simple wheel and axle, Single and double purchase winch crabs, Simple and differential screw jacks, Problems.
Power Transmission Devices: Introduction, Belt drive, Rope drive, Chain drive, Gear drive, Types of gears, gear trains, Clutches: single plate and multi plate clutches.

UNIT-IV

Stresses and Strains: Introduction, types of Stresses and strains, elastic limit, Hooks law, stress-strain diagram, factor of safety, Poison's ratio, Elastic constants & their relationships, thermal stresses, stress and strains in simple and compound bars under axial loading, Problems.
Shear Force and Bending Moment: Introduction, types of beams, types of loads, SF and BM diagrams for cantilever and simply supported beam. Calculation of maximum SF, BM and point of contra-flexure under the loads of (i) concentrated load (ii) uniformly distributed load (iii) combination of concentrated and uniformly distributed loads, Problems.

Text and Reference Books:

1. Elements of Mechanical Engineering – Mahesh Kumar, I.K. International, 2013
2. Elements of Mechanical Engineering- R.K. Rajput, Laxmi Publication.
3. Basics of Mechanical Engineering - Mridual Singal and R. K. Singal, I K Internation.
4. Basics of Mechanical Engineering- D.S. Kumar, Pub. – Kataria & Sons, New Delhi.
5. Basics of Mechanical Engineering – Sadhu Singh, S.Chand
6. Hydraulic Machines – Jagdish Lal, Pub.- Metropolitan, Allahbad.
7. Thermal Science and Engineering – D.S. Kumar, Pub. – Kataria & Sons, New Delhi.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	-	2	1	-	1	1	1	1
CO2	3	3	2	1	1	1	2	-	2	1	-	1	1	1	2
CO3	3	3	2	1	1	1	1	1	2	1	-	1	1	2	2
CO4	3	3	3	2	2	1	2	1	2	2	-	2	1	2	2

DIGITAL ELECTRONICS LAB
PCC-ECE203-P

Course Credits: 1 Contact Hours: 2/week per group(L-T-P: 0-0-2) Mode: Lab Work	**Course Assessment (Internal: 30; External: 70)**

Course Outcomes:

Sr. No.	At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the various digital IC's and understand their operation.	L1
CO 2	Understand Boolean Laws to simplify the digital circuits.	L2
CO 3	Demonstrate basic combinational circuits and verify their functionalities.	L3
CO 4	Develop the design procedures to design basic sequential circuits.	H3

List of Experiments

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR. Realization of basic gates using Universal logic gates.
2. Design & realize a given function using K-maps and verify its performance.
3. Design and realize adder and subtractor circuits.
4. Design and realize comparator and parity generator circuits.
5. Design and realize 3 bit binary to gray code converter.
6. Implementation of multiplexer/encoder using logic gates.
7. Implementation and verification of Decoder/De-multiplexer.
8. To verify the truth tables of S-R, J-K, T & D type flip flops.
9. Design a 4-bit shift-register and verify its operation.
10. Design, and verify the 4-bit synchronous counter.
11. Design, and verify the 4-bit asynchronous counter.
12. Design, and verify the 4-bit ring counter and twisted ring counter.
13. To design and verify the operation of synchronous decade counter using J K flip-flops.
14. To design and verify the operation of asynchronous decade counter using T flip-flops.
15. Simple project (Any topic related to the scope of the course).

NOTE:
At least eight experiments are to be performed in the semester, out of which atleast six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	-	-	2	1	1	1	1	2
CO2	3	3	2	1	3	1	1	1	2	2	1	1	2	2	2
CO3	3	3	2	1	2	1	1	1	2	2	1	1	3	2	2
CO4	3	3	3	2	3	1	2	2	3	3	3	2	3	3	3

ANALOG ELECTRONICS-I LAB
PCC-ECE205-P

Course Credits: 2 Contact Hours: 4/week (L-T-P: 0-0-4) Mode : Lab Work	**Course Assessment Method : (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To trace the characteristics of semiconductor devices.	L1
CO 2	To identify the various electronic components and differentiate them based upon their characteristics.	L2
CO 3	To demonstrate simple applications of semiconductor devices.	L3
CO 4	To test the electronic component and circuits, and to carry experimentation with them.	H1

List of Experiments

1. To study V-I characteristics of diode.
2. To design and study the characteristics of half wave rectifier with filter circuit.
3. To design and study the characteristics of full wave rectifiers with filter circuit.
4. To study of Zener diode as a voltage regulator.
5. To design clipper circuits and observe their output waveforms.
6. To design the clamper circuits and observe their output waveforms.
7. To design the dc voltage doubler.
8. To study the characteristics of CB configurations of a transistor.
9. To study the characteristics of CE configurations of a transistor.
10. Study of CC amplifier as a buffer.
11. Study of transistor as a constant current source in CE configuration.
12. To study the V-I characteristics of FET in CS configuration.
13. To study the V-I characteristics of FET in CD configuration.
14. To study the frequency response of RC coupled amplifier.
15. To study the 3-terminal IC voltage regulators.
16. Study of IR diode (IR-emitter) and photodiode (IR receiver).
17. Study of opto-coupler (opto-isolator).
18. Simple project (Any topic related to the scope of the course).

Note: Atleast 12 experiments are to be performed in the semester, out of which minimum 8 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	1	2	2	1	1	3	3	3
CO2	3	3	2	1	3	1	2	1	2	2	1	1	3	3	3
CO3	3	3	2	1	2	1	1	1	2	2	1	1	3	3	3
CO4	3	3	3	2	3	1	2	2	3	3	3	2	3	3	3

NETWORK ANALYSIS & SYNTHESIS LAB
ESC-ECE207-P

Course Credits: 1 Contact Hours: 2/week per group (L-T-P: 0-0-2) Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Pre-requisites: Electrical Technology.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To relate theoretical concepts with practical experiments.	L1
CO 2	To apply theoretical concepts related to two-port network parameters on hardware.	L3
CO 3	To examine theoretical concepts related to transient response on hardware.	H1
CO 4	To evaluate and judge performance of various active filters.	H2

List of Experiments

1. To study the step response of series RC circuit.
2. To study the step response of series RL circuit.
3. To study of phenomenon of resonance in RLC series circuit.
4. To calculate and verify "Z" parameters of a two port network.
5. To calculate and verify "Y" parameters of a two port network.
6. To calculate and verify "ABCD" parameters of a two port network.
7. To calculate and verify “H” parameters of a two port network.
8. To determine equivalent parameter of parallel connections of two port network.
9. To plot the frequency responses of low pass filter (LPF) and determine half-power frequency.
10. To plot the frequency responses of high pass filter (HPF) and determine the half-power frequency.
11. To plot the frequency responses of band-pass filters (BPF) and determine the band-width.
12. To synthesize a network of a given network function and verify its response.

Note: At least eight experiments are to be performed in the semester, out of which atleast six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	-	-	2	1	1	2	2	2
CO2	3	3	2	1	2	1	1	1	1	2	1	1	2	3	3
CO3	3	3	3	2	3	1	2	1	2	2	1	2	2	2	3
CO4	3	3	3	2	3	1	2	2	2	3	3	2	3	3	3

Detailed Syllabus
of
B.Tech.(ECE)
4th Semester

ELECTRONIC MEASUREMENTS & INSTRUMENTATION
PCC-ECE202-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Knowledge of basic electronic components.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define the fundamental concepts and techniques used in electronic measurements and instrumentation.	L1
CO 2	Understand and explain construction and working of various measuring instruments.	L2
CO 3	Execute the knowledge of waveform generators, waveform analyzers, transducers.	L3
CO 4	Compare and categorize waveform generators, waveform analyzers, transducers.	H1

Course Contents

UNIT-1

INTRODUCTION: Introduction of Measurement, Classification of Measurement Errors, Instrument Accuracy, accuracy & Precision, Resolution, Significant Figures, Analog Multimeter, digital Multimeter, digital Frequency meter, Digital measurement of time, Digital measurement of frequency(Mains), Digital tachometer, Digital pH meter,Q meter

UNIT-II

OSCILLOSCOPES: Block Diagram based Study of CRO, vertical amplifier, Horizontal Deflecting System, Role of Delay Line, Typical CRT connections, Dual-Trace CROs, Measurement using Oscilloscope-Measurement of Voltage, Frequency, Phase Difference, Rise Time, Fall Time, Lissajous Figures in Detection of Frequency and Phase, Digital Storage Oscilloscope (DSO), Applications of DSO.

UNIT –III

GENERATION & ANALYSIS OF WAVEFORMS: Low frequency Signal Generators, function generators, pulse generators, R.F signal generators, Sweep frequency generators,

frequency synthesizer, Basic wave analyzer, Frequency selective wave analyzer, heterodyne wave analyzer, harmonic distortion analyzers, spectrum analyzer.

UNIT-IV

TRANSDUCERS: Introduction, Electrical transducer, Selection Criteria of Transducers, Transducers types: Resistive transducer, Inductive transducer, capacitive transducer, Thermal transducer, optoelectronic transducer, Piezoelectric transducers. Introduction to Analog and Digital Data Acquisition Systems and Telemetry.

TEXT BOOKS:

1. Electronic Instrumentation and Measurements : David A Bell; Oxford
2. Electronic Instrumentation : H.S.Kalsi ;TMH,2ndEdition
3. A course in Electrical & Electronics Measurements & Instrumentation : A.K.Sawhney; Dhanpat Rai .

REFERENCE BOOKS:

1. Electronic Instrumentation And Measuring Techniques: W.D. Cooper; PHI
2. Modern Electronic Instrumentation & Measuring Techniques: Helfrick & Copper ; PHI
3. Measurement Systems: E.O.doebilin ; McGraw Hill

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	2	1	-	1	3	1	1
CO2	3	3	2	1	1	1	2	1	2	1	-	1	3	2	2
CO3	3	3	2	1	1	1	1	1	2	1	-	1	3	2	2
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	3

ANALOG & DIGITAL COMMUNICATION
PCC-ECE204-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Electronic circuits and introductory concepts of communication science.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the basic principles of communication system.	L1
CO 2	To explain the generation & detection of modulated signals.	L2
CO 3	To evaluate the performance of signal under effects of noise.	H1
CO 4	To examine information signals against various impairments & limitations.	H2

Course Contents

UNIT-1

AMPLITUDE MODULATION: Basic block diagram, Modulation, Amplitude (Linear) Modulation: Linear Modulation Schemes, Generation of AM, Envelope Detector, DSB-SC Product Modulator, Coherent Detection, VSB Modulator and Demodulator, Noise in AM Receiver using Envelope detection, Threshold Effect.

UNIT-II

ANGLE 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 method, Pre-emphasis and De-emphasis in FM. FM Demodulators: Slope detector, Balanced Slope Detector, Foster-Seeley Discriminator, Ratio Detector, PLL demodulator.

UNIT –III

PULSE MODULATION: Sampling Process, PAM, PWM, PPM, Quantization, PCM, DPCM, ADPCM, Noise in PCM System, Companding, Comparison of the Noise Performance of AM,FM,PCM and DM.

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.

UNIT-IV

DIGITAL MODULATION: General description of ASK, FSK and PSK. Transmission, Reception and Signal space representation: BPSK, DPSK, QPSK, M-ary PSK, ASK, QASK, BFSK, M-ary FSK, MSK. Power spectra of digitally modulated signals, Performance comparison of different digital modulation schemes.

TEXT BOOKS:

1. B.P. Lathi, Modern Digital & Analog Communication Systems, 3rd Edn, Oxford University Press, Chennai, 1998.
2. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems, 4 th Edn, MGH, New York, 2002.
3. George Kennedy, Bernard Davis&SRM Prasanna, "Electronic Communication Systems", 5th Edition, McGraw Hill.

REFERENCE BOOKS:

1. John G. Proakis, Digital Communication, PHI.
2. Taub & Schilling, Principles of Communication, TMH.
3. Simon Haykin, "Communication Systems", 4th Edition, Wiley.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	2	1	-	1	3	2	2
CO2	3	3	2	1	1	1	1	1	2	2	-	1	2	3	2
CO3	3	3	3	2	2	1	2	2	2	1	-	1	2	3	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	2

ANALOG ELECTRONICS II
PCC-ECE206-T

Course Code : Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog Electronics-I.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe various amplifiers and oscillator circuits.	L1
CO 2	To explain the construction and operation of semiconductor devices and to demonstrate their use in electronics circuits.	L2
CO 3	To operate the different circuits for amplifiers, power amplifiers and oscillator categories.	L3
CO 4	To design the various analog circuits based upon their performance.	H1

Course Contents

UNIT-1

AMPLIFIER: Distortions in amplifier, General frequency consideration, frequency response of an amplifier, RC coupled amplifier, frequency response of an RC coupled stage, Cascaded CE transistor stages, Gain and bandwidth considerations, step response of an amplifier, bandpass of cascaded stages, effect of an emitter(or a source) bypass capacitor on low frequency response.

UNIT –II

POWER AMPLIFIERS: Class A, B, and C operations; Class A large signal amplifiers, Second and higher order harmonic distortion, efficiency, transformer coupled power amplifier, Class B amplifier: efficiency & distortion, push-pull amplifiers, class AB operation.

UNIT-III

FEEDBACK AMPLIFIERS: Classification of amplifiers, Feedback concept, transfer gain with feedback, general characteristics of negative feedback amplifiers, effect of negative

feedback on input and output resistance, voltage series feedback, current series feedback, current shunt feedback, voltage shunt feedback.

OSCILLATORS: Sinusoidal oscillators, Barkhausen criteria, R-C phase shift oscillator, resonant circuit oscillator, general form of oscillator circuit, wien-bridge oscillator, and crystal oscillator.

UNIT-IV

PNPN DEVICES: Thyristor, SCR, SCS, GTO, light activated SCR, Shockley diode, DIAC, TRIAC, UJT, phototransistor, opto-isolator.

FREQUENCY RESPONSE OF TRANSISTORS: Emitter Follower, Miller's theorem, Hybrid –pi common emitter transistor model, CE emitter short circuit current gain, frequency response, beta cut-off frequency, gain bandwidth product.

TEXT BOOKS:

1. Electronics devices and Circuits (4e): Millman, Halkias and Jit ; McGrawHill
2. Electronics Devices & Circuits: Boylestad & Nashelsky ; Pearson
3. Electronic circuit analysis and design (Second edition): D.A.Neamen; TMH.

REFERENCE BOOKS:

1. Electronics Principles: Malvino ; McGrawHill
2. Electronics Circuits: Donald L. Schilling & Charles Belove ; McGrawHill
3. Microelectronics Circuits, theory and applications:Sedra & Smith;OXFORD

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	2	1	-	1	3	2	3
CO2	3	3	2	1	1	1	2	1	2	2	-	1	3	2	3
CO3	3	3	2	1	1	1	1	1	2	1	-	1	3	2	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	3

ELECTROMAGNETIC THEORY
PCC-ECE208-T

Course Code : Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Microprocessor, Digital electronics.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define and recognize different coordinate systems and vector calculus to describe the spatial variations of the physical quantities dealt in electromagnetic field theory as they are functions of space and time.	L1
CO 2	To explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different media using the fundamental laws.	L2
CO 3	To apply Maxwell's equations to find solution of EM Wave for Homogeneous, Isotopic Dielectric and Conducting medium.	L3
CO 4	To evaluate various transmission line parameters using Smith Chart.	H2

Course Contents

UNIT-I

STATIC ELECTRIC FIELDS: Coulomb's Law, Gauss's Law, potential function, field due to a continuous distribution of charge, equi-potential surfaces, Gauss's Theorem, Poison's equation, Laplace's equation, method of electrical images, capacitance, electro-static energy, boundary conditions, the electro-static uniqueness theorem for field of a charge distribution, Dirac-Delta representation for a point charge and an infinitesimal dipole.

UNIT-II

STEADY MAGNETIC FIELDS: Faraday Induction law, Ampere's Work law in the differential vector form, Ampere's law for a current element, magnetic field due to volume distribution of current and the Dirac-delta function, Ampere's Force Law, magnetic vector potential, vector potential (Alternative derivation), far field of a current distribution, equation of continuity.

UNIT-III

TIME VARYING FIELDS: Equation of continuity for time varying fields, inconsistency of Ampere's law, Maxwell's field equations and their interpretation, solution for free space conditions, electromagnetic waves in a homogeneous medium, propagation of uniform planewave, relation between E & H in a uniform plane-wave, wave equations for conducting medium, Maxwell's equations using phasor notation, wave propagation in a conducting medium, conductors, dielectrics, depth of penetration, polarization, linear, circular and elliptical.

UNIT-IV

REFLECTION AND REFRACTION OF EM WAVES: Reflection and refraction of plane waves at the surface of a perfect conductor & perfect dielectric (both normal incidence as well as oblique incidence), Brewester's angle and total internal reflection, reflection at the surfaces of a conductive medium, surface impedance, poynting theorem, interpretation of E x H, power loss in a plane conductor.

TRASMISSION LINE THEORY: Transmission line as a distributed circuit, transmission line equation, travelling, standing waves, characteristic impedance, input impedance of terminated line, reflection coefficient, VSWR, Smith's chart and its applications.

TEXT BOOKS:

1. Electro-magnetic Waves and Radiating System: Jordan & Balmain, PHI.
2. Anteena & Wave Propagation: K.D. Prasad, Satya Prakashan.
3. Field and Wave Electromagnetics: David K. Cheng, Pearson, Second Edition.

REFRENCE BOOKS:

1. Engineering Electromagnetics by William Hayt, TATA McGraw-Hill.
2. Engineering Electromagnetics: Umran S. Inan & Aziz S. Inan, Pearson.
3. Electro-Magnetics: Krauss J.DF; Mc Graw Hill.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	1	2	1	-	1	2	2	3
CO2	3	3	2	1	1	1	2	1	2	1	-	1	2	3	3
CO3	3	3	2	1	1	1	1	1	2	1	-	1	3	2	3
CO4	3	3	3	2	2	1	2	1	2	2	-	2	3	3	3

ELECTRONIC MEASUREMENTS & INSTRUMENTATION LAB
PCC-ECE202-P

Course Credits : 2 Contact Hours : 4 per week per group (L T P : 0 0 4) Mode : Lab Work	**Course Assessment (Internal: 30; External: 70)**

Pre-requisites: Knowledge of basic electronic components.

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe measuring instruments.	L1
CO 2	Understand and explain working of waveform generators, waveform analyzers, and transducers.	L2
CO 3	To operate various measuring instruments.	L3
CO 4	To analyze performance of waveform generators, waveform analyzers, transducers.	H1

List of Experiments

1. To find Resolution, accuracy & Precision for analog multi meter.
2. To analyze digital multimeter for various measurements.
3. To study the front panel controls of CRO.
4. To find frequency, time and phase difference for waveforms of choice using CRO
5. To find rise time and fall time for waveforms of choice using CRO
6. To study and observe Lissajous Figures on CRO.
7. To study the front panel controls of function generator.
8. To find and observe harmonics of waveforms of choice using spectrum analyzer.
9. To study measurement of different components & parameters like Q of a coil etc using LCR Q meter.
10. To find least count of micrometer.
11. To study and analyze working of LVDT.
12. To measure distance using LDR.
13. To measure temperature using R.T.D.
14. To measure temperature using Thermocouple.
15. To measure strain using Strain Gauge.
16. To measure pressure using Piezo-Electric Pick up.
17. To measure distance using Capacitive Pick up.
18. To measure distance using Inductive Pick up.
19. To measure speed of DC Motor using Magnetic Pick up.
20. To measure speed of DC Motor using Photo Electric Pick up.

NOTE: At least twelve experiments are to be performed in the semester, out of which at least eight experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	1	2	2	1	1	2	2	2
CO2	3	3	2	1	3	1	1	1	2	2	1	1	3	3	2
CO3	3	3	2	1	2	1	1	2	2	3	1	1	2	2	3
CO4	3	3	3	2	3	1	2	2	3	3	2	2	3	2	3

ANALOG AND DIGITAL COMMUNICATION LAB
PCC-ECE204-P

Course Code Course Credits : 1 Contact Hours: 2 hours/week Mode : Lab Work	Course Assessment Methods (Internal: 30; External: 70)

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the modulation and demodulation process in analog and digital communication system.	L1
CO 2	To illustrate simple analog communication systems	L2
CO 3	To compare digital modulation signals for ASK, BPSK, QPSK and FSK and perform their detection	H1
CO 4	To design a simple project on the digital communication system	H2

List of Experiments

1. Familiarization with the control panel and various measurements using CRO & Function Generator.
2. Study of Amplitude Modulation & Demodulation and determination of Modulation index.
3. Study of Frequency Modulation and Demodulation.
4. Study of Pulse Amplitude Modulation and Demodulation.
5. Study of Pulse Width Modulation and Demodulation.
6. Study of Pulse Code Modulation.
7. Study of ASK Modulation Technique.
8. Study of FSK Modulation Technique.
9. Study of BPSK Modulation Technique.
10. Study of QPSK Modulation Technique
11. Simple project (Any topic related to the scope of the course).

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	1	2	2	1	1	2	2	2
CO2	3	3	2	1	3	1	2	1	2	2	1	1	3	3	2
CO3	3	3	2	1	2	1	1	1	2	2	1	1	2	2	3
CO4	3	3	3	2	3	1	2	2	3	3	3	2	3	2	3

ANALOG ELECTRONICS - II LAB
PCC-ECE206-P

Course Credits: 2 Contact Hours: 4/week per group (L-T-P: 0-0-4) Mode: Lab Work	**Course Assessment(Internal: 30; External: 70)**

Pre-requisites: Analog Electronics-I Lab.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To trace the characteristics of semiconductor devices.	L1
CO 2	To identify the various electronic components and differentiate among them based upon their characteristics.	L2
CO 3	To demonstrate the applications of semiconductor devices.	L3
CO 4	To design various analog circuits and evaluate their parameters.	H2

List of Experiments

1. To study the characteristics of UJT.
2. To study the characteristics of DIAC.
3. To study the characteristics of TRIAC.
4. To study the characteristics of SCR.
5. To design a BJT Darlington emitter follower and determine the gain.
6. To design and study Class A power amplifier.
7. To design and study Class B power amplifier.
8. To design and study Class A-B push-pull power amplifier.
9. To design and study class C power amplifier.
10. To design and study the frequency response of a RC coupled amplifier.
11. To study the effect of BJT voltage series feedback amplifier and determine the gain, frequency response, input and output impedance with and without feedback.
12. To study the effect of FET voltage series feedback amplifier and determine the gain, frequency response, input and output impedance with and without feedback
13. To study the RC phase shift oscillator circuit.
14. To study the Wein bridge oscillator circuit.
15. To study the Hartley's oscillator circuit.
16. To study the Colpitt's oscillator circuit.
17. Simple project (Any topic related to the scope of the course).

