AC-5101 ENGINEERING CHEMISTRY

L T P   **Credits:4**
3 1 0

UNIT-I
REDOX REACTION AND ELECTRO CHEMSITRY: Electrolytic conductance (specific, equivalent and molar conductance), factors affecting conductance, strong and weak electrolytes, Kohlrausch's law, Effect of dilution on ionic and equivalent conductance, Oxidation, reduction, oxidation number, redox reactions in terms of oxidation number, oxidation reduction as electron transfer process, equivalent weights of oxidizing and reducing agents, Electrochemical cell, Types of electrodes, electrode potential, EMF, cell reactions, EMF of galvanic cell, electrochemical series and its applications, Nernst's equation, relationship of EMF with equilibrium constant and free energy, primary and secondary batteries, Fuel Cells (acid, alkaline and carbonate).
(10 Hrs)
CORROSION: Direct, chemical corrosion and mechanism, electrochemical corrosion and mechanism, Galvanic corrosion, concentration cell corrosion, atmospheric corrosion, passivity, pitting corrosion, factors influencing corrosion, prevention of corrosion.
(04 Hrs)

UNIT-II
LUBRICANTS: Classification of lubricants, lubricating oils, semisolid lubricants, solid and synthetic lubricants. Properties of lubricating oils (viscosity, flash and fire points, cloud and pour point, mechanical stability and saponification number). (04 Hrs)
PHASE RULE: Introduction, definitions, Gibbs phase rule, phase diagrams, one component systems (water, carbon dioxide, sulfur system), two component systems (Pb-Ag, KI-water, Na_2SO_4-water system).
(05 Hrs)

UNIT-III
ANALYTICAL CHEMISTRY: UV-VIS spectroscopy: Introduction, theory, Frank-Condon principle, Lambert-Beer law, instrumentation, electronic transitions, chromophore, auxochrome, bathochromic, hypsochromic, hypochromic and hyperchromic shifts, effect of polarity and conjugation on ▢max., applications of UV spectroscopy in simple organic molecules.   (04 Hrs)
IR spectroscopy: Introduction, theory, selection rules, simple harmonic oscillator, factors affecting molecular vibrations, FT-IR, instrumentation, finger print region, applications of IR to simple functional groups (carbonyl, hydroxyl, amino, carboxylic acids & their derivatives)
(04 Hrs)

UNIT-IV
NMR spectroscopy: Introduction, theory, instrumentation, chemical shift, shielding and deshielding of protons, factors effecting chemical shift (inductive, anisotropic, hydrogen bonding), spin-spin interactions, coupling constant, applications (ethanol, benzene, isopropanol and acetic acid.
(06 Hrs)
Chromatography: Introduction, basic principle and theory of chromatography, thin layer chromatography and column chromatography, gas chromatography, gas liquid chromatography, gas-solid chromatography, high performance liquid chromatography, Simple applications of chromatography.
(05 Hrs)

RECOMMENDED BOOKS
1. Electrochemistry for chemists   S. Glasstone
2. Engineering Chemistry   P.C. Jain
3. A text book of Engineering Chemistry   M.M. Uppal
4. Principles of Physical Chemistry   Marron and Protton
5. Modern Electrochemistry   Bockris & Reddy
6. Instrumental Methods of Analysis   Willard, Merrit & Dean
7. Fundamentals of Analytical Chemistry   Skoog & West

AC-5201   ENGINEERING CHEMISTRY

L T P   **Credits-4**
3 1 0

UNIT-I

BONDING AND MOLECULAR STRUCUTRE: Chemical bonds (Ionic, Covalent and coordinate bond) polarity in bonds, Fajan rules, Valence bond theory, hybridization (*s, p* and *d* orbitals with examples) LCAO method, Molecular orbital theory (MOT), bonding and antibonding orbitals, MO diagrams of homo and heteronuclear diatoms molecules/ions, Bond order and magnetic properties from MOT, Metallic bond (Electron sea model, VB Model, band theory). Hydrogen bonding (types & consequences).