NOTE: At least 12 experiments are to be performed in the semester, out of which at least 8 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	1	2	2	1	1	2	2	2
CO2	3	3	2	1	3	1	2	1	2	2	1	1	2	3	3
CO3	3	3	2	1	2	1	1	1	2	2	1	1	3	3	3
CO4	3	3	3	2	3	1	2	2	3	3	3	2	3	3	3

Detailed Syllabus
of
B.Tech.(ECE)
5th Semester

MICROWAVE ENGINEERING
PCC-ECE301-T

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Electromagnetic Theory

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the basic concepts of waveguide & wave propagation	L 1
CO 2	To Illustrate the operations and principals of various microwave components and devices	L 2
CO 3	To describe the microwave component layouts.	L 3
CO 4	To examine the performance of different microwave devices.	H 1
CO 5	To design different microwave component structures for various applications.	H 2
CO 6	To Evaluate the performance of active microwave devices.	H 3

Course Contents

UNIT-1

WAVEGUIDES & MICROWAVE COMPONENTS: Introduction, propagation in TE and TM mode, rectangular wave guide, tem mode in rectangular wave guide, characteristic impedance, introduction to circular waveguides and planar transmission lines, s-parameters, scattering matrix and its properties, directional couplers, microwave tees, irises, posts and tuning screws, attenuators, cavity resonators, re-entrant cavities, mixers & detectors, matched load, phase shifter, wave meter, ferrite devices.

UNIT-II

MICROWAVE TUBES & MEASUREMENTS: Limitation of conventional tubes; Construction and Operation Principal of Two Cavity Klystron amplifier, Reflex Klystron, Magnetron (Cylindrical Magnetron and description of Π mode), TWT, BWO, Crossed field

amplifiers, Measurement of Power, VSWR, frequency, attenuation, insertion loss, wavelength and impedance.

UNIT –III

MICROWAVE SOLID STATE DEVICES: Transferred Electron Devices- GUNN EFFECT; Negative Differential Resistance Phenomenon, field domain formation, GUNN diode structure, Varactor diode, Tunnel diode, Schottky diode, IMPATT, TRAPATT, BARITT and PIN diodes. MASER, Parametric amplifiers.

UNIT-IV

MODERN TRENDS IN MICROWAVES ENGINEERING: Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference/ Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication, RF MEMS for microwave components, Microwave Imaging, microwave propagation, microwave Antennas

TEXT BOOKS:

1. Microwave devices and circuits: Samuel Liao; PHI.
2. Microwave devices & Radar Engg: M. Kulkarni; Umesh Publications.
3. Microwave Engineering: Annapurna Das, S. K. Das, MCGraw Hill Education.

REFERENCE BOOKS:

1. Microwaves and Radar: A.K. Maini; Khanna.
2. Microwave Engineering, David M. Pozar, Wiley.
3. Microwave & Radar Engg, Dr. A. K. Gautam, katson Books.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	1	2	2	-	2	3	3	2
CO2	3	3	2	2	2	2	2	-	2	2	-	2	3	2	2
CO3	3	3	2	2	1	2	2	-	2	1	-	2	3	3	3
CO4	3	3	3	2	1	2	1	1	2	1	-	2	3	3	2
CO5	3	3	3	2	2	-	2	1	2	1	-	2	3	2	3
CO6	3	3	3	2	1	1	2	1	2	2	-	2	3	3	3

EMBEDDED SYSTEM DESIGN
PCC-ECE303-T

Course Credits: 3.0 Contact Hours: 3/week, (L-T-P: 3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 hours	Course Assessment Methods (internal: 30; external: 70) Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Microprocessor, Digital electronics.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the evolution of processor architectures.	L1
CO 2	Describe the instruction set of Microcontroller.	L2
CO 3	Apply instruction set in writing assembly language programs.	L3
CO 4	Evaluate the performance of timers and counters in real-time response.	H1
CO 5	Design an Embedded System for various applications.	H2

Course Contents

UNIT-I

PIC MICROCONTROLLER ARCHITECTURE: Introduction to PIC Microcontrollers, Processor Architectures: Harvard vs. Von Neumann, CISC vs. RISC, Comparison between PIC10, PIC12, PIC14, PIC16, PIC18 devices. PIC 16 Microcontroller, Architecture and pipelining, Block diagram, program memory considerations, Addressing modes, CPU Registers, Instruction set, simple operations.

UNIT-II

INTERRUPT AND I/O PORTS OF PIC MCU: Interrupt logic, Timer2 scalar initialization, Interrupt service routine, Loop time subroutine, External interrupts and timers, Synchronous serial port module, Serial peripheral device, Output port expansion, Input port expansion, UART.

UNIT-III

PROGRAMMING WITH PIC MICROCONTROLLER: Arithmetic operations, Bit addressing, Loop control, stack operations, subroutines, RAM direct addressing, State machines, Oscillators, Timer interrupts, memory mapped input/output. Development

tools/environments, assembly language programming style, interpreters, high level languages, Intel hex format object files, Debugging.

UNIT-IV

DESIGNING WITH PIC MICROCONTROLLER: PWM Motor control, Temperature sensor, Pressure sensor, DC Motor, Stepper motor, Servo motor, Analog to digital converter, Digital to analog converter, seven segment display, LCD interfacing with PIC 16 Microcontroller.

Text Books:

1. "Design with PIC Microcontroller", by John B. Peatman, Pearson.
2. "PIC Microcontroller and Embedded Systems: using assembly and C for PIC 18" by Muhammad Ali Mazidi, Pearson.

Reference Books:

1. "Microcontroller Programming, the Microchip PIC", by Julio Sanchez, Maria P. Canton, CRC Press.
2. "Embedded C programming and the microchip PIC" by Richard H. Barnett, Larry O' Cull, Delmar Cengage Learning.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**1**	**-**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**2**	**2**	**-**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**2**	**-**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**3**

DATA STRUCTURES AND APPLICATIONS
ESC-ECE307-T

General Course Information

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor Tests Each of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Programming in C

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe various types of data structures and operations that can be implemented on these data structures.	L1
CO 2	Demonstrate the use of various data structures and their related operations.	L2
CO 3	Apply data structure to solve computational problems.	L3
CO 4	Compare the suitability of alternative data structures and prescribed operations for various problem situations.	H2
CO 5	Defend solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems.	H3

Course Content

UNIT I

Introduction to data structures and their types, Abstract data types, linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists. Representing sets and polynomials using linked lists.

UNIT II

Stack and Queue: Static and linked implementations, Operations and Applications. Circular queues, Tress, Binary trees and related terminology, Tree traversals (Recursive), Threaded Binary Trees, Binary Search Trees implementation and operations, Priority queues.

UNIT III

Height Balanced or AVL trees and B trees. Graph definitions and related terminology, memory representations and related operations (traversal, insertion, deletion, search), Path Matrix, Warshall's Shortest path algorithm Hashing, Hash tables, hash function and collision resolution.

UNIT IV

Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Count sort, Heap sort, Comparison of searching and sorting techniques based on their complexity analysis, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

Text Books:

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., Data Structures and Algorithms, Addison-Wesley, 1983.
2. LangsamYedidyah, Augenstein J Moshe, Tenenbaum M Aaron, Data Structures using C and C++, 3rd edition, PHI, 2009.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., Introduction to Algorithms, MIT Press, 2009.

Reference Books:

1. Robert L. Kruse, Data Structure and Program Design in C, Pearson Education India, 2007.
2. Weiss, M. A., Data Structures and Algorithm Analysis in C++, Addison-Wesley, 2007.
3. Sahni, S., Data Structures, Algorithms, and Applications in C++, WCB/McGraw-Hill, 2001.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	1	2	1	-	2	3	3	2
CO2	3	3	2	2	1	2	-	1	2	-	-	2	3	3	2
CO3	3	3	2	2	-	2	-	1	-	-	-	2	3	3	2
CO4	3	3	3	2	-	2	1	1	2	2	-	2	3	3	3
CO5	3	3	3	2	1	2	1	1	-	1	-	2	3	3	3

CONTROL SYSTEM ENGINEERING
ESC-ECE309-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Mathematics, Physics, Electrical Technology

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define various types of control systems and feedback control mechanism.	L1
CO 2	To describe various time domain and frequency domain tools used for the analysis and design of linear control systems.	L2
CO 3	To illustrate and interpret time domain analysis of 2^{nd} order system.	L3
CO 4	To test the stability of the system using techniques based on transfer function of system.	H1
CO 5	To evaluate and design compensation networks and controllers.	H2

Course Contents

UNIT I

INPUT / OUTPUT RELATIONSHIP: System / Plant model, illustrative examples of plants & their inputs and outputs, open loop & closed loop control system & their illustrative examples, mathematical modeling and representation of physical systems, Concept of transfer function, relationship between transfer function and impulse response, order of a system, block diagram algebra, signal flow graphs: Mason's gain formula & its application, characteristic equation, derivation of transfer functions of electrical and electromechanical systems.

UNIT II

TIME DOMAIN ANALYSIS: Typical test signals, time response of first order systems to various standard inputs, time response of 2nd order system to step input, time domain specifications, steady state error and error constants, concept of stability, pole-zero configuration and stability, necessary and sufficient conditions for stability, Hurwitz stability criterion, Routh stability criterion and relative stability. Root locus concept, development of root loci for various systems, stability considerations.

UNIT III

FREQUENCY DOMAIN ANALYSIS: Relationship between frequency response and time-response for 2nd order system, polar, Nyquist, Bode plots, stability, Gain-margin and Phase Margin, relative stability, frequency response specifications.

UNIT IV

COMPENSATION: Necessity of compensation, compensation networks, application of lag and lead compensation, basic modes of feedback control, proportional, integral and derivative controllers.

CONTROL COMPONENTS: Synchros, servomotors, stepper motors, magnetic amplifier.

TEXT BOOK:

1. Control System Engineering: I.J. Nagrath & M. Gopal; New Age Publishers.
2. Automatic Control Systems: B.C. Kuo, PHI. Publishers.
3. Control System Engineering: U.A. Bakshi,V.U. Bakshi;Technical Publications

REFERENCE BOOKS:

1. Modern Control Engg: K. Ogata; PHI. Publishers.
2. Control Systems - Principles & Design: Madan Gopal; Tata Mc Graw Hill. Publishers.
3. Modern Control Engineering, R.C. Dorf & Bishop; Addison-Wesley Publishers.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**1**	**-**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**2**	**-**	**-**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**3**

MICROWAVE ENGINEERING LAB
PCC-ECE301-P

Course Credits :1 Contact Hours: 2Hours/week Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To state the practical concepts of generation of microwave signal	L1
CO 2	To describe the various parameters related to microwave components.	L2
CO 3	To classify various microwave components	L3
CO 4	To Examine the microwave frequency signals and how it is measured.	H1
CO 5	To evaluate microwave systems for different practical application.	H2
CO 6	To create a model for microwave frequency generation.	H3

List of Experiments

1. Study of wave guide components.
2. To study the characteristics of Reflex Klystron and determine its tuning range.
3. To measure frequency of microwave source and demonstrate relationship among guide dimensions, free space wave length and guide wavelength.
4. To measure VSWR of unknown load and determine its impedance using a smith chart.
5. To match impedance for maximum power transfer using slide screw tuner.
6. To measure VSWR, insertion losses and attenuation of a fixed and variable attenuator.
7. To measure coupling and directivity of direction couplers.
8. Study of Power Division in Magic Tee.
9. To measure insertion loss, isolation of a three port circulator.
10. To measure the Radiation Pattern and Gain of Waveguide Horn Antenna.
11. To study the V-I characteristics of GUNN diode.

Note: At least eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	1	2	2	2	2	3	3	3
CO2	3	3	3	2	3	3	2	-	3	3	2	2	3	3	2
CO3	3	3	3	2	3	2	1	-	3	2	2	2	3	3	3
CO4	3	3	3	2	2	3	1	2	2	3	3	2	3	2	2
CO5	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3
CO6	3	3	3	2	3	2	1	2	2	2	3	2	3	3	2

EMBEDDED SYSTEM DESIGN LAB
PCC-ECE303-P

General Course Information:

Course Credits: 2 Contact Hours: 4/week per group(L-T-P: 0-0-4) Mode: Lab Work	**Course Assessment** **(Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the procedure to write a program on MP Lab software.	L1
CO 2	Recognize the various modules available with the development board of PIC Microcontroller.	L2
CO 3	Apply instructions set to write assembly language programs.	L3
CO 4	Analyze real-time response of embedded systems.	H1
CO 5	Design and develop an embedded system using PIC Microcontroller.	H2

LIST OF EXPERIMENTS

1. Write an assembly language program to perform addition, subtraction, multiplication and division operation using PIC 16 Microcontroller.
2. Write an assembly language program to perform 16-bit addition and subtraction operation using PIC Microcontroller.
3. Write an assembly language program to perform the addition of a series of numbers using PIC Microcontroller.
4. Write an assembly language program to perform logical operations using PIC Microcontroller.
5. Write an assembly language program for delay calculation using PIC Microcontroller.
6. Write a program for the blinking of LED's using PIC Microcontroller.
7. Write an assembly language program to find the largest number from a given series.
8. Write an assembly language program to find the smallest number from a given series.
9. Write an assembly language program to sort a given number of series in ascending order.
10. Seven segment display interfacing with PIC Microcontroller.
11. LCD Interfacing with PIC Microcontroller.
12. DC Motor interfacing with PIC Microcontroller.
13. Stepper motor interfacing with PIC Microcontroller.
14. Servo motor interfacing with PIC Microcontroller.
15. Temperature sensor interfacing with PIC Microcontroller.
16. Accelerometer sensor interfacing with PIC Microcontroller.
17. Simple project (Any topic related to the scope of the course).

NOTE: At least twelve experiments are to be performed in the semester, out of which at least eight experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	3	2	2	3	2	2
CO2	3	3	2	2	3	3	2	-	3	2	2	2	3	3	3
CO3	3	3	2	2	2	3	1	2	2	2	2	2	3	2	2
CO4	3	3	3	2	3	3	1	2	2	3	3	2	3	3	3
CO5	3	3	3	2	2	3	2	2	3	3	3	2	3	3	3

SKILLS & INNOVATION LAB
PCC-ECE305-P

Course Credits : 1 Contact Hours : 2 per week per group (L T P : 0 0 2) Mode : Lab Work	**Course Assessment** (Internal: 30; External: 70)

Pre-requisites: Network Analysis and Synthesis lab, Analog Electronics- I Lab, Analog Electronics -II Lab

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe Circuit schematic design, PCB layout design and fabrication process.	L1
CO 2	To understand and explain PCB design and fabrication process.	L2
CO 3	To apply, implement, execute the knowledge of Electronic circuit design, layout design and fabrication process.	L3
CO 4	To investigate Circuit schematic design, PCB design and fabrication process.	H2
CO 5	To design and construct PCB for electronic circuits.	H3

List of Experiments

1. Introduction of circuit schematic and layout tool.
2. Design schematic of regulated DC power supply.
3. Design layout (Silk layer and copper layer) of regulated DC power supply.
4. Introduction of Design rule check (DRC) and Netlist.
5. To fabricate a PCB for regulated DC power supply circuit including image transfer, etching, drilling and soldering.
6. To test electronic circuit implemented on PCB.
7. Design schematic of electronic circuit of practical importance.
8. Design layout (Silk layer and copper layer) of electronic circuit of practical importance.
9. To fabricate PCB and test electronic circuit of practical importance.
10. To study data sheets of diode.
11. To study data sheets of transistor.

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	2	2	3	3	2	3	2	2
CO2	3	3	3	2	3	3	2	-	3	3	3	2	3	3	3
CO3	3	3	3	2	2	3	2	2	2	3	2	2	3	2	2
CO4	3	3	3	2	2	3	1	2	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	1	2	3	3	3	3	3	3	3

Practical Training-I

General Course Information:

Course Code: INT-ECE311-P Course Credits: 1.0 Type: Compulsory Contact Hours: 2 hours per week (L-T-P: 0-0-2) Mode: Practical	**Course Assessment Methods (Internal: 100)** Assessment of Practical Training-I will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of 4th sem.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	outline technical documents and give oral presentations related to the work completed	L1
CO 2	recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the industry	L2
CO 3	acquire and apply fundamental principles of engineering and an ability to work in actual working environment.	L3
CO 4	analyze practical application of the subjects taught during the course	H1
CO 5	develop social, cultural , global and environmental responsibilities as an engineer	H2
CO 6	identify, formulate and model problems and find engg. Solution based on a system approach	H3

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

Detailed Syllabus
of
B.Tech.(ECE)
6^{th} Semester

COMPUTER NETWORKS and IOT
PCC-ECE302-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questionsare to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand networking of devices & describe the concepts of IOT.	L1
CO 2	Identify the different technologies used for information transfer.	L2
CO 3	Apply IOT to different applications.	L3
CO 4	Analysis and evaluate protocols used in IOT.	H1
CO 5	To analyze the data transfer on networks and troubleshooting of various possible errors.	H2
CO 6	Design and develop smart city in IOT.	H3

Course Contents

Unit-I

Uses of Computer Networks, History of computer networks, Introduction to models and layers: OSI & TCP/IP model.

Data Link Layer & LAN: Error-detection and correction techniques, Multiple access protocols, addressing, Ethernet, switches.

Unit-II

Transport Layer: Connection less transport (UDP), Principles of reliable data transfer, Connection oriented transport (TCP), Congestion control.

Network Layer: Introduction, Virtual and Datagram networks, study of router, IP protocol and addressing in the Internet

Application Layer: Web and HTTP, E-mail, DNS

Unit-III

Internet of things overview: Internet of Things definition evolution, IoT architectures, Resource management, IoT data management and analytics, Communication protocols, Internet of Things applications, Security, Identity management and authentication, Privacy, Standardization and regulatory limitations

Open source semantic web infrastructure for managing IoT resources in the cloud: Background/related work, Open IoT architecture for IoT/cloud convergence, Scheduling process and IoT services lifecycle, Scheduling and resource management, Validating applications and use cases, Future research directions

Unit-IV

The foundations of stream processing in IoT, Continuous Logic Processing System, Challenges and future directions

Distributed data analysis for IoT: Preliminaries, Anomaly detection, Problem statement and definitions, Distributed anomaly detection, Efficient incremental local modelling

Security & Reliability: Concepts, IoT security overview, Security frameworks for IoT, Privacy in IoT networks, IoT characteristics and reliability issues, Addressing reliability

TEXT BOOKS:

1. Data Communications and Networking (4th edition), Behrouz Forouzan, McGraw Hill
2. Internet of Things, Principles and Paradigms; Rajkumar Buyya, Elsevier

REFERENCE BOOKS:

1. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi,4th Edition
2. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill
3. The Internet of Things: From RFID to the Next-Generation Pervasive Networked LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning
4. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , ArshdeepBahga
5. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
6. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO2	3	3	2	2	3	3	2	-	3	2	2	2	3	3	2
CO3	3	3	2	2	2	3	1	-	3	2	2	2	3	3	3
CO4	3	3	3	2	3	3	1	2	2	2	3	2	3	3	3
CO5	3	3	3	2	3	3	2	2	2	3	3	2	3	3	2
CO6	3	3	3	2	2	3	2	2	3	3	3	2	3	3	3

VLSI DESIGN
PCC-ECE304-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog Electronics and Digital Electronics

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the MOS technology and its applications for VLSI design.	L1
CO 2	Illustrate the design equations and their analysis for VLSI circuit system.	L2
CO 3	Demonstrate the importance of CMOS design in VLSI system design.	L3
CO 4	Compare the various circuit topologies for digital VLSI design	H1
CO 5	Define and evaluate the layout of VLSI circuits.	H2
CO 6	Develop or create CMOS system for VLSI design.	H3

Course Contents

UNIT-1

REVIEW OF MOS TECHNOLOGY: Introduction to IC technology, MOS Transistor enhancement mode and depletion mode operations, fabrication of NMOS, CMOS and BiCMOS devices. Equivalent circuit for MOSFET and CMOS.
VLSI FABRICATION: Crystal growth, oxidation, diffusion, ion implantation, epitaxy, photo-lithography, etching, dielectric and polysilicon film deposition, metalization.

UNIT-II

MOS TRANSISTOR THEORY: MOS device design equations, Evaluation aspects of MOS transistor, threshold voltage, MOS transistor trans conductance & output conductance, figure of merit, Channel Length Modulation, Body Effect
MOS INVERTER: Introduction, nMOS inverter: resisive load, enhancement load, depletion load, determination of pull -up to pull-down ratio for an nMOS inverter driven by another nMOS

inverter & by one or more pass transistor, CMOS inverter: DC characteristics, circuit model, Bi-CMOS logic, latch up in CMOS circuitry and BiCMOS , Latch up susceptibility.

UNIT –III

CMOS DESIGN: Gate Logic: inverter, nand gate, nor gate. Ratioed logic, pseudo NMOS logic, DCVSL Logic, Switch Logic: pass transistor and transmission gate, dynamic logic, charge sharing logic, domino logic. Combination logic: Parity generator, multiplexer. Sequential logic: two phase clocking, memory-latches and registers, setup and hold time violations, causes, effects and remedies.

CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION: Sheet resistance, resistance estimation, capacitance estimation, inductance estimation, switching characteristic, propagation delays, CMOS gate transistor sizing, power dissipation: static and dynamics.

UNIT-IV

SCALING OF MOS CIRCUITS: Scaling models and scaling factors for device parameters, limitations of scaling: substrate doping, limits of miniaturization, limit of interconnect and contact resistance.

MOS CIRCUIT DESIGN PROCESS: MOS layer, stick diagram: NMOS Design style, PMOS Design style, CMOS design style, design rules and layout: lambda based design rule, layer representation, contact cuts, double metal MOS process rules, CMOS lambda based design rules.

DESIGN EXAMPLE USING CMOS : Incrementer/ decrementer, left/right shift serial/parallel register, comparator for two n-bit number, a two phase non-overlapping clock generator with buffered output on both phases, design of an event driven element for EDL system.

TEXT BOOKS :

1. Introduction to Digital Integrated Circuits : Rabaey,Chandrakasan & Nikolic.
2. Principles of CMOS VLSI Design : Neil H.E. Weste and Kamran Eshraghian; Pearson.
3. Integrated Circuits: K.R. Botkar; Khanna

REFERENCE BOOKS :

1. Introduction to Digital Circuits : Rabaey LPE (PHI)
2. VLSI Fabrication: S.K.Gandhi, Wiley.
3. VLSI Technology: S.M. Sze; McGraw-Hill.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	1	2	1	-	2	3	3	2
CO2	3	3	2	2	1	2	2	1	2	1	-	2	3	3	2
CO3	3	3	2	2	1	2	1	-	2	2	-	2	3	3	2
CO4	3	3	3	2	-	2	1	-	2	2	-	2	3	3	3
CO5	3	3	3	2	-	2	2	1	2	2	-	2	3	3	3
CO6	3	3	3	2	1	2	2	1	2	1	-	2	3	3	3

LINEAR INTEGRATED CIRCUITS & APPLICATIONS
PCC-ECE306-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog Electronics I, Analog Electronics II

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	To describe linear integrated circuits and their application circuits.	L1
CO 2	To understand and explain operational amplifier circuits and their application circuits.	L2
CO 3	To apply the knowledge of linear integrated circuits.	L3
CO 4	To compare and analyze operational amplifier circuits and their application circuits.	H1
CO 5	To design operational amplifier based comparators and converters.	H3

Course Contents

UNIT I

INTRODUCTION: Block diagram, Op-Amp equivalent circuit and its analysis, Types and development of integrated circuits, IC package types, Device Identification, Power supplies for ICs.

INTERPRETATION OF DATA SHEETS: Interpretation of data sheets, Ideal Op-Amp and its equivalent circuit, Ideal voltage transfer curve, open loop op-amp configurations.

UNIT II

FEEDBACK CIRCUITS: Block diagram representation of feedback configurations. Voltage series feedback amplifier, Voltage shunt feedback amplifier, differential amplifiers.

PRACTICAL OP-AMP: Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, effect of variation in power supply voltages on offset voltage, change in input offset voltage and input offset current with time, temperature and supply voltage sensitive parameters, Noise, Common -Mode configuration and common mode rejection ratio.

UNIT III

FREQUENCY RESPONSE: Frequency response of internally compensated and non compensated Op-Amps, High frequency Op-Amp equivalent circuit, open loop voltage gain as a function of frequency, closed loop frequency response, circuit stability, and slew rate.
APPLICATIONS: DC and AC amplifier, Peaking Amplifier, summing, scaling and averaging amplifiers, Instrumentation amplifier, Differential input and output amplifier. Voltage to current converter with floating and grounded load, Very high input impedance circuit. Integrator and differentiator circuit.

UNIT IV

FILTERS & OSCILLATORS: First and second order low pass and high pass Butterworth filter. Band pass and band reject filters. Phase shift and Wien bridge oscillator, square wave generator.
COMPARATOR & CONVERTORS: Basic comparator, Schmitt trigger, comparator characteristics and limitations. Voltage limiters, window detector, voltage to frequency and frequency to voltage converters, A/D and D/A converters, Clippers and clampers, peak detector.

Text Books:

1. Ramakant A. Gayakwad, Op-Amps and linear integrated circuits, 4th edition, Pearson

Reference Books:

1. Bruce Carter and Ron Mancini, Op Amps for Everyone, 5th edition, Elsevier
2. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd edition, McGraw Hill

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	-	2	1	-	2	3	3	2
CO2	3	3	2	2	2	2	1	-	2	1	-	2	3	3	2
CO3	3	3	2	2	1	2	2	-	2	2	-	2	3	3	2
CO4	3	3	3	2	1	2	1	1	2	2	-	2	3	3	3
CO5	3	3	3	2	2	2	2	1	2	2	-	2	3	3	3

COMPUTER NETWORKS & IOT LAB
PCC-ECE302-P

Course Credits: 1 Contact Hours: 2/week, (L-T-P: 0-0-2) Mode: Lab work Examination Duration: 3 hours	**Course Assessment(Internal: 30; External:70)**

Pre-requisites: Basic knowledge of the inter-computer, internet connections and addressing.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand the concept of internetworking of devices.	**L1**
CO 2	To describe application of IOT.	**L2**
CO 3	To make use of Devices, Gateways and Data Management in IOT.	**L3**
CO 4	To design the computer links among different networks to transfer the information.	**H1**
CO 5	To evaluate the Market perspective of IOT.	**H2**
CO 6	To design state of the art architecture in IOT.	**H3**

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List of Experiments

1. Configure a network topology using packet tracer software.
2. To establish a Web Server Connection Using the PC's Web Browser.
3. Viewing Device Tables and Resetting the Network.
4. To establish a full duplex network using routers.
5. Hands on experience on Node MCU board(installation, install ESP8266 board in Arduino IDE, flashing NodeMCU firmware on the ESP8266).
6. To control LED using IoT on Node MCU board.
7. To study PIR Motion Sensor using Node MCU board.
8. To study web server with Arduino IDE.
9. To publish Temperature Readings using ADC.
10. To study Weather Forecaster.
11. To study Door Status Monitor.
12. To study Servo motor control using Node MCU board.
13. To study RGB Color Picker using Color Sensor
14. Hands on experience on Raspberry Pi.

NOTE: Eight experiments are to be performed out of which at least Six experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	1	2	2	2	2	3	3	2
CO2	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO3	3	3	2	2	3	3	2	1	3	2	2	2	3	3	2
CO4	3	3	3	2	3	3	2	2	2	3	3	2	3	3	3
CO5	3	3	3	2	3	3	-	2	3	3	3	2	3	3	3
C06	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3

VLSI DESIGN LAB
PCC-ECE304-P

Course Credits : 1 Contact Hours: 2/week per group (L-T-P: 0-0-2) Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the CMOS technology and its applications for VLSI design.	L1
CO 2	Illustrate the VLSI circuit design techniques practically.	L2
CO 3	Demonstrate the importance of CAD tools in VLSI system design.	L3
CO 4	Compare the various circuit topologies for digital VLSI design.	H1
CO 5	Design and evaluate the layout of VLSI circuits.	H2
CO 6	Develop or create CMOS system using VLSI CAD tools.	H3

List of Experiments

1. To plot the output characteristics and transfer characteristics of an n-channel and p-channel MOSFET.
2. To design and plot the static (VTC) and dynamic characteristics of digital CMOS inverter.
3. To design and plot the characteristics of 2-input NAND and NOR CMOS digital logic gate.
4. To design and plot the characteristics of 2-input XOR CMOS digital logic gate.
5. To design and plot the characteristics of 2x1 digital multiplexer using pass transistor logic.
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.
7. To design and plot the characteristics of a master slave positive and negative edge triggered flip-flop based on multiplexers.
8. To design and plot the characteristics of a CMOS 1-bit full adder.
9. To design and plot the characteristics of a CMOS Non-Overlapping two phase Clock.
10. To design and plot the characteristics of a CMOS comparator.
11. To design and plot the characteristics of a CMOS SRAM Cell.
12. Simple project (Any topic related to the scope of the course).

Note: At least eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	2	3	2	2	3	3	2
CO2	3	3	2	2	3	3	2	-	3	2	2	2	3	3	2
CO3	3	3	2	2	2	3	1	-	2	3	2	2	3	3	2
CO4	3	3	3	2	2	3	1	2	3	3	3	2	3	3	3
CO5	3	3	3	2	2	3	2	2	3	2	3	2	3	3	3
CO6	3	3	3	2	3	3	1	2	2	2	3	2	3	3	3

LINEAR INTEGRATED CIRCUITS & APPLICATIONS LAB
PCC-ECE306-P

General course information

Course Credits : 1 Contact Hours : 2 per week per group (L T P : 0 0 2) Mode : Lab Work	**Course Assessment (Internal: 30; External: 70)**

Pre-requisites: Linear Integrated Circuits and Applications

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe linear integrated circuits and their application circuits.	L1
CO 2	To understand and explain operational amplifier circuits and their application circuits.	L2
CO 3	To operate various operational amplifier based circuits	L3
CO 4	To compare and analyze operational amplifier circuits and their application circuits.	H1
CO 5	To design operational amplifier based oscillators, filters, comparators and converters.	H3

List of Experiments

1. Design and simulate PSpice model of inverting amplifier and obtain plots of input signal voltage versus time and output signal voltage versus time.
2. Design and simulate PSpice model of noninverting amplifier and obtain plots of input signal voltage versus time and output signal voltage versus time.
3. Design and simulate PSpice model of differential amplifier and obtain plots of input signal voltages versus time and output signal voltage versus time.
4. Design and simulate PSpice model of inverting amplifier with feedback and obtain plots of input signal voltage versus time and output signal voltage versus time.
5. Create and simulate PSpice model of inverting averaging circuit and measure output voltage.
6. Create and simulate PSpice model of noninverting summing amplifier circuit and measure voltage at inverting, noninverting and output terminals.
7. Create and simulate PSpice model of voltage to current converter with grounded load and measure voltage at inverting, noninverting and output terminals. Also measure load current.
8. Create and simulate PSpice model of second order low pass Butterworth filter and obtain plot of output voltage versus frequency.
9. Create and simulate PSpice model of second order high pass Butterworth filter and obtain plot of output voltage versus frequency.

10. Create and simulate PSpice model of square wave generator and obtain plots of capacitor voltage versus time and output signal voltage versus time.
11. Design and simulate PSpice model of noninverting comparator and obtain plots of input signal voltage versus time and output signal voltage versus time.
12. Design and simulate PSpice model of inverting comparator and obtain plots of input signal voltage versus time and output signal voltage versus time.
13. Simple project (Any topic related to the scope of the course).

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	-	-	2	3	2	2	3	3	2
CO2	3	3	2	2	2	3	1	-	3	2	2	2	3	3	2
CO3	3	3	2	2	2	3	2	-	2	3	2	2	3	3	2
CO4	3	3	3	2	2	3	1	2	3	3	3	2	3	3	3
CO5	3	3	3	2	3	3	2	2	3	2	3	2	3	3	3

Detailed Syllabus
of
B.Tech.(ECE)
7^{th} Semester

Digital Signal Processing
PCC-ECE401-T

Course Credits : 2.0 Mode : Lectures (L) Teaching schedule :4 hour/week Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: signals and systems

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand the concept and advantages of digital signal processing.	L1
CO 2	To summarize differences between time domain and frequency domain analysis tools.	L2
CO 3	To apply DFT and FFT tools to determine the spectral components of a discrete time signal.	L3
CO 4	To examine the realization of digital filters using different realization structures.	H1
CO 5	To design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters for processing of discrete time signals.	H3

Course Contents

UNIT-1

DISCRETE FOURIER TRANSFORM (DFT): Frequency Domain Sampling and Reconstruction of Discrete-Time signals, Discrete Fourier Transform, DFT as a Linear Transformation, Properties of DFT, Linear filtering methods based on DFT: use of DFT in linear filtering, Filtering of long data Sequences.

FAST FOURIER TRANSFORM (FFT): Fast Fourier Transform Algorithms, Radix-2 and Radix-4 FFT Algorithms, Applications of FFT Algorithms: Efficient Computation of the DFT of Two Real Sequences, Efficient Computation of the DFT of a 2N-Point Real Sequence, use of FFT in Linear filtering and correlation.

UNIT-II

STRUCTURES FOR FIR SYSTEMS: Direct Form Structures, Cascade Form Structures, Frequency Sampling Structures, Lattice Structure.

STRUCTURES FOR IIR SYSTEMS: Direct Form Structures, Signal Flow graphs & Transposed Structures, Cascade Form Structures, Parallel Form Structures; Lattice & Lattice-Ladder Structures for IIR Systems.

UNIT –III

FIR & IIR FILTER DESIGN: FIR and IIR filters properties, Design of FIR filters: importance of Linear Phase response, Design of linear phase FIR filters using Windows, Desirable Window function properties for FIR filter design, Frequency Sampling method for Linear Phase FIR Filter Design. Design steps for IIR Filter design, Design of IIR low pass analog filters: Butterworth, Chebyshew, Elliptic; Conversion of analog system to digital system by: Approximation of Derivatives, Impulse Invariance, Bilinear Transformation, Frequency Transformations.

UNIT-IV

MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction to Multirate digital signal processing, interpolation and decimation, sampling rate conversion by rational factor, filter design and implementation for sampling rate conversion, multistage decimator and interpolators, Applications of Multirate Signal Processing.

TEXT BOOKS:

1. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing, Principles, Algorithms, & Applications", Prentice – Hall India.
2. T.K. Rawat, "Digital Signal Processing" Oxford University Press.
3. S. Mitra, "Digital Signal Processing- A computer based approach" TMH.

REFERENCE BOOKS:

1. L. R. Rabiner & B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall India.
2. A. V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete-Time Signal Processing", Prentice Hall India.
3. A. V. Oppenheim, R. W. Schafer, "Digital Signal Processing", Prentice Hall India.
4. Salivahanan, Vallavaraj and Gnanapriya, "Digital Signal Processing", TMH.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	-	2	1	-	3	3	3	2
CO2	3	3	2	2	1	3	2	-	2	2	-	3	3	2	3
CO3	3	3	2	2	2	3	2	-	2	1	-	3	3	2	3
CO4	3	3	3	3	2	3	1	1	2	2	-	3	3	3	2
CO5	3	3	3	3	1	3	1	1	2	1	-	3	3	3	3

WIRELESS COMMUNICATION
PCC-ECE403-T

Course Credits : 03 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of communication engineering and antenna & wave propagation.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the evolution & advancements in wireless networks.	L1
CO 2	To explain the operation of cellular networks.	L2
CO 3	To define the channel behaviour and associated losses.	L3
CO 4	To evaluate the performance of cellular networks.	H1
CO 5	To formulate efficient cellular radio resource planning.	H2

Course Contents

UNIT-1

INTRODUCTION: Introduction to Generation of Wireless communication systems- 1G, 2G, 3G, 4G, 5G. Examples of various wireless communication systems: paging system, Wireless Local Loop, Bluetooth, Introduction to frequency bands for radio transmission, Applications of wireless communication.

UNIT-II

CELLULAR SYSTEM: The Cellular concept, Frequency Reuse, basic theory of hexagonal cell layout, Frequency Management and Channel Assignment, Call drops, hand off, types of handoff, Method to improve capacity, Call Control, Mobility Management and location Tracing, Erlang capacity comparison.

UNIT –III

PATH LOSS ANALYSIS: Models for Path loss: Free space propagation, Okumura model, Hata model, Longley-Rice model, PCS extension to Hata model, Partition loss modelling, Log

distance path loss model, Ericsson multiple breakpoint model. Concept of coherence bandwidth, coherence time & Doppler spread. Types of fading: Flat fading, frequency selective fading, fast fading, slow fading. Diversity techniques in mobile radio.

UNIT-IV

MULTIPLE ACCESS TECHNIQUES & WIRELESS STANDARDS: Multiple Access Techniques used in Mobile Wireless Communications: FDMA, TDMA, CDMA, SSMA, cellular CDMA & its capacity, Rake receiver.

GSM & GPRS STANDARD: Architecture, channels, RF specifications. IS-95 standard: architecture, channels, RF specifications. Introduction to WCDMA, OFDM, LTE, 5G Technology: Basic architecture/ block diagram, RF specifications, applications.

TEXT BOOKS:

1. Theodore S. Rappaport, Wireless Communications Principles and Practice, IEEE Press, Prentice Hall.
2. William C.Y.Lec, Mobile Cellular Telecommunications, Analog and Digital Systems, McGraw Hill Inc.

REFERENCE BOOKS:

1. Mobile Communication Hand Book, 2nd Ed., IEEE Press.
2. Wireless Communications, TL Singal, McGraw Hill (India).
3. Wireless and personal Communication Systems by VK Garg and JE Wilkes; Prentice Hall, 1996.
4. Mobile and Personal Communication Systems and Services, Raj Pandya, Wiley IEEE Press.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	-	2	1	-	3	3	3	2
CO2	3	3	2	2	1	3	-	-	2	2	-	3	3	3	3
CO3	3	3	2	2	2	3	2	-	2	1	-	3	3	3	2
CO4	3	3	3	3	1	3	-	1	2	1	-	3	3	3	2
CO5	3	3	3	3	2	3	2	1	2	2	-	3	3	3	3

DIGITAL SYSTEM DESIGN
PCC-ECE405-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog & Digital Circuits, Microprocessor and its Applications

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe digital system design process.	L1
CO 2	Explain various design methodologies for digital system design.	L2
CO 3	Apply the knowledge of digital design techniques for system design.	L3
CO 4	Demonstrate the use of HDL in Digital systems design.	H1
CO 5	Evaluate and compare different design techniques available for digital logics	H2
CO 6	Design the specifications for the system to be created/implemented using HDL	H3

Course Contents

UNIT I

Benefits of CAD, Design abstractions, Digital system design process, Computer aided design tools for digital systems, Hardware Description Languages, introduction to VHDL/Verilog and its capabilities, VHDL-data objects, classes and data types, operators, overloading, logical operators, types of delays, Entity and Architecture declaration. Introduction to behavioral, dataflow and structural models, Hierarchical Modeling Concepts: Design Methodologies.

UNIT II

Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.

UNIT III

VHDL Models and Simulation of combinational circuits such as Multiplexers, De-multiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc, VHDL Models and Simulation of Sequential Circuits, Shift Registers, Counters etc.

UNIT IV

Design with PLDs, Programmable logic devices: ROM, PLAs, PALs, CPLDs and FPGA, Design implementation using ROM, PLA, PAL, CPLDs and FPGAs. Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL

Text Books:

1. Introduction to Digital Systems: Milos Ercegovac, T Lang, and J H Moreno, Wiley-2014
2. VHDL Modular design and synthesis of Cores and systems: Z Navabi, McGraw Hill, 2014
3. VHDL Analysis and Modeling of Digital system : Z Navabi, McGraw Hill, 2nd Ed

References Books:

1. A VHDL Primer: J Bhaskar, PHI 1995.
2. Digital Design with introduction to HDL: Mano and Ciletti, Pearson 2013.
3. VHDL Synthesis: A Practical Primer; J Bhaskar, BS Publication 2001
4. Digital System Design Using VHDL: Charles H Roth, Jr: Thomson Books/Cole 1998
5. Verilog Digital system Design: Z Navabi; McGraw Hill, 2nd Ed 2006.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	-	2	1	-	3	3	2	2
CO2	3	3	2	2	2	3	2	-	2	2	-	3	3	3	3
CO3	3	3	2	2	2	3	2	-	2	2	-	3	3	2	2
CO4	3	3	3	3	2	3	1	1	2	2	-	3	3	3	2
CO5	3	3	3	3	3	3	1	1	2	1	-	3	3	3	3
CO6	3	3	3	3	3	3	1	1	2	1	-	3	3	2	3

DIGITAL SIGNAL PROCESSING LAB
PCC-ECE401-P

Course Credits :2 Contact Hours: 4/week Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand the basic operations of signal processing & plot basic discrete/digital signals using MATLAB.	L2
CO 2	To demonstrate interpolation and decimation operations using MATLAB.	L3
CO 3	To analyze and examine the sampling theorem.	H1
CO 4	To evaluate magnitude and phase spectrum of a discrete time signal using DFT to determine the spectral components of the signal.	H2
CO 5	To develop and design IIR and FIR band pass, band stop, low pass and high pass filters using MATLAB.	H3

List of Experiments

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine) in MATLAB.
2. To generate triangular, saw tooth and square waveform using MATLAB program.
3. To develop program for discrete convolution.
4. To develop program for discrete correlation.
5. To develop program for sampling of a continuous time signal with different sampling frequency in order to study aliasing effect.
6. To develop a program to determine the impulse response of a system for which input sequences and output sequences are given.
7. To design Butterworth IIR filters (low-pass, high pass, band-pass, band-stop).
8. To design digital FIR filters using windows technique. (Rectangular window, Blackman window, Hamming window, Hanning window.
9. To plot the magnitude and phase spectrum of a signal using DFT.
10. To perform interpolation and decimation using MATLAB.
11. To develop program for computing linear and circular convolution.
12. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
13. To generate DTMF signals using MATLAB.
14. To develop program for stability test using MATLAB.
15. To develop a program for computing inverse Z-transform of a rational transfer function.
16. To develop a program for computing parallel realization values of IIR digital filter.
17. To develop a program for computing cascade realization values of IIR digital filter.

Note: At least twelve experiments are to be performed in the semester, out of which minimum eight experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	3	2
CO2	3	3	2	2	3	3	2	-	3	3	3	3	3	2	3
CO3	3	3	3	3	2	3	1	2	2	3	3	3	3	3	2
CO4	3	3	3	3	2	3	1	2	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	2	2	3	2	3	3	3	2	3

DIGITAL SYSTEM DESIGN LAB
PCC-ECE405-P

Course Credits: 2 Contact Hours: 4/week, (L-T-P: 0-0-4) Mode: Lab work Examination Duration: 3 hours	**Course Assessment (Internal: 30; External:70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the use of HDLs for VLSI digital system design.	L1
CO 2	Illustrate the various CAD tools available for Digital system design.	L2
CO 3	Demonstrate the importance of HDL and CAD tools in VLSI digital system design.	L3
CO 4	Compare the various design techniques for digital system design.	H1
CO 5	Design and evaluate the performance of digital systems.	H2
CO 6	Develop or create digital system using HDLs and FPGAs.	H3

List of Experiments

1. Familiarization with VHDL/Verilog and CAD tools.
2. Design all digital logic gates using VHDL.
3. Design a half adder digital logic using VHDL.
4. Design a 3-to-8 Decoder using 1-to-2 Decoder using VHDL.
5. Design a 8-to-1 MUX using 2-to-1 MUX using VHDL.
6. Design 1-bit full adder using 2x1 Multiplexer in VHDL.
7. Design a 4-Bit Comparator using VHDL.
8. Design all logic gates and 4-bit Full Adder using VHDL.
9. Design a 4-bit Full Adder-Subtractor using VHDL.
10. Design a 4-bit ALU using VHDL.
11. Design a D-latch D-FF using VHDL.
12. Design register, shifter and counter using VHDL.
13. FPGA implementation of 4bit Counter using VHDL.
14. FPGA implementation of Finite state machine using VHDL.
15. FPGA implementation of 7-segment decoder using VHDL.
16. Write VHDL code to display messages on an alpha numeric LCD display.