(10 Hrs)

UNIT-II

SOLID STATE CHEMISTRY: Introduction, symmetry elements (planes of symmetry, axes of symmetry and center of symmetry), law of rational indices, crystallographic systems, space lattices, Bragg's law, imperfections in crystals (Frenkel, Schottey and non-stochiometric defects), conductivity in ionic solids and in organic polymers, types of semiconductors, superconductors and insulators.

(06 Hrs)

MOLECULAR ELECTRONIC AND NANO CHEMISTRY: Need for molecular devices, molecular electronics, definition, molecular wires and rectifiers, types of molecular wires with examples, insulation of molecular wires, preliminary idea about measurement of conductivity by various methods(AFM, optical electron transfer etc.), molecular switches : types(pH, optical, temperature, fluorescence with example), logic gates: YES, NOT,AND and OR logic gates with examples, self-assembly.

(04 Hrs)

UNIT-III

REDOX REACTION AND ELECTRO CHEMSITRY: Electrolytic conductance (specific, equivalent and molar conductance) factors affecting conductance, strong and weak electrolytes, Kohlrausch's law, Effect of dilution on ionic and equivalent conductance. Oxidation, reduction, oxidation number, redox reactions in terms of oxidation number, oxidation reduction as electron transfer process, equivalent weights of oxidizing and reducing agents, Electrochemical cell,Types of electrodes, electrode potential,EMF,cell reactionsl, EMF of galvanic cell, electrochemical series & its applications, Nernst's equation, relationship of E with equilibrium constant and free energy,primary and secondary batteries, Fuel Cells (acid, alkaline and carbonate).

(10 Hrs)

UNIT-IV

ANALYTICAL CHEMISTRY: UV-VIS spectroscopy: Introduction, Theory, Frank-Condon Principle, Lambert-Beer Law, Instrumentation, Electronic Transitions, chromophore, auxochrome, bathochromic, hypsochromic, hypochromic and hyperchromic shifts, effect of polarity and conjugation on   max.,Applications of UV spectroscopy in simple organic molecules. **IR spectroscopy**: Introduction, Theory, selection rules, Simple harmonic oscillator, Factors affecting molecular vibrations, FT-IR, Instrumentation,Finger print region, Applications of IR to simple functional groups (carbonyl, hydroxyl, amino, carboxylic acids & their derivatives) **NMR spectroscopy**: Introduction, Theory, Instrumentation, Chemical shift(shielding & deshielding of protons, Factors effecting Chemical shift (Inductive, anisotropic, hydrogen bonding), spin-spin interactions, coupling constant, Applications (ethanol, benzene, isopropanol and acetic acid).

(12 Hrs)

RECOMMENDED BOOKS:
1. Inorganic Chemistry   P W Atkins
2. Physical chemistry   P.W. Atkins
3. J. Chem. Ed., 78, 321-328 (2000)   MB Ward
4. Inorganic chemistry   Jolly
5. Science, 254, 1312-19 (1991)   Seto CT.
6. Instrumental Methods of Analysis   Willard, Merrit & Dean

AM-5101   ENGINEERING MATHEMATICS-I

L T P   **Credits:4**
3 1 0

UNIT-I
Elementary transformations: Row reduced Echelon forms, Rank of a matrix, normal form, linearly dependent and independent vectors, Consistency of system of linear equations, Linear transformations, Eigen values and eigenvectors, Properties of eigen values, Reduction to diagonal form, Cayley-Hamilton Theorem, Inverse of a non-singular matrix, Idempotent matrices, Complex matrices.

(10 Hrs)

UNIT-II
Sequences: Convergence and divergence of an infinite series. Series of positive terms. Tests of convergence - Comparison test, Integral test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Alternating series, Leibnitz's rule, Absolute and conditional convergence, Power series.

(09 Hrs)

UNIT-III
Functions of two or more variables: Partial derivatives, Homogenous functions. Euler's Theorem, Total derivative, Derivative of an implicit function, Tangent and normal to a surface, Change of variables, Jacobians,   Taylor's theorem for a function of two variables, Maxima and minima of a function of two variables, Lagrange's method of undetermined multipliers, Double integral, Change of order of integration, Triple integral, Change of variables, Applications to area and volume, Beta and Gamma functions.