NOTE: At least twelve experiments are to be performed out of which at least eight experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	-	2	2	3	3	3	2	2
CO2	3	3	3	3	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	-	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

MINOR PROJECT
PROJ-ECE413-P

Course Credits :4 Contact Hours: 8/week Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Relate practical knowledge within the chosen area of technology for project development	L1
CO 2	Understand methodologies and professional way of documentation and communication.	L2
CO 3	Illustrate the key stages in development of the project.	L3
CO 4	Identify, analyze, formulate and handle projects with a comprehensive and systematic approach	H1
CO 5	Contribute as an individual or in a team in development of technical projects	H2
CO6	Develop effective communication skills for presentation of project related activities	H3

NOTE: The minor project will be completed and evaluated at the end of the 7th semester on the basis of its implementation, presentation, viva-voce and report.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

Practical Training-II

General Course Information:

Course Code: INT-ECE415-P Course Credits: 1.0 Type: Compulsory Contact Hours: 2 hours per week (L-T-P: 0-0-2) Mode: Practical	**Course Assessment Methods (Internal: 100)** Assessment of Practical Training-II will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of 6th sem.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	outline technical documents and give oral presentations related to the work completed	L1
CO 2	recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the industry	L2
CO 3	acquire and apply fundamental principles of engineering and an ability to work in actual working environment.	L3
CO 4	analyze practical application of the subjects taught during the course	H1
CO 5	develop social, cultural , global and environmental responsibilities as an engineer	H2
CO 6	identify, formulate and model problems and find engg. Solution based on a system approach	H3

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	3	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	3	3	3	3	3	2	2

Detailed Syllabus
of
B.Tech.(ECE)
8th Semester

MAJOR PROJECT
PROJ-ECE428-P

Course Credits :6 Contact Hours: 12/week Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Extend or use the idea in mini project for major project.	L1
CO 2	Describe a through and systematic understanding of project contents	L2
CO 3	Use effectively oral, written and visual communication	L3
CO 4	Identify, analyze, and solve problems creatively through sustained critical investigation.	H1
CO 5	Demonstrate an awareness and application of appropriate personal, societal, and professional ethical standards.	H2
CO6	Know the key stages in development of the project.	H3

NOTE: The major project will be completed and evaluated at the end of the 8th semester on the basis of its implementation, presentation, viva-voce and report.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	3	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	3	3	3	3	3	2	2

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-1

CONSUMER & INDUSTRIAL ELECTRONICS
PEC-ECE308-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites:

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Name different types of Audio/Video devices	L1
CO 2	Explain the devices on component level.	L2
CO 3	Illustrate state of the art technology in consumer items	L3
CO 4	Examine proper transducer and other constituent components on the basis of particular application.	H1
CO 5	Judge the faults in consumer electronic items	H2
CO 6	Develop the idea of troubleshooting in consumer electronics items	H3

Course Contents

UNIT-1

AUDIO SYSTEMS: Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity and linearity, Reverberation; Audio level metering, decibel level in acoustic measurement; Microphone: working principle, sensitivity, nature of response, directional characteristics; Types: carbon, condenser, crystal, electrets, tie-clip, wireless; Loud speaker: working principle, characteristic impedance, watt capacity, Types: electrostatic, dynamic, permanent magnet etc , woofers and tweeters; Sound recording: Optical recording, stereophony and multichannel sound, MP3 standard; Audio system: CD player, home theatre sound system, surround sound; Digital console: block diagram, working principle, applications.

UNIT-II

VIDEO SYSTEMS: Basic block diagram and working of the following: Digital TVs, LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver; Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI Multimedia Interface), Digital Video Interface; CD and DVD player: working principles, interfaces; Touch screen

UNIT –III

OFFICE GADGETS: Basic block diagram and working of the following: Desktop computer, Mouse, Keyboard, Laptop, Digital Storage Devices; Printer (inkjet, laser and 3D), Scanner, FAX machine, Photocopier, EPABX, Online and Offline UPS, LCD Projector, Bar Coding Machine

UNIT-IV

HOME GADGETS: Basic block diagram and working of the following: Air Conditioner, Digital Camera/ Camcoder, Refrigerator, Microwave Oven, Mobile Phone Handset, Mobile Charger, RO system, Different types of Batteries, Inverter, Home security and CCTV

TEXT BOOKS:

1. S.P Bali, “Consumer Electronics”, Pearson Education Asia Pvt., Ltd.
2. R Bali and S.P Bali, “Audio Video Systems: Principle Practice & Troubleshooting, Khanna Publication.
3. Philip Hoff, “Consumer Electronics for Engineers”, Cambridge University Press

REFERENCE BOOKS:

1. W. Jerry and B. Blair, “Standard Handbook of Audio Engineering”, Mc Graw Hill Professional
2. Millman, “Integrated Circuits”, Tata Mc Graw Hill Publishers
3. Boylsted, “Electronic Devices and Circuit Theory”, Pearson

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**-**	**2**	**-**	**1**	**2**	**1**	**-**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**1**	**1**	**2**	**-**	**1**	**2**	**2**	**-**	**2**	**2**	**2**	**2**
CO3	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**3**	**3**

INFORMATION THEORY AND CODING
PEC-ECE310-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability theory**.**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe information theory methods as well as advanced techniques of digital signal processing to communication systems	L1
CO 2	To derive equations for entropy mutual information and channel capacity for all types of channels	L2
CO 3	To apply various source and error control codes and their properties.	L3
CO 4	To compare block codes, convolution codes etc. For error detection and correction.	H1
CO 5	To design various cryptography algorithms & standards.	H3

Course Contents

UNIT-1

INTRODUCTION TO INFORMATION THEORY: Review of Probability Theory, Introduction to Information Theory, Uncertainty and Information, Entropy, Rate of Information, Joint Entropy, Conditional Entropy, Mutual Information, Channels: Noise Free Channel, Binary Symmetric Channel (BSC), Binary Erasure Channel (BEC), Channel Capacity, Shannon's Theorem, Continuous Channel, Capacity of a Gaussian Channel: Shannon-Hartley Theorem, Bandwidth and S/N Trade-off.

UNIT-II

SOURCE CODING: Source Coding Theorem, Shannon- Fano Coding, Huffman Coding, The Lempel-Ziv Algorithm, Lossy Data Compression: Rate Distortion Function, Introduction to Image Compression.

ERROR CONTROL CODING: Introduction to Error Control Coding, Type of Codes, General Description of Basic ARQ Strategies, Hybrid ARQ Schemes.

UNIT –III

LINEAR BLOCK CODES: Linear Block Codes: Properties, Specific Linear Block Codes, Hamming Code, Cyclic Codes, B.C.H Codes, Reed-Solomon Codes, Decoding of Linear Block Codes, Maximum Likelihood Decoding, Error Detecting and Correcting Capabilities of a Block Code.

UNIT-IV

CONVOLUTIONAL CODES: Transfer Function of a Convolutional Code, Viterbi Decoding, Distance Properties of Binary Convolutional Codes, Burst Error Correcting Convolutional Codes.

INFORMATION THEORY AND CRYPTOGRAPHY: Introduction to cryptography, Encryption Techniques, Encryption Algorithms, Symmetric Key Cryptography, Asymmetric Key Algorithms, Data Encryption Standard (DES).

TEXT BOOKS:

1.J G Proakis, “Digital Communications”, Tata McGraw Hill, 2001.
2. Ranjan Bose, “ITC and Cryptography”, Tata McGraw-Hill.
3. ArijitSaha, Nilotpal Manna, SurajitMandal, “Information Theory, Coding and cryptography”, Pearson Education, 2013.

REFERENCE BOOKS:

1. Thomas M. Cover, Joy A. Thomas, “Elements of Information Theory”, Wiley Publication.
2. R.P. Singh and S.D. Sapre, “Communication System: Analog and Digital”, Tata McGraw-Hill.
3. Simon Haykin, “Digital communication”, John Wiley.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	2	-	1	2	1	-	3	2	2	2
CO2	3	3	2	1	1	2	1	1	2	2	-	3	2	2	2
CO3	3	3	2	1	1	2	1	1	2	2	-	3	2	3	2
CO4	3	3	3	2	1	2	1	2	2	3	-	3	3	3	3
CO5	3	3	3	2	2	2	2	2	2	3	-	3	3	3	3

ADVANCED INSTRUMENTATION and CONTROL
PEC-ECE312-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	Course Assessment Methods (Internal: 30; External: 70) Two Minor Tests Each of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: EMI

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the various types of instruments and their characteristics.	L1
CO 2	Understand the criteria for selection of transducers.	L2
CO 3	Illustrate the various types of signal conditioning techniques.	L3
CO 4	Analyze the various types of A/D converters and D/A converters.	H1
CO5	Design the various Modes of data transmission.	H3
CO6	Develop and analyze state space models.	H3

Course Content

UNIT- I

Introduction: Functional block diagram of generalized Instrumentation system. Input-output configuration, specifications under steady and transient state & their performance characteristics.
Review of Sensors and Transducers: Temperature, pressure, displacement, velocity, acceleration, strain and torque type.

UNIT-II

Signal Conditioning: Instrumentation Amplifier characteristics, CMRR, balanced modulator and demodulator, filters, voltage sensitive bridge and current sensitive bridge. Push-pull transducers, Blumlein bridge, integration, differentiation and sampling, A/D and D/A conversion, choppers, voltage to time A/D conversion, voltage to frequency conversion concept and methods.

UNIT –III

Telemetry: Modes of data transmission, DC telemetry system, voltage telemetry system, current telemetry system, AC telemetry system, AM, FM, Phase modulation, pulse telemetry system,

PAM, Pulse frequency system, pulse duration modulation(PDM), digital telemetry, pulse code modulation, transmission channels and media, wire line channels, radio channels, micro wave channels, power line carrier channels, multiplexing in telemetry systems, TDM.

UNIT- IV

Nonlinear Control System: Introduction to Nonlinear systems and their properties, Common Non-linearity, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

State Space Analysis: The Concept of State and State Models, State Diagram, State Space and State Trajectory, State Space Representation using Phase Variable and Canonical Variables, Solution of State Equation, State Transition Matrix and its Properties, Eigen Values, Eigen Vectors, Model Matrix, Diagolization, Generalized Eigen vectors, Computation of State Transition Matrix using Laplace Transformation, Power Series Method, Cayley-Hamilton Method, Similarity Transformation Method. Controllability and Observability Tests: Kalman's test, Gilbert's Test, Controllability and Observability Canonical Forms.

Text Books:

1. A.K. Sawhney, A Course in Electrical & Electronics Measurement & Instrumentation. Pub.: Dhanpat Rai & Sons.
2. A K Ghosh: Introduction to Instrumentation and Control, Prentice Hall of India, New Delhi 2004.
3. C.S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices & Systems. New Delhi: Tata McGraw-Hill Pub. Co. Ltd.

Reference Books:

1. Oliver & Cage, Electronic Measurement & Instrumentation.
2. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996
3. E.O. Doeblin, "Measurement System : Applications and Design", McGraw Hill Publications

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**-**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO3	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**3**	**3**

SATELLITE COMMUNICATION
PEC-ECE314-T

Course Credits : 03 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of communication engineering and wave propagation.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the revolving mechanism of satellites.	L1
CO 2	To explain the working principle and operation of satellites.	L2
CO 3	To illustrate the various performance affecting factors.	L3
CO 4	To evaluate the various types of satellite links.	H2
CO 5	To design different satellite links and application systems.	H3

Course Contents

UNIT-1

SATELLITES & MODULATION: Basic block diagram of satellite communication, Satellite frequency allocation & Band spectrum, Advantages of satellite communication, Active & Passive satellites, Analog FM Transmission by Satellite, S/N Ratios for FM Video Transmission, Generation of Quadrature Phase Shift Keying (QPSK) Signals, Transmission of QPSK Signals through a Bandlimited Channel, Signal-to-Noise Ratio in Digital Voice Systems.

UNIT-II

SATELLITE LINK DESIGN: Basic link analysis, Interference analysis, terrestrial interference, System Noise temperature and G/T ratio, G/T ratio for earth stations, Uplink & downlink design, Design for Specified C/N: Combining C/N and C/I Values in Satellite Links , system design examples.

UNIT –III

ORBITAL MECHANISM & MULTIPLEXING: Satellite orbit and orbital equations, Kepler's laws of planetary motion, Look angle calculation, coverage angle and slant range, orbital perturbations, Orbital Elements, Apogee and Perigee Heights. TDMA, TDMA-Frame structure, Multiple Beam (Satellite switched) TDMA satellite system, Beam Hopping (Transponder Hopping) TDMA, TDMA compared to FDMA, CDMA & hybrid access techniques.

UNIT-IV

SATELLITE BASED NAVIGATION SYSTEM: Basic principles of satellite navigation, Signal travel time, Determining position, functional segments of GPS, Improved GPS: DGPS, SBAS, A-GPS and HSGPS.

TEXT BOOKS:

1. Tri, T.Ha, "Digital Satellite Communications, " (Second Edition) Tata McGraw Hill.
2. Timothy Pratt, Jeremy E., "Satellite Communications," Willey.
3. G S Rao, "Global Navigation Satellite Systems," Tata McGraw Hill.

REFERENCE BOOKS:

1. D. Roddy, Satellite Communication (4/e), McGraw- Hill, 2009.
2. B.N. Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**-**	**2**	**-**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**1**	**1**	**2**	**-**	**1**	**2**	**2**	**-**	**3**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**3**	**3**

COMPUTER ARCHITECTURE & ORGANIZATION
PEC-ECE316-T

General Course Information

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Digital Electronics and computer systems.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Outline the general concepts of digital electronics and computer organisation and architecture	L1
CO 2	Discuss the basic components and their interfacing.	L2
CO 3	Apply instructions for performing different operations	L3
CO 4	Analyse the effect of addressing modes on the execution time of a program	H1
CO 5	Evaluate the performance of different types of memory, processing and access methods	H2
CO 6	Design of simple computer with different instruction sets.	H3

Course Content

UNIT I

INTRODUCTION: Boolean algebra and Logic gates, Combinational logic blocks (Adders, Subtractors, Multiplexers, Encoders, Decoders, Demultiplexers, K-Maps), Sequential logic blocks (Flip-Flops, Registers, Counters).

REGISTER TRANSFER & MICRO OPERATIONS: Register transfer language, register transfer, bus and memory transfer, Micro-operation (Arithmetic, Logic and Shift microperations), Arithmetic logic shift unit.

UNIT II

COMPUTER ORGANIZATION AND DESIGN: Store program control concept, computer registers and instruction, timing and control, instruction cycle, memory reference instruction, input-output and interrupt, design of basic computer and accumulator logic.

MICRO PROGRAMMED CONTROL: Control memory, address sequencing, microinstruction formats, micro-program sequencer, Implementation and design of control unit.

UNIT III

CPU & PARALLEL PROCESSING: Introduction of central processing unit, general register organization, stack organization, instruction format, addressing mode and its type (register, immediate, direct, indirect, indexed), operations in the instruction set, Instruction set based classification of processors (RISC, CISC, and their comparison), parallel processing, introduction of Pipelining and its type (Arithmetic, Instruction and RISC pipelining). vector and array processing.

UNIT IV

MEMORY HIERARCHY & I/O TECHNIQUES: The need for a memory hierarchy, Type of Memory: Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types), Auxiliary memory (Magnetic tape and Magnetic Disk), Cache memory (Associative & direct mapped cache organizations), Virtual memory and Associate memory. Memory parameters: (Access/ cycle time, cost per bit), Memory management, input-output interface, mode of transfer, DMA (Direct memory transfer).

Text and Reference Books:

1. Mano, M. Morris, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., 1981.
2. M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt. Ltd., 1993.
3. Milles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization, An Integrated Approach, JohnWiley & Sons Inc., 2007.
4. William Stallings, 10th edition, Computer Organization and Architecture, Prentice Hall, 2016.
5. Heuring, V.P., Jordan, H.F., Computer Systems Design and Architecture, Addison Wesley, 1997.
6. R.P Jain, Modern Digital Electronics, 3rd Edition, Tata McGraw Hill,, 2003.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**1**	**-**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**1**	**-**	**2**	**3**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-2

FPGA DESIGN
PEC-ECE407-T

General Information of Course:

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog & Digital Circuits.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe different IC design approaches and tools.	L1
CO 2	Explain the requirements of FPGA implementation.	L2
CO 3	Apply the knowledge of digital design techniques for efficient resource utilization in FPGA design.	L3
CO 4	examine the use of scripts SDF format, user constraint file in FPGA Design.	H1
CO 5	Evaluate and compare design techniques for FPGA implementation of combinational and sequential circuits.	H2
CO 6	Design the specifications for the digital system/circuits to be created/implemented using FPGA.	H3

Course Contents

UNIT-I

Introduction to ASICs and FPGAs, FPGA's and its Design Flows, Reconfigurable Devices, FPGA's/CPLD's, Fundamentals of digital IC design, FPGA & CPLD Architectures, Architectures of XILINX, ALTERA Devices, FPGA Programming Technologies

UNIT-II

FPGA Logic Cell Structures, FPGA Programmable Interconnect and I/O Ports, Designing with FPGAs, Architecture based coding , Efficient resource utilization, Constrains based synthesis False paths and multi cycle paths, UCF file creation, Timing analysis/Floor Planning, Back annotation, Gate level simulation, SDF Format, Scripts, industry Standard FPGA Tools

UNIT-III

FPGA Implementation of Combinational Circuits, FPGA implementation of Sequential Circuits, Timing Issues in FPGA Synchronous Circuits

UNIT-IV

Introduction to Verilog HDL, FPGA design flow with Verilog HDL, FPGA Arithmetic Circuits, FPGAs in DSP Applications, FPGA Microprocessor design, Design FPGA systems at high-level

TEXT BOOKS:

1. Bob Zeidman, Designing with FPGA and CPLDs, BSP publications @2011.
2. Chan & Murad Digital Design using FPGA, BSP @1994
3. Stephen M Trimberger, FPGA Technology, BSP @2015

REFERENCE BOOKS:

1. Wayne Wolf, "FPGA-Based System Design," Prentice Hall, 2004
2. M. D. Ciletti, “Advanced Digital Design with Verilog HDL,” Prentice Hall, 2002
3. Michael Smith, “Application-Specific Integrated Circuits,” Addison-Wesley, 1997

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	2	-	2	2	-	2	3	3	2
CO2	3	3	2	2	1	2	2	-	2	1	-	2	3	2	3
CO3	3	3	2	2	1	2	1	-	2	1	-	2	3	3	3
CO4	3	3	3	2	1	2	1	1	2	2	-	2	3	2	2
CO5	3	3	3	2	1	2	2	1	2	1	-	2	3	3	3
CO6	3	3	3	2	1	2	1	1	2	1	-	2	3	3	2

ANTENNA & WAVE PROPAGATION
PEC-ECE409-T

Course Credits :3.0 Mode :Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Electromagnetic Theory

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the basic fundamental concepts of antenna.	L1
CO 2	To understand the various types of antenna in transmission and reception of signals.	L2
CO 3	To use different wave propagation theories in communications.	L3
CO 4	To compare antennas depending upon modes of propagation and their applications.	H1
CO 5	To evaluate the Gain of antenna for various types of applications.	H2
CO 6	To design an antenna for various applications in communication.	H3

Course Contents

UNIT-1

RADIATION OF ELECTROMAGNETIC WAVES: Short Electric Dipoles, Retarded potential,Radiation from a Small Current Element, field of short dipole, Power Radiated by a Current Element and Its Radiation Resistance, Linear antenna, half wave dipole, Radiation from a Half Wave Dipole, Antenna impedance, Effect of ground on antenna pattern, Input impedance, Mutual Impedance.

UNIT-II

ANTENNA PARAMETERS: Antenna Pattern, Antenna Parameters: Front to Back Ratio, Gain, Directivity, Radiation Resistance**,** Radiation Patterns, Radiation Power Density, Radiation Intensity Efficiency, Aperture Area, Impedance, Effective Length and Beam width, Reciprocity Theorem for Antenna and Its Applications.

UNIT –III

ANTENNA ARRAYS AND TYPES OF ANTENNAS: Types of Antenna Array: Broadside Array, End Fire Array, Collinear Array and Parasitic Array, Two element array, array of point sources, pattern multiplication, Linear Array, Phased Array, Tapering of Arrays, Binomials Arrays, Isotropic Antenna ,Yagi-Uda, Microwave antenna, parabolic feeds, conical, helix, log periodic, horn, Microstrip Antenna and Patch Antenna, Frequency independent concept, RUMSEY'S Principle, Frequency independent planar log spiral antenna, Frequency independent conical spiral Antenna.

UNIT-IV

PROPAGATION: Modes of Propagation, Space wave and Surface Wave, Reflection and refraction of waves by the ionosphere, Tropospheric Wave propagation, bending mechanism of waves by ionosphere, Virtual Height, MUF, Critical frequency, Skip Distance, Duct Propagation, Space wave.

TEXT BOOKS:

1. Antennas by J.D. Kraus, TMH.
2. Antenna & Wave Propagation by K.D Prasad. Satya Prakashan Publication.
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill

REFERENCE BOOKS:

1. Antenna & Radiowave Propogation by Collin,TMH.
2. Electromagnetic Waves & Radiating Systems by Jordan & Balman, PHI.
3. Electromagnetic Waves, R.L. Yadav, Khanna Publishing House.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	2	-	2	1	-	2	3	2	2
CO2	3	3	2	2	2	2	1	-	2	2	-	2	3	3	2
CO3	3	3	2	2	1	2	2	-	2	2	-	2	3	2	2
CO4	3	3	3	2	1	2	2	1	2	1	-	2	3	3	3
CO5	3	3	3	2	2	2	1	1	2	2	-	2	3	3	3
CO6	3	3	3	2	1	2	1	1	2	1	-	2	3	3	3

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
PEC-ECE411-T

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor Tests Each Of 20 Marks, Class Performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of 70 Marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain 7 short answers type questions, Rest of the eight question is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability Theory, Mathematics.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To relate what the AI is.	L1
CO 2	To discuss theoretical concepts behind ANN algorithms.	L2
CO 3	Apply ANN and FNN for knowledge representation and reasoning.	L3
CO 4	To compare utility of various artificial intelligence techniques in various applications.	H1
CO 5	To evaluate and compare performance of pattern recognition algorithms.	H2

Course Contents

UNIT-1

Introduction: Introduction to Artificial Intelligence, Machine learning, and Artificial Neural Networks, Foundations and History of Machine Learning and Neural Networks, Applications of Artificial Intelligence.

Artificial Neural Networks: Neural networks: Biological Neural Network, Artificial Neural Network, Comparison, Artificial Neural Network terminology and definitions, Model of an artificial neural Network,

UNIT-II

Artificial Neural Networks Architectures: Mc-Culloch-Pitts Neuron Model, Learning Rules, Rosenblatt's Perceptron, Examples of learning of AND/OR gate by perceptron, XOR problem, Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

UNIT –III

Fuzzy Logic: Fuzzy Logic: Basic concepts of Fuzzy logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of Fuzzy sets, Fuzzy if-then rules, Variables inference techniques, defuzzification techniques, basic Fuzzy interference algorithm, application of fuzzy logic , Fuzzy system design implementation , useful tools supporting design.

UNIT-IV

Machine Learning using Pattern Recognition: Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

TEXT BOOKS:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial intelligence, McGraw Hill Education. 3rd edition, 2009.
2. S N Sivanandam, S Sumathi, S N Deepa, Introduction to Neural Networks using MATLAB 6.0 , McGraw Hill Education.
3. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI, 2003.
4. Tom M. Mitchell , Machine Learning , McGraw-Hill, 1997
5. J-S. R. Jang, C.-T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 1997.

REFERENCE BOOKS:

1. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007.
2. Deepak Khemani, A first course in Artificial Intelligence, McGraw Hill Education. 3rd edition, 1st edition, 2013.
3. Stuart Russel and Peter Norvig, Artificial intelligence: A modern Approach, Pearson Education, 3rd edition, 2015
4. E Charniak and D McDermott, Introduction to Artificial Intelligence, Pearson Education.
5. Bishop Christopher, Pattern Recognition and Machine Learning, Springer Verlag, 2006.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	-	2	2	3	3	3	2	3
CO2	3	3	3	2	3	3	2	-	2	1	3	3	3	2	2
CO3	3	3	3	2	3	3	1	-	2	2	3	3	3	3	3
CO4	3	3	3	3	2	3	1	1	2	2	3	3	3	3	2
CO5	3	3	3	3	2	3	2	1	2	1	3	3	3	2	3

FPGA DESIGN LAB
PEC-ECE407-P

Course Credits: 1 Contact Hours: 2/week, (L-T-P: 0-0-2) Mode: Lab work Examination Duration: 3 hours	**Course Assessment (Internal: 30; External:70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the use of HDL for FPGA implementation.	L1
CO 2	Illustrate the various CAD tools available for FPGA design and implementation.	L2
CO 3	Demonstrate the importance of HDL and CAD tools in VLSI digital system design.	L3
CO 4	Compare the various design techniques for digital system design.	H1
CO 5	Evaluate the performance of digital systems on FPGA.	H2
CO 6	Develop or create digital system using HDL and FPGA.	H3

List of Experiments

1. FPGA design with HDLs-familiarization.
2. FPGA implementation of 4-bit adder using HDL.
3. FPGA implementation of ALU using HDL.
4. FPGA implementation of Counter using HDL.
5. FPGA implementation of Finite state machine using HDL.
6. FPGA implementation of 7-segment decoder using HDL.
7. Write HDL code to display messages on an alpha numeric LCD display.
8. Write HDL code to interface Hex key pad and display the key code on seven segment display.
9. Write HDL code to control speed, direction of DC and stepper motor.
10. Write HDL code to accept 8 channel analog signal, Temperature sensors and display the data on LC panel or seven segment display
11. Write HDL code to generate different waveforms (Sine, Square, Triangle, Ramp etc.,) using DAC change the frequency and amplitude.
12. Write HDL code to simulate Elevator operation

NOTE: Ten experiments are to be performed out of which at least six experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	2	-	3	2	2	2	3	2	2
CO2	3	3	2	2	2	3	2	-	3	3	2	2	3	2	3
CO3	3	3	2	2	3	3	1	-	2	3	2	2	3	3	3
CO4	3	3	3	2	3	3	1	2	2	2	3	2	3	3	2
CO5	3	3	3	2	2	3	1	2	3	2	3	2	3	2	3
CO6	3	3	3	2	2	3	2	2	2	3	3	2	3	3	2

ANTENNA AND WAVE PROPAGATION LAB
PEC-ECE409-P

Course Credits :1.0 Contact Hours: 2 Hrs/week Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define and describe basic antenna parameters like radiation pattern, directivity and gain.	L1
CO 2	To apply basic theorems to analyze the variation of field strengths of radiated waves.	L2
CO 3	To demonstrate the structure and operation of various antennas and describe their performance.	L3
CO 4	To examine performance parameters of uniform linear and planar antenna arrays.	H1
CO 5	To design and implement special type of antennas like microstrip antennas.	H3

List of Experiments

1. To study different Antenna parameters and their importance.
2. To analyze the performance parameters of dipole antenna.
3. To analyze the performance parameters folded dipole antenna
4. To analyze the performance parameters of monopole antenna.
5. To analyze the performance parameters of Yagi-Uda antenna.
6. To study the different performance parameters of N element antenna array.
7. To analyze the different performance parameters of Horn antenna.
8. To analyze the performance parameters of reflector antenna.
9. To design a coaxial feed rectangular microstrip antenna using FR4 substrate with dielectric constant 4.4, h=1.6 mm resonating at 2.4 GHz.
10. To design inset feed microstrip antenna using FR4 substrate with dielectric constant 4.4, h=1.6 mm resonating at 2.4 GHz.

Software Required: HFSS/Scilab/CST

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	2	1	2	3	2	2	3	2	2
CO2	3	3	2	2	2	3	1	-	3	2	2	2	3	2	3
CO3	3	3	2	2	3	3	1	-	2	2	2	2	3	3	2
CO4	3	3	3	2	3	2	2	2	3	2	3	2	3	3	3
CO5	3	3	3	2	2	2	1	2	3	3	3	2	3	3	2

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB
PEC-ECE411-P

Course Credits : 1 Mode : Practical (P) Teaching schedule L T P : 0 0 2 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To relate theoretical concepts with practical experiments.	L1
CO2	To use modern software based tools.	L3
CO 3	To examine theoretical concepts related to ANN on software.	H1
CO 4	To evaluate and compare performance of various pattern classification algorithms on real world problems.	H2
CO 5	To develop an application oriented pattern classification system using modern software based tools.	H3

List of Experiments

1. To familiarize with MATLAB software.
2. To write a program for classification of linearly separable data with a perceptron model.
3. To write a program for classification of an XOR problem with a multilayer perceptron network.
4. To write a program for classification of a 4-class problem with a multilayer perceptron network.
5. To write a program for classification of an XOR problem using Radial basis function networks.
6. To familiarize with Neural Network Toolbox.
7. To familiarize with Fuzzy Toolbox.
8. To design a fuzzy inference model by using Fuzzy Toolbox.
9. To familiarize with Classification Learner App.
10. To compare performance of various classification algorithms using Classification Learner App.

Software Required: MATLAB/PYTHON

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**-**	**2**	**2**	**3**	**3**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-3

POWER ELECTRONICS
PEC-ECE402-T

General Course Information:

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 1 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Electronics

Course Outcomes:

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the basics operations and characteristics of power electronics devices.	L1
CO 2	To compare the performance of various power semiconductor devices, passive components and switching circuits.	L2
CO 3	To the use of power converters and inverters in commercial and industrial applications.	L3
CO 4	To analyze various single phase and three phase power converter circuits and understand their applications	H1
CO 5	To develop skills to build, and troubleshoot power electronics circuits.	H2
CO 6	To design the SCR controlled devices, firing and commutating circuit, inverters, choppers and drivers.	H3

Course Contents

UNIT-I

Power Semiconductor Devices: Role & applications of power electronics, Construction & Static V-I characteristics of Thyristors, Thyristor turn on methods, switching characteristics of Thyristor, two transistor model of Thyristor, Thyristor Protection, Series and parallel connection of Thyristor, Gate Turn-off Thyristor, Multilayer devices: Construction & characteristics of DIAC, TRIAC.

SCR Commutating Circuits: Thyristor Turn-off methods: Line commutation, Load commutation, forced commutation, Commutating circuits, Voltage commutation, current Commutation & Pulse commutation.

UNIT-II

Converters : Principal of phase controlled rectifiers: single phase half wave circuit with RL load, single phase half wave circuit with RL load and freewheeling diode, Single phase Full wave controlled converters: Mid-Point and Bridge converters, Dual converter: Ideal and Practical dual converter.

UNIT-III

Inverters: Basic circuit, 120 degree mode and 180 degree mode conduction schemes, Force commutated Thyristor inverters: modified McMurray half bridge and full bridge inverters, McMurray -Bedford half bridge and bridge inverters, brief description of parallel and series inverters, current source inverter (CSI).

UNIT-IV

Choppers: Principal of Chopper operation, output voltage control techniques, step-up chopper, one, two, and four quadrant choppers, Thyristor Chopper Circuit: voltage commutated chopper, current commutated chopper and Load Commutated chopper.
Cycloconverters: Basic principle of cycloconverter operation, Types of cycloconverter: non-circulating and circulating types of cycloconverters.

TEXT BOOK:

1. Power Electronics: P.S Bhimra, Khanna Publication.
2. Power Electronics : MH Rashid; PHI.
3. Power Electronics and Introduction to Drives: A.K.Gupta and L.P.Singh;Dhanpat Rai.

REFERENCE BOOKS:

1. Power Electronics: PC Sen; TMH
2. Power Electronics: HC Rai; Galgotia
3. Thyristorised Power Controllers: GK Dubey, PHI

Course Articulation Matrix:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	2	1	-	3	3	3	2
CO2	3	3	2	2	1	3	2	-	2	2	-	3	3	2	2
CO3	3	3	2	2	1	3	2	-	2	2	-	3	3	2	3
CO4	3	3	3	3	2	3	1	1	2	1	-	3	3	3	3
CO5	3	3	3	3	2	3	1	1	2	1	-	3	3	3	2
C06	3	3	3	3	2	3	2	1	2	1	-	3	3	2	3

DATABASE MANAGEMENT SYSTEM
PEC-ECE404-T

General Course Information

Course Credits : 03 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Prerequisite: Knowledge of UNIX, Windows, a programming language and data structures

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe fundamental elements of Database Management System.	L1
CO 2	Discuss principles of relational Database modelling.	L2
CO 3	Apply SQL for designing queries for Relational Databases.	L3
CO 4	Contrast various concurrency control and recovery techniques with concurrent transactions in DBMS.	H2
CO 5	Design models of databases using ER modelling and normalization for real life applications.	H3

Course Content

UNIT - I

OVERVIEW: Database, File Systems vs. DBMS, Characteristics of the Data Base Approach, Database users, Advantages and Disadvantages of a DBMS, Responsibility of Database Administrator.

DATA BASE SYSTEMS CONCEPTS AND ARCHITECTURE: Data Models, Schemas and Instances, DBMS architecture and various views of Data, Data Independence, Database languages.

UNIT - II

E-R MODEL: Entity Types, Attributes & Keys, Relationships, Roles and Structural Constraints, E-R Diagrams, Reduction of an E-R Diagram to Tables. Relational Data Model: Relational Algebra & various operations.

UNIT - III

SQL: Data Definition, Constraints, Insert, Delete & Update statements in SQL, Queries in SQL.
RELATIONAL DATABASE DESIGN: Functional Dependencies, Integrity Constraints, Decomposition, Normalization (Up to 4NF).

UNIT - IV

CONCURRENCY CONTROL TECHNIQUES: ACID properties of a Transaction, Locking Techniques, Time-stamp ordering, Multi-version Techniques, Deadlock, Recovery Techniques in centralized DBMS.
DDBMS DESIGN: Replication and Fragmentation Techniques.

Text and Reference Books:

1. Elmasri, R., and Navathe,S. B., Fundamentals of Database Systems, 3rd Edition, Addison Wesley, 2002.
2. Silberschatz, A., Korth, H. F., and Sudarshan, S., Database System Concepts, McGraw Hill, 2011.
3. Pannerselvam R., Database Management Systems, 2ndEdition, PHI Learning, 2011.
4. Desai, B. C., An Introduction to Database System, Galgotia Publication, 2010.
5. Leon, A., and Leon, M.,Database Management Systems,First Edition, Vikas Publishing, 2009.
6. Mata-Toledo, R., Cushman, P., Sahoo, D., Database Management Systems, Schaums' Outline series, TMH, 2007.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	-	2	1	-	3	3	3	3
CO2	3	3	2	2	2	3	2	-	2	1	-	3	3	2	3
CO3	3	3	2	2	2	3	2	-	2	2	-	3	3	2	2
CO4	3	3	3	3	1	3	1	1	2	2	-	3	3	2	3
CO5	3	3	3	3	2	3	2	1	2	1	-	3	3	3	2

PROBABILITY THEORY AND STOCHASTIC DESIGN
PEC-ECE406-T

Course Credits : 03 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of information theory and engineering mathematics.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the significance of probability & random variables in communication theory.	L1
CO 2	To explain the concept of distribution, density & stochastic theory.	L2
CO 3	To illustrate the significance of random variables & functions in communication engineering.	L3
CO 4	To examine the temporal & spectral characteristics of various functions & signals.	H1
CO 5	To judge the distribution of different variables in the real world applications.	H2

Course Contents

UNIT-1

PROBABILITY & RANDOM VARIABLE: Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events. Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous, and Mixed Random Variables.

UNIT-II

DISTRIBUTION & DENSITY FUNCTIONS: Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh and Conditional Distribution, Methods of defining Conditional Event, Conditional Density, and Properties. Operation on One Random Variable – Expectations: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Characteristic Function, Moment Generating Function.

UNIT –III

MULTIPLE RANDOM VARIABLES: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, Unequal Distribution, Equal Distributions.

UNIT-IV

STOCHASTIC PROCESSES: Stochastic Processes, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationary and Statistical Independence, First-Order Stationary Processes, Second-Order and Wide-Sense Stationary, Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, 4 Ed., 2001, TMH.
2. Probability and Random Processes – Scott Miller, Donald Childers, 2 Ed, Elsevier, 2012.
3. Theory of Probability and Stochastic Processes- Pradip Kumar Gosh, University Press

REFERENCE BOOKS:

1. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, 4 Ed., TMH.
2. Random Processes with Application to Signal Processing – Henry Stark and John W. Woods, 3 Ed., PE
3. Statistical Theory of Communication - S.P. Eugene Xavier, 1997, New Age Publications.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	2	2	-	3	3	3	3
CO2	3	3	2	2	1	3	1	-	2	1	-	3	3	2	3
CO3	3	3	2	2	2	3	1	-	2	2	-	3	3	2	2
CO4	3	3	3	3	2	3	2	1	2	1	-	3	3	3	3
CO5	3	3	3	3	1	3	1	1	2	1	-	3	3	3	2

AUDIO & SPEECH PROCESSING
PEC-ECE408-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 1 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To Define speech signal modelling	L1
CO 2	To Illustrate the structure of human ear	L2
CO 3	To Apply various speech quantizers	L3
CO 4	To Compare different speech production models	H1
CO 5	To Evaluate filter coefficients	H2

Course Contents

UNIT-1

INTRODUCTION: Speech production and modelling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid; Requirements of speech codec's –quality, coding delays, robustness, Audio synthesis and Audio effects.

SPEECH SIGNAL PROCESSING: Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

UNIT-II

LINEAR PREDICTION OF SPEECH: Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals-prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT –III

SPEECH QUANTIZATION: Scalar quantization-uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization–distortion measures.

SCALAR QUANTIZATION OF LPC: Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT-IV

LINEAR PREDICTION CODING: LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.
CODE EXCITED LINEAR PREDICTION: CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders.
SPEECH CODING STANDARDS - An overview of ITU-T G.726, G.728 and G.729standards.

TEXT BOOKS:

1. "Digital Processing of Speech Signals", Pearson Education, L.R. Rabiner and R.W. Schafer, Delhi, India, 2004.
2. "Digital Speech", A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.
3. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

REFERENCE BOOKS:

1. "Discrete-Time Processing of Speech Signals", J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis, Wiley, IEEE Press, NY, USA, 1999.
2. "Multimedia signal processing", Vaseghi, SaeedV, England John Wiley&Sons 2007

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	-	2	2	-	3	3	3	2
CO2	3	3	2	2	-	3	-	-	2	1	-	3	3	2	3
CO3	3	3	2	2	-	2	1	-	2	2	-	3	3	3	2
CO4	3	3	3	3	1	3	-	1	2	1	-	3	3	3	3
CO5	3	3	3	3	1	2	1	1	2	1	-	3	3	3	2

RADAR & SONAR ENGINEERING
PEC-ECE410-T

Course Credits :3.0 Mode :Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Antenna & Wave Propagation, Microwave & Radar Engineering

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define basic principal of radar system.	L1
CO 2	To compare various tracking system used in radar.	L2
CO 3	To illustrate different types of radars and their applications	L3
CO 4	To compare various types of radar systems.	H1
CO 5	To select detection theory to radar and sonar systems.	H2
CO 6	To design basic sonar, radar, and navigation systems	H3

Course Contents

UNIT-1

INTRODUCTION TO RADAR: Radar Block Diagram & operation, Radar Frequencies, Radar development, Application of Radar, Simple form of Radar Equation, Prediction of Range performance, Minimum detectable signal, Receiver noise, Signal to Noise ratio,Transmitter Power, Pulse repetition frequency & range ambiguities, System losses, Propagation effects.

UNIT-II

CW & MTI RADAR: The Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple Frequency CW, Radar, Delay Line Cancellors, Multiple or staggered, Pulse repetition frequencies, Range-Gated Doppler Filters, Digital Signal Processing, Other MTI delay line, Limitation of MTI performance, Noncoherent MTI, Pulse Doppler Radar, MTI from a moving platform.

UNIT –III

RECEIVERS &TRACKING RADAR: Tracking with Radar, Sequential Lobbing, Conical Scan, Monopulse Tracking Radar, tracking in range, Acquisition, Radio Navigational Aids: Radio direction finding system, Direction finding using loop antenna & Adcock antenna, LORAN, radar Antennas, Radar Receivers, Noise Figure, Mixer, Low-noise Front ends, Displays, Duplexer, Receiver protectors.

UNIT-IV

SONAR: Introduction to Sonar, Block diagram& Working, Active & Passive Sonar, Performance Factors, Effect of Sonar on Marine Life, Applications

TEXT BOOKS:

1. Skolnik, Merrill," Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2001.
2. Lawrence J. Ziomek, "An Introduction to Sonar" CRC Press.
3. K. K. Sharma, fundamentals of Radar, Sonar and Navigation Engineering, S K Kataria & Sons.

REFERENCE BOOKS:

1. Electronic Communication Systems: Kennedy; TMH.
2. M. Kulkarni, Microwave & Radar Engineering, Umesh Publications.
3. Microwave & Radar Engg, Dr. A. K. Gautam, Katson Books.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	-	2	2	-	3	3	3	3
CO2	3	3	2	2	1	3	1	-	2	1	-	3	3	3	2
CO3	3	3	2	2	-	3	2	-	2	2	-	3	3	2	2
CO4	3	3	3	3	-	3	2	1	2	2	-	3	3	3	3
CO5	3	3	3	3	1	3	2	1	2	1	-	3	3	3	3
CO6	3	3	3	3	-	3	1	1	2	1	-	3	3	3	3

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-4

ROBOTICS
PEC-ECE412-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the history, concepts and key components of robotics technologies.	L1
CO 2	To describe and compare various robot sensors and their perception principles that enable a robot to analyse their environment, reason and take appropriate actions toward the given goal.	L2
CO 3	To apply the learned knowledge and skills in practical robotics applications.	L3
CO 4	To analyse the problems in spatial coordinate representation and spatial transformation, robot locomotion, kinematics, motion control, localization and mapping, navigation and path planning.	H1
CO 5	To plan, design and implement robotic systems, algorithms and software capable of operating in complex and interactive environments.	H2
CO 6	To develop robotic path motions and to use hydraulics and pneumatics in industrial robots.	H3

Course Contents

UNIT-1

BASICS OF ROBOTICS: Robots and their applications: Robot subsystems, classification of robots, industrial applications**.**

Actuators and grippers: Electric actuators, hydraulic actuators, pneumatic actuators, selection of motors, grippers.

Sensors, vision and Signal conditioning: Sensor classification, internal sensors, external sensors, vision, signal conditioning, sensor selection

UNIT-II

KINEMATICS AND DYNAMICS OF ROBOT: Kinematics: Forward position analysis, inverse position analysis, velocity analysis, link velocities, Jacobian computation, DeNOC, forward and inverse velocity analysis, acceleration analysis**.**

Dynamics: Inertia properties, Euler-Lagrange formulation, Newton-Euler formulation, recursive Newton- Euler algorithm, dynamic algorithms Recursive robot dynamics: Dynamic modelling, analytical expressions, recursive inverse dynamics of robo analyser, recursive forward dynamics and simulation

UNIT –III

LINEAR AND NONLINEAR CONTROLS FOR ROBOTS: Linear control: Control techniques, dynamic systems, transfer function and state space representation, robotic joint, performance and stability of feedback control, PID control of a moving block.
Nonlinear controls: Control of a moving block, multivariable robot control, stability of multi-DOF robot, linearized control, PD position control, computed torque control, feed forward control, robust control, adaptive control, Cartesian control.

UNIT-IV

MOTION PLANNING AND CONTROL HARDWARE: Motion planning: Joint space planning, cartecian space planning, path primitives, cartesian trajectories, point to point vs continuous path planning. Control hardware: Control considerations, hardware architecture, hardware for joint controllers, computational speed.

TEXT BOOKS:

1. S.K Saha, “Introduction to Robotics”, McGraw Hills
2. Mittal and Nagrath, ‘Robotics and Control”, McGraw Hills
3. N. Odrey, “Industrial Robotics - SIE: Technology - Programming and Applications”, McGraw Hills

REFERENCE BOOKS:

1. S.K. Saha, “Dynamics of Three-Type Robotic Systems”, Springer
2. I.J. Nagrath, “Control System Engineering”, New Age International
3. R.S. Khurmi, “A Text Book of Engineering Mechanics”, S. Chand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	3	2	-	2	2	-	3	3	3	3
CO2	3	3	2	2	-	3	1	-	2	1	-	3	3	2	2
CO3	3	3	2	2	-	3	2	-	2	1	-	3	3	2	2
CO4	3	3	3	3	-	3	2	1	2	2	-	3	3	3	3
CO5	3	3	3	3	-	3	1	1	1	1	-	3	3	3	3
CO6	3	3	3	3	-	3	2	1	2	1	-	3	3	2	3

OPTICAL COMMUNICATION
PEC-ECE414-T

Course Credits : 3.0 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Dual nature of light, basics of communication

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the principles of optical fiber communication.	L1
CO 2	To classify various components and advantages of optical communication.	L2
CO 3	To demonstrate the operation of LASERs, LEDs and detectors.	L3
CO 4	To compare and differentiate various components and parts of optical communication system according to their application	H1
CO 5	To select the appropriate fiber for communication according to the requirements	H2
CO 6	To analyse and design optical network and understand optical communication systems and networks.	H3

Course Contents

UNIT-1

INTRODUCTION TO OPTICAL COMMUNICATION SYSTEMS : Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model, Different types of optical fibers, Electromagnetic spectrum used for optical communication, block diagram of optical communication system, Advantages of optical fiber communication.