(15 Hrs)

UNIT-I V
Cartesian co-ordinate system: Distance formula, Section formulae, Direction ratios and direction cosines, Equation of a plane, Equations of a straight line, Condition for a line to lie in a plane, Coplanar lines, Shortest distance between two lines, Intersection of three planes, Equation of a sphere, Tangent plane to a sphere, Equations of a cone and a cylinder.

(14 Hrs)

RECOMMENDED BOOKS:

Text Book
1. R.K.Jain, S.R.K. Iyengar , Advanced Engg. Mathematics, Narosa
2. V. Krishnamurthy, An Introduction to Linear Algebra (for section I)
3. Thomas & Finney, Calculus, Pearson Education (for sections II, III, IV)

Reference Books
1. Denial A Murray, Elementary Course in Differential Equations, Longman
2. Erwin Kreyszig, Advanced Engg. Mathematics, Wiley Eastern Limited, New Delhi
3. M.R.Spiegal, Advanced Calculus – Theory and Problems, Schaum Publications, New York

AM- 5201 ENGINEERING MATHEMATICS-II

L T P   **Credits-4**
3 1 0

UNIT-I

Higher order linear differential equation with constant coefficients, complementary function and particular integral, Method of variation of parameters, Cauchy's and Legendre's equations, Formation of partial differential equation, Lagrange's linear partial differential equation, Non-linear partial differential equation of first order. Charpit's method, Homogenous linear partial differential equations with constant coefficients.

(14 Hrs)

UNIT-II

Laplace transforms of elementary functions, Properties of Laplace transform, Transform of derivatives and integrals, Evaluation of integrals by Laplace transforms, Inverse Laplace transforms, Convolution theorem, Solution of ordinary differential equations, Unit step function and unit impulse function, Engineering applications, Fourier series. Change of interval, Even and odd functions, Half-range series, Applications to standard waveforms.

(12 Hrs)

UNIT-III

Limit of a complex function, Differentiation, Analyticity, Cauchy-Riemann equations, Harmonic functions, Conformal mapping, Some special transformations- translation, inversion and rotation, Bilinear transformation.

(10 Hrs)

UNIT-IV

Differentiation of a variable vector, Scalar and vector point functions, Vector operator – Del, Gradient, curl and divergence - their physical interpretation and applications, Directional derivative, Line, surface and volume integrals, Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.

(12 Hrs)

RECOMMENDED BOOKS

Text Book
R.K.Jain&S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publishing House
G.B. Thomas & R.L. Finney, Calculus: Analytical Geometry, Addison Wesley

Reference Books
Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern
David Widder, Advanced Calculus, PHI
Glyn James, Advanced Modern Engg. Mathematics, Pearson

AM- 6101/6201   NUMERICAL METHODS

L T P   **Credits:3**
3 0 0

UNIT-I
Errors in arithmetic operations and functions, Round-off error, truncation error, Absolute error, Relative error, Percentage error, Principles of equal effect, Significant digits, Intermediate value property, Bisection method, Method of false position, Secant Method, Newton-Raphson method, Iterative method, Convergence of these methods.

(13 hrs)

UNIT-II
Gauss Elimination method (with and without partial pivoting), Gauss-Seidel, Jacobi's methods, Triangularization method, Eigen value problem, Rayleigh's power method, Finite differences- forward, backward and central differences, Shift and averaging operators.

(11 hrs)

UNIT-III
Newton's forward, backward and divided difference interpolation formulae, Lagrange's formula, Gauss forward and backward difference interpolation formulae, Spline interpolation – quadratic and cubic, Numerical differentiation using Newton's forward and backward difference formulae.

(12 hrs)

UNIT-IV
Numerical integration – Trapezoidal rule, Simpson's one third and three-eighth rules, Romberg's integration, Error in integration, Taylor series method, Picard's method, Euler method, Modified Euler's method, Runge-Kutta methods (upto fourth order) for solution of ODE of first order.