UNIT-II

OPTICAL FIBERS: Optical fibers structures and their types, fiber characteristics : attenuation, scattering, absorption, fiber bend loss, dispersion, material, waveguide, polarized mode dispersion, intermodal and intramodal dispersion, fiber couplers and connectors, Signal degradation on optical fiber due to dispersion and attenuation, OTD.

UNIT –III

OPTICAL SOURCES AND SWITCHES: LEDs and LASERs, Photo-detectors - PIN-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties, internal and external quantum efficiency, Optical switches - coupled mode analysis of directional couplers, electro-optic switches, optical cross connects, Fiber Bragg grating.

UNIT-IV

AMPLIFIERS AND OTHER SYSTEMS: Optical amplifiers - EDFA, Raman amplifier, WDM and DWDM systems. Principles of WDM networks, Non-linear effects in fiber optic links. Concept of self-phase modulation, solutions, SONET, ROF, XPM, FWM, SBS, SRS, fiber to home, fiber to premises, optical transport networks.

TEXT BOOKS:

1. J. Keiser, Fiber Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
3. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

REFERENCE BOOKS:

1. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
2. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
3. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979.
4. G. Agrawal, Nonlinear fiber optics, Academic Press, 2nd Ed. 1994.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	3	1	-	3	2	-	3	3	3	3
CO2	3	3	2	2	-	3	1	-	2	1	-	3	3	2	3
CO3	3	3	2	2	-	3	2	-	3	1	-	3	3	3	2
CO4	3	3	3	3	-	3	1	1	3	2	-	3	3	3	3
CO5	3	3	3	3	-	3	2	1	3	2	-	3	3	3	3
CO6	3	3	3	3	-	3	2	1	2	1	-	3	3	3	3

OPERATING SYSTEMS
PEC-ECE416-T

Course Credits: 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: programming in C and knowledge of computer fundamentals.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	List various functions and design characteristics of operating systems	L1
CO 2	Explain fundamental concepts of operating systems.	L2
CO 3	Apply operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc.	L3
CO 4	Analyze the issues related to various operating systems.	H1
CO 5	Design solutions for the memory and process management problems	H3

Course Content

UNIT I

INTRODUCTORY CONCEPTS: Operating systems functions and characteristics, operating system services and systems calls, system programs, operating system structure. Operating systems generation, operating system services and systems calls. Types of Operating systems: Batch operating system, Time-sharing OS, Distributed operating system, Real-time systems.

FILE SYSTEMS: Types of Files and their access methods, File allocation methods, Directory Systems: Structured Organizations, directory and file protection mechanisms, disk scheduling and its associated algorithms.

UNIT II

PROCESSES: Process concept, Process Control Block, Operations on processes, cooperating processes. CPU scheduling: Levels of Scheduling, scheduling criteria, Comparative study of scheduling algorithms, Algorithm evaluation, multiple processor scheduling. Critical-section problem, Semaphores.

UNIT III

STORAGE MANAGEMENT: Storage allocation methods: Single contiguous allocation, non-contiguous memory allocation, Paging and Segmentation techniques, segmentation with paging, Virtual memory concepts, Demand Paging, Page replacement Algorithms, Thrashing.

UNIT IV

DEADLOCK: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

Text and Reference Books:

1. Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 8th Edition, WileyIndian Edition, 2010.
2. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India, 2008.
3. Naresh Chauhan, Principles of Operating Systems, Oxford Press, 2014.
4. D.M. Dhamdhere, Operating Systems, 2nd edition, Tata McGraw Hill, 2010.
5. William Stallings, Operating Systems– Internals and Design Principles, 5th Edition, Prentice Hall India, 2000.

Course Articulation Matrix:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	2	2	-	3	3	3	2
CO2	3	3	2	2	1	3	2	-	2	1	-	3	3	3	3
CO3	3	3	2	2	2	3	-	-	2	2	-	3	3	2	2
CO4	3	3	3	3	1	3	1	1	2	1	-	3	3	3	3
CO5	3	3	3	3	2	3	2	1	2	2	-	3	3	3	3

ROBOTICS LAB
PEC-ECE412-P

Course Credits : 1 Contact Hours: 2 Hours Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the functionality and limitations of robot actuators and sensor.	L1
CO 2	To generate programs for a robot to perform a specified task (e.g obstacle avoidance or wall following) in a target environment.	L2
CO 3	To employ automation by programmable controllers	L3
CO 4	To examine effect of electronics, circuits and sensors on automation controls.	H1
CO 5	To judge faults in robotic systems	H2
CO 6	To develop robotic path motions and to use hydraulics and pneumatics in industrial robots	H3

List of Experiments

1. ADC and DAC interfacing with Micro-Controller
2. Temperature control using Micro-Controller interface
3. Stepper motor Interfacing with Micro-Controller
4. Servo motor Interfacing with Micro-Controller
5. LCD interfacing with Micro-Controller
6. Interfacing of PMW with DC motor using Micro-Controller interface
7. Study and selection of Gripper.
8. Study of robotic arm and its configuration
9. Study the robotic end effectors
10. Study of different types of hydraulic and pneumatic valves
11. Study of different actuators and end effector for robot.
12. Robot programming and simulation for pick and place
13. Robot programming and simulation for Shape identification
14. Robot programming and simulation for Colour identification
15. Robot programming and simulation for multi process.

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	2	2	3	3	3	2	3
CO2	3	3	2	2	3	3	2	-	2	3	3	3	3	3	2
CO3	3	3	2	2	2	3	1	-	3	3	3	3	3	2	3
CO4	3	3	3	3	2	3	1	2	3	2	3	3	3	3	2
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	2	3
CO6	3	3	3	3	2	3	1	2	2	3	3	3	3	3	3

OPTICAL COMMUNICATION LAB
PEC-ECE414-P

Course Credits : 1.0 Contact Hours: 3 Mode : Lab Work	**Course Assessment Methods (Internal: 30; External: 70)**

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the principles of optical fibre communication.	L1
CO 2	To classify various components and advantages of optical communication.	L2
CO 3	To demonstrate the operation of LASER, LEDs and detectors.	L3
CO 4	To compare and differentiate various components and parts of optical communication system through simulation.	H1
CO 5	To select the appropriate fibre for communication according to the requirements	H2
CO 6	To assemble and design optical network through simulation.	H3

List of Experiments

1. To study the characteristics and parameters of Single mode and multi mode fibers.
2. To calculate the numerical aperture of fiber.
3. To calculate acceptance angle in fiber.
4. To set up 8- 16 channel WDM systems.
5. To study Optsim simulator.
6. To study optical RoF link on Optsim.
7. To set up an optical communication link using Optsim.
8. To study non linear affects using Optsim.
9. To ascertain BER for various data rates for single and multimode fibers using Optsim
10. To design optical amplifier using Optsim.

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	3	3	3	3	3	3	3
CO2	3	3	2	2	3	3	1	-	2	2	3	3	3	3	2
CO3	3	3	2	2	2	3	1	-	3	2	3	3	3	2	3
CO4	3	3	3	3	2	3	2	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3
CO6	3	3	3	3	2	3	1	2	2	3	3	3	3	3	3

OPERATING SYSTEMS LAB
PEC-ECE416-P

Course Credits : 1 Mode : Lab Work Teaching schedule L T P : 0 0 2 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)**

Pre-requisites: Basic programming skills.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe various memory allocation strategies and analysing their performance.	L3
CO 2	Discuss the performances of different process scheduling, protection and security mechanisms.	L3
CO 3	Apply the basic concepts of file system and management, process control, scheduling and communication, as well as memory management.	L3
CO 4	Analyze and implementing various deadlock handling strategies.	H1
CO 5	Evaluate the performance of various page replacement policies by implementing them.	H2
CO 6	Develop and test page fault for different page replacement algorithm.	H3

List of experiments

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Write a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Banker's algorithm for deadlock avoidance.
9. Write a program to implement Banker's algorithm for deadlock prevention.
10. Write a program to implement the following the following file allocation methods: (a) contiguous (b) Linked (c) Indexed .
11. Write a program to simulate the following techniques of memory management:
a) Paging b) Segmentation
12. Write a program to simulate the following File organization techniques:
a) Single level directory b) Two level c) Hierarchical.

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	3	2	3	3	3	3	3
CO2	3	3	2	2	3	3	2	2	3	2	3	3	3	2	2
CO3	3	3	3	3	2	3	2	2	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	1	2	2	3	3	3	3	2	2
CO5	3	3	3	3	3	3	2	2	3	2	3	3	3	2	3

Detailed Syllabus
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Program Elective Course-5

RECENT TRENDS IN COMMUNICATION SYSTEMS
PEC-ECE418-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes At the end of the semester:	RBT Level
CO 1	Students will be able to define the wireless network Fundamentals and future evaluation	L1
CO 2	Students will be able to understand about Cognitive Radio and wireless sensor network.	L2
CO 3	Students will be able to apply application of Cognitive Radio in Communication	L3
CO 4	Students will be able to compare the Wireless sensor and Optical network.	H1
CO 5	Students will be able to formulate the LTE based project.	H3

Course Contents

UNIT-1

Wireless Network Fundamentals & Future Evolution: Introduction to 4G, OFDM, MIMO, Massive MIMO, Long Term Evaluation (LTE) Technologies, Need of LTE, LTE System Architecture, LTE Operations, LTE communication protocol. LTE-Advanced and VoLTE., Fundamentals of 5G Mobile Communication, Evolving LTE to 5G capability, 5G Standardization, 5G Spectrum, 5G Architecture & Applications.

UNIT-II

Wireless Sensor Network: Introduction of Wireless Sensor Networks, Design Issues, Unique constraints and Challenges, Applications of WSN, MAC layers and routing protocols in WSN, Topology Control in WSNs, Data Retrieval Techniques in WSNs: Sensor databases, distributed query processing, Data dissemination and aggregation schemes, Operating Systems for WSN, Security issues in WSN, Future direction of WSNs.

UNIT-III

Cognitive Radios: Cognitive Radio – functions, components and design rules, Challenges to Implement Cognitive Radio, Cognitive Radio Products and Applications. Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT-IV

Optical Networks: WDM, DWDM, CWDM, Radio over fiber: Introduction the concept of radio over fiber, categories, performance and application of radio over Fiber, link design issues in radio over Fiber, MM waves: Introduction, Generation and detection of MM waves , All optical networks, Sub carrier multiplexing and CATV applications.

TEXT BOOKS:

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons, 2006.
2. Christopher-Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications", Wiley, 1st Edition.
3. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
4. Optical Fiber Communications, Gerd Keiser, 2nd Edition.

REFERENCE BOOKS:

1. Erik Dahlman , Stefan Parkvall and Jhoan Skold "5G NR: The Next Generation Wireless Access Technology" Academic Press, 2018.
2. Optical Fiber Communications, John M. Senior, 3nd Edition.
3. Alexander M. Wyglinski, Maziar Nekovee , Thomas Hou, "Cognitive Radio Communications and Networks: Principles and Practice", Elsevier, Ist addition.
4. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
5. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2006

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**-**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**1**	**3**	**1**	**2**	**2**	**2**	**-**	**3**	**2**	**2**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**3**	**3**

VLSI TECHNOLOGY AND APPLICATIONS
PEC-ECE420-T

General Course Information:

Course Credits: 3 Contact Hours: 3/week, (L-T-P: 3-0-0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Analog & Digital Circuits, Electronics Semiconductor Devices.

Sr. No.	Course Outcomes: At the end of the semester, students will be able to:	RBT Level
CO 1	Describe methodology to fabricate an IC.	L1
CO 2	Understand the diffusion of materials using different techniques.	L2
CO 3	Use thorough knowledge on design tools to draw layouts for the transistor structures.	L3
CO 4	Analyze the characterization of different materials.	H1
CO 5	Design VLSI circuits starting from PMOS, NMOS, and CMOS technology based design	H3

Course contents

UNIT I

Microelectronics processing: Introduction, Clean Room, Pure Water System, Vacuum Science and Technology, Practical vacuum systems, Operating principle: Rotary Pump, Diffusion pump, Cryo Pump and Turbo Pump, Vacuum Gauges: Sources for vacuum deposition, Sputtering (DC, RF and RF Magnetron), Chemical Vapor Deposition, reactors for chemical vapor deposition, CVD Applications, PECVD, Metallization, Epitaxy: Introduction, Vapor phase epitaxy, Liquid phase epitaxy and Molecular beam epitaxy, Hetroepitaxy.

UNIT II

Thermal Oxidation of Silicon, Oxide Formation, Kinetics of Oxide Growth, Oxidation Systems, Properties of Thermal Oxides of Silicon, Impurity Redistribution during Oxidation, Uses of Silicon Oxide, Basic diffusion process, Diffusion Equation, Diffusion Profiles, Evaluation of

Diffused Layers, Diffusion in Silicon, Emitter-Push Effect, Lateral Diffusion, Distribution and Range of Implanted Ions, Ion Distribution, Ion Stopping, Ion Channeling, Disorder and Annealing, Multiple Implantation and Masking, Pre-deposition and Threshold Control.

UNIT III

Photolithography, Negative and Positive Photoresist, Resist Application, Exposure and Development, Photolithographic Process Control. E-Beam Lithography, X-Ray Beam Lithography and Ion Beam Lithography. Wet Chemical Etching, Chemical Etchants for SiO2, Si3N4, Polycrystalline Silicon and other microelectronic materials, Plasma Etching, Plasma Etchants, Photoresist Removal, Lift off process, Etch Process Control.

UNIT IV

Fundamental considerations for I.C processing, PMOS and NMOS IC Technology, CMOS I.C technology, Packaging design considerations, Special package considerations, Yield loss in VLSI, Reliability requirements for VLSI.

Text Books:

1. VLSI Fabrication Principles: Silicon and Gallium Arsenide by Sorab K. Ghandhi (John Wiley & Sons).
2. VLSI Technology By S.M.Sze (2nd Edition), TMH.
3. Microelectronic Processing: An Introduction to the Manufacture of Integrated Circuits by W. Scot Ruska (McGraw Hill International Edition).

Reference Books:

1. Microchip Fabrication: A Practical Guide to Semiconductor Processing by Peter Van Zant (2nd Edition) (McGraw Hill Publishing Company).
2. Semiconductor Devices: Physics and Technology by S.M. Sze, Wiley.
3. Thin Film Processes Part I & II by John L. Vossen and Wirner Kern (Academic Press).

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**3**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**-**	**2**	**1**	**-**	**3**	**3**	**2**	**2**
CO3	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**1**	**3**	**2**	**1**	**2**	**2**	**-**	**3**	**2**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**-**	**3**	**3**	**3**	**3**

ARM
PEC-ECE422-T

General Course Information:

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Embedded System Design

Course Outcomes:

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define ARM basic architecture, Operating modes and its Pipeline structure	L1
CO 2	To understand ARM assembly instructions and their formats and usage.	L2
CO 3	To analyze various peripherals used with ARM core and it basic functioning.	H1
CO 4	To develop skills to build ARM controlled based devices.	H2
CO 5	To design an ARM interfacing with other coprocessor.	H3

Course Contents

UNIT-I

INTRODUCTION: Processor architecture and organization, Abstraction in hardware design, MU0 - a simple processor, Instruction set design, Processor design trade-offs, The Reduced Instruction Set Computer, Design for low power consumption.
ARCHITECTURE: The Acorn RISC Machine, Architectural inheritance, The ARM programmer's model, and ARM development tools.

UNIT-II

INSTRUCTION SET: Introduction, Exceptions, Conditional execution , Branch and Branch with Link (B, BL), Branch with Link and exchange (BX, BLX), Software Interrupt (SWI), Multiply instructions, Count leading zeros (CLZ - architecture v5T only), Single word and unsigned byte instructions, Half-word and signed byte instructions, Multiple register transfer

instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to status register transfer instructions.

UNIT-III

PROGRAMMING: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs, Examples and exercises.

UNIT-IV

ARM ORGANISATION & IMPLEMENTATION: ARM architecture variants, 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface.

PROCESSOR CORES: ARM7TDMI, ARM8, ARM9TDMI, and ARM10TDMI.

TEXT BOOK:

1. ARM System-on-Chip Architecture, by "Steve Furber", PEARSON.
2. ARM Assembly Language Programming & Architecture by Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Shujen Chen, MicroDigitaEd.com
3. ARM Programming, CRC Press, Hohl, W., 2009.

REFERENCE BOOKS:

1. ARM Architecture Reference Manual, Addision-Wesley.
2. ARM System Developer Guide by Andrew Sloss, Dominic Symes and Chris Wright, May 2004, Morgan Kaufmann Publication.
3. The ARM RISC Chip: A Programmers Guide by Alex van Someren and Carol Atack, Addison-Wesley.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**-**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**1**	**3**	**1**	**2**	**2**	**2**	**-**	**3**	**2**	**2**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**3**	**3**

MEMS & ITS APPLICATIONS
PEC-ECE424-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: IC Fabrication and Technology, VLSI Circuits

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the requirements and need of MEMS	L1
CO 2	To describe the MEMS process	L2
CO 3	To demonstrate the principles of sensing and actuations in MEMS design	L3
CO 4	To differentiate MEMS devices according to their application	H1
CO 5	To select MEMS devices according to the requirements	H2
CO 6	To assemble and design MEMS according to need and application	H3

Course Contents

UNIT-1

INTRODUCTION : History of MEMS Development, Characteristics of MEMS, micro electronics integration, evolution of micro sensors and actuators, MEMS Applications.

MEMS FABRICATION: Overview of Micro fabrication Processes- Photolithography ,Thin Film Deposition, Thermal Oxidation of Silicon, Wet Etching, Silicon Anisotropic Etching, Plasma Etching and Reactive Ion Etching, Doping, Wafer Dicing, Wafer Bonding, Microelectronics Fabrication Process Flow, Packaging and Integration.

UNIT-II

ELECTRICAL & MECHANICAL PROPERTIES OF MEMS MATERIALS: Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, torsional deflection, intrinsic stress, Dynamic System, Resonant Frequency, and Quality Factor.

UNIT –III

ELECTROSTATIC SENSING & ACTUATION-Introduction to electrostatic sensors and actuators, parallel-plate capacitor, equilibrium position of electrostatic actuator under bias, pull-in effect of parallel-plate actuators, applications of parallel-plate capacitors, inertia sensor, pressure sensor, flow sensor, parallel-plate actuators,

THERMAL SENSING & ACTUATION- Introduction to thermal sensors, thermal actuators, fundamentals of thermal transfer, sensors and actuators based on thermal expansion, thermal bimorph principle, thermal actuators with a single material.

UNIT-IV

TYPES OF SENSORS AND ACTUATORS: Mechanical, Radiation, Magnetic, Optical, Chemical and biological.

MEMS DESIGN: Design issues, Budget planning, Computer aided design, Assembly and System Integration, Packaging issues, Barometer, Gyroscope.

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, @2012
2. Tai – Ran Hsu, "MEMS & MICROSYSTEMS: Design and Manufacturing", TATA McGRAW- HILL, 2002
3. V. K. Aatre, K. N. Bhat, G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, "Micro and Smart Systems", Wiley India, 201**0**
4. N P Mahalik, "MEMS" TMH@2008

REFERENCE BOOKS:

1. Marc J. Madou, "Fundamentals of Microfabrication", 2nd Edition, CRC Press, 2002.
2. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC Press, 2002
3. M.Elwenspoek, R.Wiegerink, "Mechanical Microsensors", Springer-Verlag Berlin Heidelberg, 2001.
4. P. Rai-Choudhury, "Handbook of Microlithography, Micromachining & Microfabrication", SPIE, 1997

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	2	1	2	1	-	2	3	2	2
CO2	3	3	2	1	2	1	2	1	2	1	-	3	3	2	2
CO3	3	3	2	2	3	2	2	2	2	1	-	3	3	3	2
CO4	3	3	3	3	3	3	2	1	2	1	-	3	3	3	3
CO5	3	2	3	3	3	3	3	2	2	2	-	3	3	3	3
CO6	3	3	3	3	3	3	3	2	2	2	-	3	3	3	3

DIGITAL IMAGE PROCESSING
PEC-ECE426-T

Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two Minor tests each of (20 Marks), class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination of (70 Marks). For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions, rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Digital signal processing.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe general terminology of digital image processing.	L1
CO 2	Explain various types of images, intensity transformations and spatial filtering.	L2
CO 3	Apply Fourier transform for image processing in frequency domain.	L3
CO 4	Compare the methodologies for image segmentation, restoration etc.	H1
CO 5	Select image processing and analysis algorithms for particular application.	H2
CO 6	Develop image processing algorithms for practical applications.	H3

UNIT-1

INTRODUCTION: What Is Digital Image Processing? The Origins of Digital Image Processing. Examples of Fields that Use Digital Image Processing. Fundamental Steps in Digital Image Processing. Components of an Image Processing System. Elements of Visual Perception. Light and the Electromagnetic Spectrum. Image Sensing and Acquisition. Image Sampling and Quantization. Some Basic Relationships Between Pixels. Linear and Nonlinear Operations.

IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN : Background. Some Basic Gray Level Transformations. Histogram Processing. Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering. Smoothing Spatial Filters. Sharpening Spatial Filters.

UNIT-II

IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN: Background. Introduction to the Fourier Transform and the Frequency Domain. Smoothing Frequency-Domain Filters. Sharpening Frequency Domain Filters.

IMAGE RESTORATION: A Model of the Image Degradation/Restoration Process. Noise Models. Restoration in the Presence of Noise Only-Spatial Filtering. Periodic Noise Reduction by Frequency Domain Filtering. Estimating the Degradation Function. Inverse Filtering. Minimum Mean Square Error (Wiener) Filtering.

UNIT –III

COLOR IMAGE PROCESSING : Color Fundamentals. Color Models. Pseudocolor Image Processing. Basics of Full-Color Image Processing. Color Transformations. Smoothing and Sharpening. Noise in Color Images.

IMAGE COMPRESSION: Fundamentals. Image Compression Models. Basics of Error-Free Compression and Lossy Compression.

UNIT-IV

IMAGE SEGMENTATION: Detection of Discontinuities. Edge Linking and Boundary Detection. Thresholding. Region-Based Segmentation. Segmentation by Morphological Watersheds. The Use of Motion in Segmentation (in spatial domain).

REPRESENTATION AND DESCRIPTION : Representation. Boundary Descriptors. Regional Descriptors. Relational Descriptors.

TEXT BOOKS:

1. Digital Image Processing; Gonzalez & Woods, PHI
2. Fundamentals of Digital Image Processing by Anil K Jain, Pearson.
3. Digital Image Processing by William K Pratt,Wiley.