(12 hrs)

RECOMMENDED BOOKS:
Text Book
S.S. Sastry, Introductory Method of Numerical Analysis, PHI
Gerald Wheatley, Applied Numerical Analysis, Pearsons Education
Reference Books
M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Sc. and Engg. Computation,
P.B Patial & U P Verma, Numerical Computational Mathematics, Narosa
J.H. Mathew, Numerical Methods for Maths., Science and Engg., PHI

AP-5101/5201   ENGINEERING PHYSICS

L T P   **Credits:4**
3 1 0

UNIT – I
RELATIVITY: Newtonian mechanics and Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, time dilation and length contraction, space-time interval, twin paradox, relativistic addition of velocities, variation of mass with velocity, mass energy equivalence, relativity and Doppler effect, basic ideas of optical gyroscope, cosmology and red shift.

(10 Hrs)

UNIT – II
QUANTUM MECHANICS: Need of quantum mechanics, Basis of quantum mechanics, wave function, Schroedinger's time-independent and time-dependent equations, expectation values of physical quantities (position, momentum and energy), applications of time independent equation; for a particle in a box (one dimensional), step potential, finite square well potential, tunneling effect, problem of harmonic oscillator.

(10 Hrs)

UNIT – III
STATISTICAL MECHANICS: Introduction, principle of equal a priori probability, equilibrium state of a dynamic system, thermodynamic probability, distribution of particles in compartments, phase space, Maxwell-Boltzmann statistics, speed distribution; need for quantum statistics, Bose-Einstein statistics, Planck's, Wein's displacement and Stephan's laws; Fermi-Dirac statistics, Free electron gas model, Fermi energy, average KE and speed of electron at 0K.

(10 Hrs)

UNIT – IV
SUPERCONDUCTIVITY: Introduction, type I & type II superconductors, Meissner's effect, isotope effect, effects of magnetic field, London's equations, penetration depth, specific heat, BCS theory (electron-lattice-electron interaction, Cooper-pair, coherence length, energy gap), high temperature superconductors, applications of superconductivity.

(06 Hrs)

RADIATION PHYSICS AND LASERS : Elementary ideas about interaction of charged particles, electromagnetic radiations and neutrons with matter, detection of radiations by: proportional counter, GM counter, scintillation detectors, solid state detectors and BF3 detector (basic principle only), applications of radiations in industry, agriculture and health science, radiation hazards.
Lasers: Principle of lasers, types of lasers   (He-Ne, Ruby, CO_2 and semiconductor laser), applications of Lasers.

(06 Hrs)

RECOMMENDED BOOKS:
Text Books
Arthur Beiser ; Concepts of Modern Physics (McGraw Hill)
C. Kittel: Introduction to Solid Satate Physics(John-Wiley&Sons) Engineer
Reference Books
Serway, Moses and Moyer   Modern Physics (Thomson)

CH-5101   CHEMICAL PROCESS CALCULATIONS

L T P   Credits:5
3 2 0

Unit-I
Basic Chemical Process Calculations and Psychrometry: Techniques of problem solving, concentration calculations for solutions, Raoult's Law for ideal solutions, Ideal Gas Law, Equations of state for real gases, Dalton's Law for gaseous mixtures, Humidification operations, psychrometric chart for air water system, psychrometric operations calculations other than air water system, Humidity charts & their uses.

(10 Hrs)

Unit –II
Material Balance: Process flow sheet, material balance without chemical reactions and with chemical reactions, Recycle, bypass and purge operations with and without chemical reactions, Degree of freedom analysis, Applications of material balance to various chemical plant operations.

(12 Hrs)

Unit –III
Energy Balances: Heat Capacity, Heat capacity of gases at constant pressure, Heat capacity for gaseous mixtures, and specific heat of liquid mixtures, Latent heats, Heat of formation, Heat of combustions and heat of reaction, theoretical flame temperature and their calculations, Energy balances over distillation.