REFERENCE BOOKS:

1. Fourier Methods in Imaging; Roger L. Easton, Wiley
2. Digital Signal Processing; Prokis, Pearson
3. Digital Signal Processing; Salivahanan, McGraw Hills

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**-**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**-**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO3	**3**	**3**	**2**	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**1**	**3**	**1**	**2**	**2**	**2**	**-**	**3**	**2**	**2**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**3**	**3**

Annexure - IX

OPEN ELECTIVES COURSES

offered for

B. Tech. Programmes

(2018 – Scheme)

Approved by faculty for implementation wef 2018 onwards batch

18/7/19

Open Elective Courses offered for various B. Tech. Programmes

(2018 Scheme)

Open Elective Course - I for B. Tech. 5th Semester

S. No.	Course Code	Course Nomenclature	Offered By	Credits
1	OE-PTG-391-T	Fundamentals of Printing	Printing Technology	3
2	OE-ME-391-T	Industrial Engineering	Mechanical Engineering	3
3	OE-CSE-391-T	Information and Cyber Security	Computer Science & Engineering	3
4	OE-ECE-391-T	Principles of Digital Electronics	Electronics & Communication Engineering	3
5	OE-FT-391-T	Processing and Preservation of Foods	Food Technology	3
6	OE-CE-391-T	Introduction to Civil Engineering	Civil Engineering	3
7	OE-EE-391-T	Utilization of Electrical Energy	Electrical Engineering	3

Open Elective Course - II for B. Tech. 6th Semester

S. No.	Course Code	Course Nomenclature	Offered By	Credits
1	OE-PTG-392-T	Graphics Design Fundamentals	Printing Technology	3
2	OE-ME-392-T	Solar Energy Engineering	Mechanical Engineering	3
3	OE-CSE-392-T	Introduction to Soft Computing	Computer Science & Engineering	3
4	OE-ECE-392-T	Fundamentals of Communication Systems	Electronics & Communication Engineering	3
5	OE-FT-392-T	Food Safety, Quality and Regulations	Food Technology	3
6	OE-CE-392-T	Introduction to Fluid Mechanics	Civil Engineering	3
7	OE-EE-392-T	Renewable Energy Resources	Electrical Engineering	3

Open Elective Course - III for B. Tech. 7th Semester

S. No.	Course Code	Course Nomenclature	Offered By	Credits
1	OE-PTG-491-T	Fundamentals of Packaging	Printing Technology	3
2	OE-ME-491-T	Computer Aided Design and Manufacturing	Mechanical Engineering	3
3	OE-CSE-491-T	Statistical Computing	Computer Science & Engineering	3
4	OE-ECE-491-T	Introduction to MATLAB and Simulink	Electronics & Communication Engineering	3
5	OE-FT-491-T	Instrumental Analysis of Foods	Food Technology	3
6	OE-CE-491-T	Environmental Engineering	Civil Engineering	3
7	OE-EE-491-T	Energy Management and Audit	Electrical Engineering	3

Note: ***Student can opt for any open electives other than open Elective offered by his/her own department.***

5th Semester

FUNDAMENTALS OF PRINTING

(Students from Department of Printing Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–PTG-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

History: Brief history of Printing across the Globe, Evolution of Printing processes and methods from a craft to the present day as a sophisticated technology. **Basic operations in printing**: Pre press, press and post press operations.

Introduction to Major Printing Processes: Basic principles, characteristics, identification and applications of Letterpress, Flexography, Lithography and Offset, Gravure, Screen printing etc. Modes of taking impressions for major printing processes, Comparison of major printing processes

UNIT-II

Letterpress Printing : Introduction to Letterpress Printing, General Principles, Characteristics, identification, advantages, limitations and applications of Letterpress Printing, classification of Letterpress Printing Machines. Types of Letterpress Printing Machine - Platen, Cylinder and Rotary machines; their mechanical and operational features and their uses; merits and demerits.

Offset Printing : Introduction to Lithography Printing, Introduction to Offset Printing, General principles, characteristics, identification, advantages, limitations and applications of Offset Printing, classification of Offset Printing Machines. Types of Offset Printing Machines- Sheet fed, Web Fed and its types, their mechanical and operational features

UNIT-III

Gravure Printing: Introduction to Intaglio Printing, Introduction to Gravure Printing, General principles, characteristics, identification, advantages, limitations and applications of Gravure printing, classification of Gravure printing machines.

Screen Printing: Introduction to Screen Printing, general principles, characteristics, identification, advantages, limitations and applications of Screen Printing.

Digital Printing: Introduction to Digital Printing, general principles, characteristics, identification, advantages, limitations and applications of Digital Printing, classification of Digital Printing machines.

UNIT-IV

Flexography Printing: Introduction to Flexography Printing, Mechanical principles of flexography - Fountain roll, Anilox roll, plate cylinder, impression cylinder. Anilox roll - construction, cell structure, Anilox roll wear, selecting the night anilox roll, chrome plating.

Common Running Defects of Printing: Common printing faults, causes and their remedies, Basic requirements for process Colour Printing, **Understanding Colour:** Dimensions of colour,Colour theory, Primarycolours, Secondary colours, Additive Colour and Subtractive Colour,Colour schemes, Colour symbolism and emotional effects of colour.

Text & Reference Books:

1. **Letter Press Printing** Part 1, 2, By C.S. Misra
2. **Printing Technology** by Adams, Faux, Rieber, 5th edition
3. **Hand Book of Print Media** byH.Kippan.
4. **Art and Production** by N.N. Sarkar

INDUSTRIAL ENGINEERING

(Students from Department of Mechanical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ME-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Plant Layout: Objectives of Good Plant Layout, Importance of Plant Layout, Types of Plant Layout, Advantages and Limitations of Different Types of Plant Layouts

Material Handling: Function of Material Handling, Principles of Material Handling, Material Handling Devices, Relation between Plant Layout and Material Handling

UNIT-II

Work Study: Definition and Concept of Work Study, Need of Work Study, Advantages of Work Study, Techniques of Work Study, Work Study and Management, Work Study and Productivity

Method Study: Objectives and Procedure of Method Study, Process Chart Symbols, Flow Diagram, String Diagram, Therblig, Multiactivity Charts

UNIT-III

Work Measurement: Objectives of Work Measurement, Basic Procedure for Time Study, Difference between Time Study and Motion Study, Various Time Estimates and Production Standard, Level of Performances, Allowances, Various Time Recording Techniques in Time Study

Value Engineering: Types of Values, Concept of Value Engineering, Phases of Value Engineering Studies, Application of Value Engineering

UNIT-IV

Ergonomics: Concept of Ergonomics, Objectives of Ergonomics, Man Machine System Interface, Anthropometry, Ergonomics and Safety, Ergonomics and Fatigue

Intellectual Property Rights: Intellectual Property Rights, Patents, Trade Marks, CopyRights, Law of Contract

Text and Reference Books:

1. Industrial Engineering and Management by Hicks, Tata McGraw Hill, New Delhi
2. Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers
3. Motion and time study by R. Bernes, John-Wiley & Sons
4. Ergonomics at work by D.J. Oborne, John Wiley & Sons
5. Techniques of Value Analysis and Engineering by Miles, McGraw Hill

INFORMATION AND CYBER SECURITY

(Students from Department of CSE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CSE-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Cryptography: Overview of information security, Basic concepts, Cryptosystems, Cryptoanalysis, Ciphers & Cipher modes, Symmetric key Cryptography DES, AES asymmetric key cryptography, RSA algorithm, Key management protocols, Diffie Hellman algorithm. Digital signature, Public Key Infrastructure.

UNIT-II

System Security: Program security, Security problems in coding, Malicious logic, Protection. Database Security- Access controls, Security & integrity threats, Defense mechanisms. OS security-protection of system resources, Models for OS security, Net Security-User based security, Code access security, form authentication.

UNIT-III

Ethics in Cyber Security: Privacy, Intellectual property in the cyberspace, Professional ethics, Freedom of speech, Fair user and ethical hacking, Trademarks, Internet fraud, Electronic evidence, Forensic technologies, Digital evidence collections. Tools and methods used in cybercrime: Introduction, Password cracking, Keyloggers and spywares, Virus and worms, Phishing and identity theft, Trojan horses and backdoors, Steganography

UNIT - IV

Cybercrimes and Cybersecurity: Cybercrime and legal landscape around the world, Cyberlaws, The Indian IT Act, Challenges, Digital signatures and Indian IT Act, Amendments to the Indian IT Act, Cybercrime and punishment, Cost of Cybercrimes and IPR Issues, Web threats for organizations, Social computing and associated challenges for organizations.

Text and Reference Books:

1. William Stalling, *Cryptography and Network security-Principles and Practices*, Pearson Education, Ninth Indian Reprint 2005.
2. Charlie Kaufman, *Network Security: Private communication in Public World*, Prentice-Hall International, Inc. April 2008
3. Nina Godhole and SunitBelapure, *Cyber Security*, Wiley India, 2011.
4. James Graham, Ryan Olson, Rick Howard, *Cyber Security Essentials*, CRC Press, Taylor & Francis, 2011.

PRINCIPLES OF DIGITAL ELECTRONICS

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ECE-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

DIGITAL FUNDAMENTALS: Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, **Codes** – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems. **Logic gates:** Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT-II

COMBINATIONAL CIRCUIT DESIGN :Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT-III

SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, conversion of FF. **Design of Counters**- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT-IV

MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS: Basic memory structure – ROM ,PROM, EPROM, EEPROM, EAPROM, RAM, Static and dynamic RAM. **Programmable Logic Devices:** Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA). **Digital Logic Families:** Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, RTL, TTL, ECL, CMOS.

Text Books:

1 Modern Digital Electronics(Edition III) : R. P. Jain; TMH

2 Digital Fundamentals : Thomas L Floyd
3 Digital circuits and design : S. Salivahanan, and S. Arivazhagan

Reference Books:

1 Digital Integrated Electronics: Taub & Schilling; MGH
2 Digital Principles and Applications: Malvino & Leach; McGraw Hill.
3 Digital Design: Morris Mano; PHI.

PROCESSING AND PRESERVATION OF FOODS

(Students from Department of Food Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–FT-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT– I

Sources of food, scope and benefit of industrial food preservation, perishable, non-perishable food, causes of food spoilage. Microbial growth curve and general principle of preservation. Preservation factors.

UNIT –II

Thermal processing methods of preservation – Principle and equipment:Canning, blanching, pasteurization, sterilization, evaporation. Use of low temperature – Principal, equipment and effect on quality. Chilling, cold storage, freezing.

UNIT –III

Preservation by drying dehydration and concentration – Principle, Methods, Equipment and effect on quality :Difference, importance of drying & dehydration over other methods of drying and dehydration, equipments and machineries, physical and chemical changes in food during drying and dehydration .Need and Principle of concentration, methods of concentration – Thermal concentration, Freeze concentration, membrane concentration, changes in food quality by concentration.

UNIT– IV

Preservation by radiation, chemicals & preservatives. Definition, Methods of Irradiation, Direct & Indirect effect, measurement of radiation dose, dose distribution, effect on microorganisms. Deterioration of Irradiated foods physical, chemical and biological; effects on quality of foods. Presentation of foods by chemicals, antioxidants, mould inhibiters, antibodies, acidulates etc. Preservation by salt & sugar – Principle, Method, Equipment and effect on food quality. Recent methods in preservation: Pulsed electric field processing, High pressure processing, Processing

using ultrasound, dielectric, ohmic and infrared heating. Theory, equipments and effect on food quality.

Recommended Readings

1. Norman N. Potter, Joseph H. Hotchkiss , Food Science – 5th ed. Springer, 1998 - Technology & Engineering - 608 pages
2. Giridhari Lal, G.S. Siddappa and G. L. Tandon, Preservation of Fruits and Vegetables; CFTRI, ICAR , New Delhi -12
3. MirceaEnachescuDauthy, 'Fruit and vegetable processing', FAO Agricultural Services Bulletin 119; International Book Distributing Co.
4. B J B Wood, Microbiology of Fermented Foods, Vol. I; Elsevier Applied Science Publishers.
5. Diane M Barrett, Laszlo Somogyi, HoshahalliRamaswamy, Processing Fruits, Science and Technology; CRC Press.
6. Marcus Karel, Owen R Fernnema, Physical principles Food Science, Part I and II; Marcel Dekker inc

INTRODUCTION TO CIVIL ENGINEERING

(Students from Department of Civil Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CE-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT - I

Construction Materials: Stones -Characteristics of good building stones-common building stones and their uses, **Bricks**-Characteristics of good bricks-classification of bricks and their uses, **Timber**: Classification of Timber and their uses-Cement-Types of cement and their uses

UNIT – II

Components of building: Components of sub structure and their functions-Components of super structure and their functions -Types of forces – compression, tension, shear – Stress – Strain-Concrete- Ingredients of concrete and its importance in construction -Steel- Types of steel and its importance in construction

UNIT - III

Survey and Highway Engineering: Definition and classification of surveying – linear and angular measurements – levelling, Modes of transportation – Classification of highways - Classification of pavements – Super elevation.

UNIT – IV

Irrigation and Water supply: Definition and classification of irrigation – Irrigation structures – dams, weirs, cross drainage works, canal drops-Quality of water-Treatment methods, **Geotechnical Engineering:** Origin of soil – types of soil – bearing capacity of soil – Types of foundation – shallow and deep

Recommended Readings

1. B C Punmia, Ashok K Jain, Arun K Jain, (1st Edition, 2003), "Basic Civil Engineering", Laxmi Publications (P) Ltd.
2. G K Hiraskar, (1st Edition, 2004), "Basic Civil Engineering", Dhanpat Rai Publication

UTILIZATION OF ELECTRICAL ENERGY

(Students from Department of Electrical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE--EE-391-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT – I

Illumination and Refrigeration: Illumination – Terminology, Laws of illumination, Photometry, lighting calculations. Electric lamps – Different types of lamps, LED lighting and Energy efficient lamps, Design of lighting schemes – factory lighting, flood lighting, street lighting. Refrigeration-Domestic refrigerator and water coolers, Air –Conditioning, Various types of air conditioning system and their applications, smart air conditioning units

UNIT – II

Domestic utilization of electrical energy: House wiring, Induction based appliances, Online and OFF line UPS, Batteries, Power quality aspects, nonlinear and domestic loads, Earthing; domestic, industrial and sub-station. Energy Efficient motors: Standard motor efficiency, need for more efficient motors, Motor life cycle, direct savings and payback analysis, efficiency evaluation factor.

UNIT - III

Electric Heating and Electrolytic Processes: Types of heating and applications, Electric furnaces - Resistance, Inductance and Arc Furnaces, Electric welding and sources of welding, Electrolytic Processes: Definition of various terms used in Electrolysis, Faradays' laws of Electrolysis, Extraction of Metals, Refining of metals, Electro-Deposition, Power Supply for Electrolytic Processes.

UNIT – IV

Traction system –Requirement of an ideal traction system, power supply, traction drives, electric braking, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Electric traction motors & their control, Speed control and braking, recent trend in electric traction.

Recommended Readings

1. R. K. Rajput., Utilization of Electrical Power', Laxmi Publications, 1st edition, 2006.

2. S.L. Uppal and S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3. J. B. Gupta, Utilization of Electrical Energy and Electric Traction, S. K. Kataria and Sons, 10th edition, 2012.
4. N. V. Suryanarayana, Utilization of Electrical Power, New Age International Publishers, reprinted 2005.
5. C. L. Wadhwa, Generation Distribution and Utilization of Electrical Energy, New Age International Publishers, 4th edition, 2011.
6. H. Partab, Modern Electric Traction, Dhanpat Rai & Co., 3rd edition, 2012.
7. Energy Efficiency in Electrical Utilities, BEE Guide Book, 2010.

6th Semester

GRAPHIC DESIGN FUNDAMENTALS

(Students from Department of Printing Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–PTG-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction to Graphic Design: Introduction to design, introduction to Graphic Design, Introduction to Printer's design, Concept of Graphic Arts, Concept of Graphic Communications, Understanding steps involve in Graphic Communications and Making the Print work.**Fundamentals of Design:** Point, Line, Shape, Tone, value, weight, texture, size, space, etc. **Principles of Design**: Balances, Proportion, Rhythm, Unity, Contrast, Simplicity, Fitness.

UNIT-II

Colours in Package Design: Introduction of Colour, function of Colour, Physical Dimension of Colour, Responses to Colour, emotional effects of colour. Colour Combination - Colour schemes, Dimension of colour, colour symbolism, Colour Theory- Additive theory, Subtractive theory. Division of Design -Natural, Conventional, Decorative, Geometrical and abstract.

Typography : Typography -Structure Design and Function, Introduction to 2D & 3D Types, Physical structure of type, type measurement, Introduction to Digital Types, Post Script Fonts, True Type Fonts, Open Type Fonts, Methods of type arrangement, classification of typeface of font designing.

UNIT-III

Introduction to Type Design : Design style, Grouping of Type Faces, Type Families, Introduction to Indian Type Faces, Function of type Composition, Readability, Legibility, concept of Spacing- Letter Spacing, Word Spacing, Line Spacing, Paragraph Spacing.

Print Planning of Package: Introduction to Layout, Terms in Layout Planning, Stage of Layout Planning, Rough layout, comprehensive and artwork.Understanding of scale and sense of proportion. **ORIGINALS:** Introduction to originals, Type of originals, sizing, masking and cropping.

UNIT-IV

Computers in Design: Introduction to Computer in Design, Introduction to Desktop Publishing, Introduction to Desktop Designing. Introduction to Designing Software. Uses, Applications, Advantages and Limitations of Prominent Design Software.

Designing for Print Production: Introduction of Printing Processes for Design Prospective. Selection of an appropriate printing process for printing of a job.

Text & Reference Books:

1. **The Designer's Handbook** by Alistair Campbell
2. **Design & Technology** by Van No strand
3. **Handbook of Advertising Art Production** by Schelmmer.
4. **Art & Production** by N.N. Sarkar.
5. **Advertising, Art & Production** by J. Nath.
6. **A.C. Book (C.D.) so hick, Fundamental of copy and layout,** Crair Book.

SOLAR ENERGY ENGINEERING

(Students from Department of Mechanical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ME-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction to solar system: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles,

Solar Radiation estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices.

UNIT-II

Effect of Solar radiation upon structures: Steady state heat transmission, solar radiation properties of surfaces, shading of surfaces, periodic heat transfer through walls and roofs.

Solar Collectors: Flat plate and concentrating – comparative study, design and materials, efficiency, selective coatings, heliostats.

UNIT-III

Heating Applications of Solar Energy: Air and Water heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

Cooling Applications of Solar Systems: Continuous and intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

UNIT-IV

Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems.**Effects on Environment:** economic scenario, ozone layer depletion, greenhouse effect, global warming, Remedial measures by international bodies.

Text and Reference Books:

1. Solar Energy: Fundamentals, Design, Modelling and Applications- GN Tiwari, CRC Press
2. Solar Energy – S P Sukhatme, Tata McGraw Hill
3. Solar Energy Process – Duffie and Bechman, John Wiley
4. Applied Solar Energy – Maniel and Maniel, Addison Wiley
5. Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH.

INTRODUCTION TO SOFT COMPUTING

(Students from Department of CSE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CSE-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction to Soft Computing and related definitions: Defining soft computing, Differentiating the situations for application of hard and soft computing; Working of a simple Genetic Algorithm: Representation/Encoding Scheme, initializing a GA population, evaluation function, genetic operators, Function optimization using GA. Study of parameters of genetic algorithms and its performance.

UNIT-II

Designing Genetic Algorithms for different applications: Different types encoding schemes, role of fitness function, different types of genetic operators, Designing GAs for numerical optimization, knapsack problem and travelling salesperson and other similar problems.

UNIT-III

Fuzzy sets: Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterisation, MFs of one and two dimensions, Derivatives of parameterised MFs, Fuzzy numbers, Extension principle and fuzzy relations, Operations on Fuzzy relations, Linguistic variables.

UNIT-IV

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem. Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning.

Text and Reference Books:

1. David.E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*, Addison Wesley, 1999.
2. ZbigniewMichalewicz, *Genetic algorithms + Data Structures = Evolution Programs*, Springers-Verlag, 1999.
3. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, 1998.
4. S. Rajasekaran& G. A. VijayalakshmiPai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications*, PHI, 2003.
5. S. N. Sivanandam& S. N. Deepa, *Principles of Soft Computing*, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 1997.
7. Simon O. Haykin, *Neural Networks, A Comprehensive Foundation*, PHI, 1994.

FUNDAMENTALS OF COMMUNICATION SYSTEMS

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ECE-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction: Introduction to Communication System, Terminologies in Communication Systems, Electromagnetic spectrum and typical application, concept of electrical communication, modes and media's of Communication, Elements of analog Communication system, Need for modulation.

UNIT-II

Amplitude Modulation: Theory of AM: mathematical expression, waveforms, modulation index, types of AM; Generation of AM: Square law modulation, Switching modulator, , Balanced modulator.

UNIT-III

Frequency Modulation: Theory of FM, mathematical expression, waveforms, modulation index; , Narrowband and Wideband FM, Comparison between AM and FM; Generation of FM: Direct Methods – Varactor diode modulator ; Indirect method – Armstrong FM system.

UNIT-IV

Digital modulation techniques: Sampling theorem, ASK, FSK, PSK techniques theory, mathematical expressions and Block diagram of generation and degeneration.

Text Books:

1. R.P. Singh, S.D. Sapre,"Communication Systems: Analog and Digital", 3rd Edition, McGraw Hill.
2. George Kennedy, Bernard Davis & SRM Prasanna, "Electronic Communication Systems", 5thEdition, McGraw Hill.
3. H.Taub, D.L. Schilling & G. Saha, "Principles of Communication Systems", 4th Edition, McGraw Hill.

Reference Books:

1. Couch: Digital and Analog Communication Systems, 6th Edition, Pearson Education.
2. Bernard Sklar: Digital Communication, 2nd Edition, Pearson Education.
3. Digital Communications by John G.Proakis; McGraw Hill.

FOOD SAFETY, QUALITY AND REGULATIONS

(Students from Department of Food Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–FT-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction, concept of food safety and standards, food safety strategies; Food hazards and contaminations – biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors; Food borne diseases causing agents. Water borne diseases, sources of contaminations and their effects.

UNIT-II

Food safety inspection services (FSIS) and their utilization; Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non-thermal processing, irradiation of foods; Environmental protection agency's (EPA) and their role in food safety system.

UNIT-III

Fundamentals of quality management principles, systems and requirements, Guidelines of performance improvements; GMP, GAP, GHP; ISO: Fundamental, requirement and guidelines.

UNIT-IV

BIS (Bureau of Indian standards); Food Safety and Standard act 2006, Food Authority of India and scientific panels, Codex Alimentarius Commission HACCP system of food protection: Principles and its applications, HACCP system for food safety; Food and drug administration (FDA).

Books Recommended:

1. Singh, S. P. (2009). Food Safety, Quality Assurance and Global Trade: Concerns and Strategies: International Book Distributing Co. Lucknow.

2. Alli, I. (2004). Food Quality Assurance: Principles and Practices: CRC Press.
3. Rekha, S. &Pushpa, R. (1997). Handbook of Indian Food Quality and authenticity: Woodhead Publishing Ltd., London
4. Julie, Miller & Jones (1998) Food safety, Association of official analytical chemist USA.
5. Michael M. &Cramera (2006) Food plant Sanitation (GMP), CRC Press, Taylor & Francis Group.

INTRODUCTION TO FLUID MECHANICS

(Students from Department of Civil Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CE-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Basic Concepts and Definitions: Distinction between a fluid and a solid; Density,Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension,capillarity, Bulk modulus of elasticity, compressibility.

UNIT-II

Fluid Statics: Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, UTube Differential Manometer, Micromanometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

UNIT-III

Fluid Kinematics: Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line,path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

UNIT-IV

Fluid Dynamics: Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation :venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitionsof Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

Text & Reference Books:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc GrawHill.R.S. Khandpur

RENEWABLE ENERGY RESOURCES

(Students from Department of Electrical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–EE-392-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction: Over view of conventional & renewable energy sources, limitations of conventional energy sources, need & development of alternate energy sources, basic schemes and applications of direct energy conversion types of renewable energy systems, future of energy use, Global and Indian energy scenario, potential of renewable energy sources, Global climate change, CO_2 reduction potential of renewable energy

UNIT-II

Solar and Wind Energy: Solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability, Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and applications, Solar energy in India, solar collectors, solar furnaces & applications, History of wind power, wind generators, theory of wind power, characteristics of suitable wind power sites, scope in India, advantages and limitations.

UNIT-III

Thermo-electric and MHD Generators: Seeback effect, Peltier effect, Thomson effect, thermoelectric convertors, brief description of the construction of thermoelectric generators, applications and economic aspects. Hall Effect, Basic principles of MHD generator different types of MHD generators, conversion effectiveness, Practical MHD generators, applications and economic aspects.

UNIT-IV

Fuel Cells and Miscellaneous Sources: Principle of action, Gibbs free energy, general description of fuel cells, types, construction, operational characteristics and applications, Geo-thermal system, characteristics of geothermal resources, Low head hydro-plants.

Text & Reference Books:

1. G.D. Rai, Non-Conventional sources of Energy, Khanna Publishers, 2009
2. G. S. Sawhney, Non-Conventional Energy Resources, PHI Learning, 2012
3. B. H Khan., Non-Conventional Energy Resources, Tata McGraw Hill, 2009
4. R.A. Coobe, An Introduction to Direct Energy Conservation, Pitman, 1968
5. M. A. Kettani, Direct Energy Conversion, Addison-Wesley Educational Publishers Inc, 1970
6. Robert L. Loftness, Energy Hand book, Van Nostrand Reinhold, 1984
7. S. S. Rao, B. B. Parulekar, Energy Technology, Khanna Publishers, 1994
8. G. N. Tiwari and M. K. Ghosal, Renewable Energy Applications, Narosa Publications, 2004
9. S. A. Abbasi. and N. Abbasi, Renewable Energy Sources and their Environmental Impact, Prentice Hall of India, 2001

7th Semester

FUNDAMENTALS OF PACKAGING

(Students from Department of Printing Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–PTG-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Packaging Introduction: Packaging – History, Need & Evolution of Packaging, Definition of Packaging. Packaging Functions – Contain, Preserve, Protect, Inform, Identify, Sell. Types of – Rigid/ Semi- Rigid/ Flexible, Package, Packaging Classifications – Primary / Secondary / Tertiary/ Unit / intermediate. Shelf Life of Package- Analysis and Evaluation. Markings on package - Handling marks, routing marks, information marks.

Packaging HAZARDS: Storage, Transportation, Chemical, Climatic, Biological. Packaging Classifications – Primary / Secondary / Tertiary / Unit / intermediate

UNIT-II

Package Design: Design Fundamentals, Need for Changes in Package Design, Feature in Effective Design, Packaging Graphics and its importance, Package Colour and its importance. Graphic Design Elements – Significance of Shape, Size, Colour, Font, Texture, Lines, Balance & Unity, Symmetry & Harmony. Shelf Appeal Studies: Recall Questioning, Focus Group, Eye-Tracking, S-scope.

Product-Package Compatibility Studies : Product Characteristics: Physical (Nature, Shape, Size, Texture, Centre of gravity, etc.), Chemical (Acidic, basic, reactivity etc.), Biological (Effect of micro-organisms) and Package Characteristics: Material (Plastic, paper, wood, etc.), Physical (Tensile, Breaking load, Burst, Molecular/ Fibre direction, etc.), Chemical (Unreacted chemicals present, pH, etc.), Biological (sensitivity to micro-organisms), Permeability (Barrier properties – Absorption/Diffusion of moisture and gases).

UNIT-III

Introduction to Packages : Introduction toPapers and Board based Packaging– Coarse Paper, Fine Paper, Treated Paper, Laminated Paper, Advantages and limitations of paper board

packaging materials, Folding Cartons, Set up Boxes, Corrugated Boxes, Multiwall paper sacks, Plastic woven Sacks, Paper Bags.

Plastic Packaging: Introduction to Plastic Packaging, Types of Plastic films, Packaging Forms of Plastics, Accepting Packaging, flexible Packaging, Freeze Packaging Protection, Tamper-Evident Banding.

UNIT-IV

Metal Packaging: Types of Metal Package, Mechanical Properties of Metal Container, Method of Manufacturing – Three piece Can, Two piece Can, Necked-in Can, Easy-Open Ends, Collapsible Tubes, aerosol Package, Metal foils, Laminates.

Glass Packaging: Glass Packaging Forms, requirements of Glass Container, Coating in Glass Containers, Closures for Glass Containers, **Wooden Packaging:**Physical Characteristics of Wooden containers, Types of Wooden Boxes, Wooden Crates, Physical and mechanical properties of timber, Defects of timber, methods of preservation of timber.

Text & Reference Books:

1. **Fundamentals of Packaging Technology** by Soroka, IoPP, 2002.
2. **The Packaging User's Handbook Paine** by F. A., 1st Ed, Blackie Academic & Professional, 1991.
3. **Packaging Technology** Byett J. et al., 2nd Ed, The Institute of Packaging (SA), 2001.
4. **Plastics Packaging: Properties, processing, Applications and Regulation** - Selke, S. E. M., Culter, J. D. and Hernandez, R. J, Carl HanserVerlag, USA, 2004.
5. **Handbook of Package Engineering** Joseph F. H, Robert J. K, Hallic F, Third Edition, Technomic Publishing, 1998.
6. **The Wiley Encyclopedia of Packaging Technology** by Yam K. L, Third Edition, Wiley, 2009.

COMPUTER AIDED DESIGN AND MANUFACTURING

(Students from Department of Mechanical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ME-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction and Geometric modeling: Historical developments, product life cycle, CAD/CAM systems, scope of CAD/CAM, CAD/CAM applications, 3D modeling approaches, types of geometric modeling, coordinate systems, sketching and sketch planes, basic features of a CAD/CAM system (extrusion, revolution, hole, cut, sweep, loft, fillet, chamfer, rib, shell, draft, patterns spiral and helix), feature based modeling, parametric modeling, datum features, geometric constraints, modeling operations, heterogeneous modeling, modeling strategies, master model, system modes, model viewing.

UNIT-II

Transformations: Introduction, transformation of points and line, 2-D translation, rotation, reflection, scaling, homogeneous representation, concatenated transformation, mapping of geometric models,3-D scaling, shearing, rotation, reflection and translation, combined transformations.

UNIT-III

Curves, surfaces and solids: Cubic-Spline curve, Bezier curve and B-Spline curve,plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, Bezier surface, B-Spline surface, geometry and topology, Solid models and representation schemes, boundary representation, constructive solid geometry, sweep representation

UNIT-IV

CNC Technology: Introduction, types of NC systems, NC machine tools, principle of operation of CNC, advantages and limitations of CNC systems, Direct numerical control (DNC) and its application, NC part programming, coordinate systems, NC programming languages, G & M codes, Part program for simple parts.

Text & Reference Books:

1. Zeid, I., "CAD/CAM", McGraw Hill, 2008.
2. Groover and Zimmer, "CAD/ CAM", Prantice Hall.
3. Rogers, D. F. and Adams, J. A., "Mathematical Elements for Computer Graphics", McGraw Hill.
4. Radhakrishnan, P. and Kothandaraman, C. P., "Computer Graphics & Design", Dhanpat Rai Publication", 2nd edition, 2005.
5. Krishnamoorathy, C. S. and Rajeev, J. S., "Computer Aided Design (Software and Analysis Tools)", Narosa Publication House, 2nd edition, 2005.
6. Kundra T. K., Rao P. N. and Tiwari N. K, "Numerical Control and Computer Aided Manufacturing", McGraw Hill.

STATISTICAL COMPUTING

(Students from Department of CSE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CSE -491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Review of Descriptive Statistics and Probability Theory: Scale of measurement and data types, Descriptive statistics, Frequency Tables and graphs, Relative frequency tables and graphs, grouping data, histograms and ogive, mean, median, mode, variance and standard deviation of sample data, Sample spaces and events, Axioms, Conditional Probability, Independent event, Bayes Theorem, Binomial Theorem.

UNIT-II

Random Variable and Distributions: Random variables, type of random variables, Mean (Expectation) and variance of a discrete random variables, Discrete uniform distribution, Bernoulli's distribution, Binomial distribution, Geometric distribution, Poisson's distribution, Mean and variance of a continuous random variable, Continuous uniform distribution: normal distribution.

UNIT-III

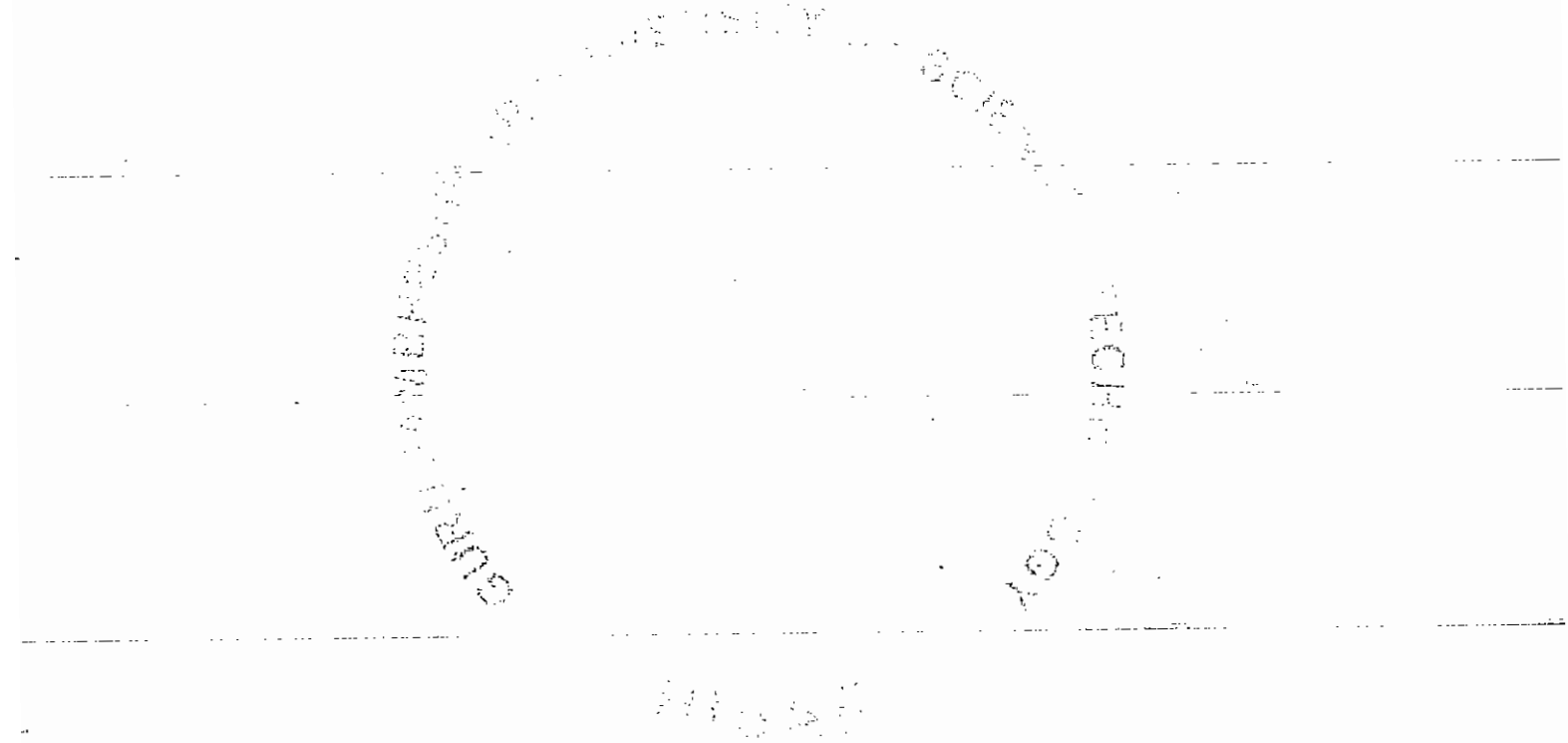
Hypothesis testing: determining levels of significance, Types of hypothesis testing errors, Hypothesis testing for population mean for large and small samples; Comparing two population means for large and small independent samples; Comparing two population means for paired samples; Chi-Square, t test and F test, Analysis of variance (ANOVA).

UNIT-IV

Statistical Learning and Linear Regression: Definition of statistical learning, Estimating a function f, The trade of between prediction accuracy and model comprehensibility, Regression versus Classification problems, Measuring the quality of fit, Linear Regression between variables, Estimating the Coefficients, accessing the accuracy of the coefficient estimates, assessing the accuracy of the model.

Text & Reference Books:

1. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 4th edition, Academic Press, 2009.
2. Douglas S. Shafer and Zhang Zhiyi, Beginning Statistics, 2012. [Available freely online under Creative Commons by-nc-sa 3.0 license.]
3. Brain S. Everitt, A Handbook of Statistical Analysis Using R, Second Edition, LLC 2014
4. Roger D. Peng, R Programming for Data Science, Lean Publishing, 2015.
5. Michael J. Crawley, Statistics, An introduction using R, Second edition, John Wiley, 2015
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2nd edition, 2009.



INTRODUCTION TO MATLAB AND SIMULINK

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–ECE-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Introduction to MATLAB: Introduction to MATLAB Software: MATLAB Window, Command window, Workspace, Command history, setting directory, basic commands, Assigning variables, operations with variables, Data files and data types: Character and String, Arrays and vectors, Column vectors, Row vectors.

UNIT-II

MATLAB Operations and Plots: Arithmetic operations, Operators and special characters, Mathematical and Logical operators, solving arithmetic equations, Matrix operations: Transpose, determinant and inverse, Trigonometric functions, Complex Numbers, Fractions, Real numbers, M files, Plots: 2D plots, 3D plots, GUI Design.

UNIT-III

MATLAB Simulink : Introduction of Simulink, Simulink environment and Interface, Study of Library, Circuit oriented design, Equation oriented design, Model, Subsystem Design, Connect call back to subsystem, Application.

UNIT-IV

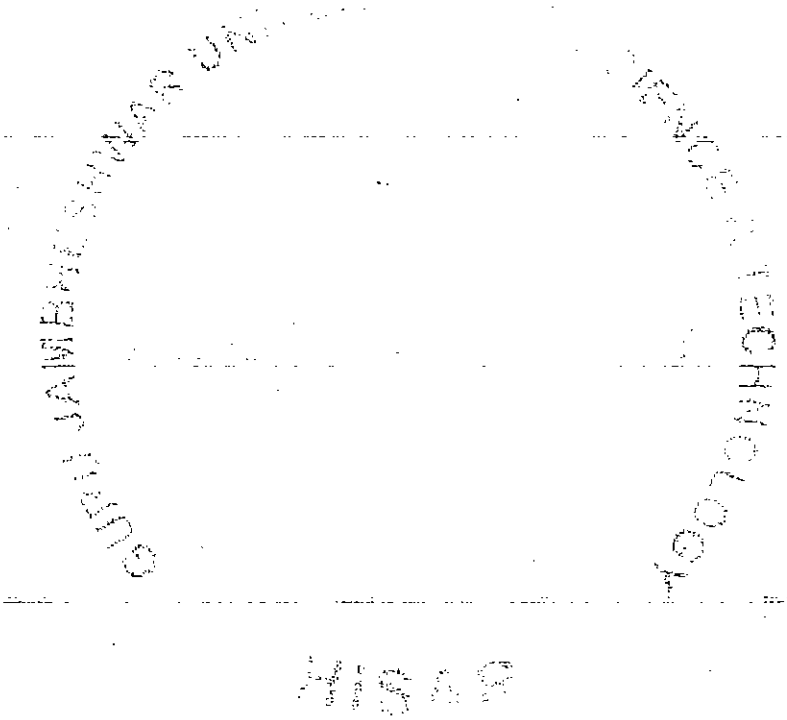
MATLAB Programming: Control statement programming, Conditional statement programming, Loop and Conditional statements: if, else, switch, for, while, continue, break. User defined functions, Built in Function, Function calling, Return value, Type of functions, Global variables.

Text Books:

1. Getting started with MATLAB by Dr. Rudra Pratap, OXFORD University Press.
2. Modeling and Simulation using MATLAB-Simulink by Dr. Shailendra Jain, Dr. Sanjeevan Kapshe, Wiley.
3. MATLAB and Simulink by Dr. Partha S Mallick, Scitech Publications Pvt. Ltd.

Reference Books:

1. Introduction to MATLAB for engineers by William J. Palm.
2. Essential of MATLAB Programming by Stephen J. Chapman.



INSTRUMENTAL ANALYSIS OF FOODS

(Students from Department of Food Technology cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–FT-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Methods of analysis, introduction and scope of various analytical methods for food samples such as food colour, pH value and turbidity; Importance, methods and types of sampling; Uses and roles of various grinding instruments/ machines for preparation of samples for analysis; Expression of results; Methods of moisture analysis in food – drying methods; Near infrared (NIR) techniques, isothermic technique; Analysis of principal food constituents such as carbohydrates, proteins, fat, vitamins and minerals by various methods.

UNIT-II

Methods for separation, identification and quantification of various food components; Separation methods – filtration, centrifugation, sedimentation; Electrophoresis: gel electrophoresis, paper electrophoresis, high voltage electrophoresis, starch gel electrophoresis; Basic principles of spectroscopy: UV, visible and fluorescence spectroscopy.

UNIT-III

Refractometric techniques (refractive index) and instruments for various food components including flavour component and food additives; Methods for measuring textural properties of foods– Instron food tester, penetrometer, texture analyser; Methods for measuring rheological properties of foods – viscoamylograph, extensograph, alveograph, farinograph and mixograph etc.

UNIT-IV

High performance liquid chromatography (HPLC)– types of column and their applications, high pressure pumps, various types of detectors for HPLC; Gas chromatograph (GC) and gas liquid chromatography (GLC); mass spectrophotometer and their applications in food.

Recommended Readings:

1. Nielson S. S. (2003) *Food analysis*, Kluwer Academic Press.

2. Pomeranz Y. J. (2000) *Food Analysis,* Springer Publications.
3. Srivastava (2000) *Instrumental Approach to chemical analysis,* S. Chand Publishers.
4. Winton A. L. (1999) *Techniques of food analysis, Allied Science, Official methods of analysis,* Association of official analytical chemist USA.
5. Das H. (2005) *Food processing operations analysis,* Asian Books private ltd.
6. James CS (1998). Analytical chemistry of foods, BlackicAcad, UK.
7. Winton, AL (1999). Techniques of food analysis, Allied Science Publication, New Delhi.

ENVIRONMENTAL ENGINEERING

(Students from Department of Civil Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–CE-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT – I

Water: Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements. Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

UNIT – II

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems Storm Water: Quantification and design of Storm water; Sewage and Sullage, Pollution dueto improper disposal of sewage, National River cleaning plans, recycling of sewage –quality requirements for various purposes.

UNIT – III

Air: Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution – Occupational hazards, urban air pollution: automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

UNIT – IV

Noise: Basic concept, measurement, effects and various control methods

Recommended Readings

1. Introduction to Environmental Engineering by P. AarneVesilind, Susan M. Morgan, Thompson / Brooks/Cole; Second Edition 2008
2. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000
3. Environmental Engineering, Vol. I ,S.K Garg ,.Khanna Publishers, New-Delhi.(1990)
4. Water Supply and Sewerage, E.W. Steel
5. CPHEEO Manual on Water Supply & Treatment

6. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
7. Integrated Solid Waste Management, Tchobanoglous, Theissen& Vigil. McGraw Hill Publication
8. Environmental Engineering by H.S.Peavy, D.R.Rowe, G.Tchobanoglous; 1991, Tata-Mcgraw Hill

ENERGY MANAGEMENT AND AUDIT

(Students from Department of Electrical Engineering cannot opt this subject as Open Elective)

General Course Information	
Course Code: OE–EE-491-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

UNIT-I

Energy Scenario: Commercial and Non-Commercial Energy, Primary and Secondary Energy Resources, Conventional and non-conventional energy, Commercial Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario.

UNIT-II

Energy Management Functions: Need for energy management, Energy management program, Organizational Structure, Energy Policy, Planning, Audit Planning, Educational Planning, Strategic Planning, Reporting

UNIT-III

Electrical Energy Management: Electricity tariff, Electrical Load Management and Maximum Demand Control, Maximum demand controllers, Power Factor & Its importance, Automatic power factor controllers.

UNIT-IV

Energy Audit: Definition, Energy audit-need, Types of energy audit, Energy Auditing Services, Basic Components of an Energy Audit, Specialized Audit Tools, Industrial Audits, Commercial Audits.

Text & Reference Books:

1. Wayne C. Turner, Steve Doty, "Energy Management Hand book", The Fairmont Press, 6th Edition, 2007
2. Amit K. Tyagi, "Handbook on Energy Audits and Management", Tata Energy Research Institute, 2nd reprint, 2003.
3. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC Press.
4. www.bee-india.nic.in, BEE Reference book: no.1/2/3/4.