(10 Hrs)

Unit –IV
Application of material and energy balance to the evaporators, reactors and other industrial processes (steady state operations), Basic calculations using chemical flow sheet simulator

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Hougen & Watson	Chemical Process Principle	Asia Publishers
Bhatt & Vohra	Stiochiometry	Tata McGraw Hill
Himmalblau	Basic Principles and Calculations in Chemical Engg.	Prentice Hall(s) Ltd.
Reference Books		
Feeder	Elementary Process Calculations	Wiley Eastern
Saha, S.N.	Fundamentals of Chemical Engineering	Dhanpat Rai Publishing, New Delhi

CH-5102   FLUID FLOW

L T P   **Credits:4**
3 1 0

Unit –I
Concept, Definitions and Flow Measuring Devices: Review of various types of flow and types of fluids, flow of incompressible fluid in pipes; Bernauli's equation and applications, laminar flow in pipes. Effect of roughness, Friction-factor chart, friction losses from sudden expansion and sudden contraction. Orifice meter, venturi meter, rotameter, Weirs and Notches, pitot tube.

(12 Hrs)

Unit –II
Viscous Flow: Reynolds experiment, boundary layer formation on a plate and enclosed conduits and boundary layer separation, mixing length. Flow past immersed bodies, Stock's Law, terminal velocity & drag coefficient, Pipes, fittings & valves; Estimation of economic pipe diameter.

(10 Hrs)

Unit –III
Review Of Fluid Motive Devices: Pumps: Reciprocating:- single and double acting, single cylinder and multi cylinder. Rotary: Internal gear and external gear. Centrifugal, different types of impellers, characteristics curves of Centrifugal pumps, NPSH, Cavitations, pump priming, specific speed and pump selection, Fans, blowers, compressors and nozzles.

(10 Hrs)

Unit –IV
Flow of Compressible Fluids: Processes of compressible flow through variable area conduits, adiabatic frictional flow, and isothermal frictional flow.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
McCabe & Smith	Unit Operation of Chemical Engineering	Tata McGraw Hill
Richardson & Coulson	Chemical Engg. Vol.-I & II	Pergamon Press
Reference Books		
Badger & Banchero	Introduction to Chemical Technology	Tata McGraw Hill
Foust	Principles of Unit Operation	John Wiley

CH-5103   UNIT OPERATIONS

L T P   **Credits:4**
3 1 0

Unit-I

PROPERTIES OF PARTICULATE MASSES AND SIZE REDUCTION: Mixing of solids, kneaders, dispersers and masticators, Muller mixture and pug mill, mixing index for paste and granular solids, Working principles and applications of Gyratory crusher, smooth roll crushers, Toothed roll crusher, derivation of critical speed of tumbling mill, fluid energy mill, Knife Cutters

(12 Hrs)

Unit-II

MECHANICAL SEPARATIONS AND FILTERATION: Screening, Screen analysis, Screening equipment namely stationary Screens & Grizzles, Gyrating Screen, Vibrating Screens, material balance over screen, capacity & effectiveness of screen, Concept of filtration, Plate & Frame filter press, Shell & Leaf filters, continuous Rotary Vacuum Filter, Principle of filtration, Centrifugal filtration.

(10 Hrs)

Unit-III

SEDIMENTATION: Flocculation, Kynch theory of settling, continuous Thickener and their application in industry, determination of Thickener area, Gravity settling processes, Gravity classifier, differential settling methods, Clarifiers & Thickeners.

(10 Hrs)

Unit-IV

CENTRIFUGAL SEPARATION: Air cyclone separator, Wet scrubbers, Batch top & under driven centrifuge, vertical solid boul centrifuge, disc type centrifuge, Centrifugal decanters, Centrifuge theory & calculations, rate of separations.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
McCabe & Smith	Unit operations of Chemical Engg.	McGraw Hill
Coulson & Richardson	Chemical Engg. Vol.-II	Pergamon Press
Reference Books		
Foust Alans	Principle of Unit Operation	John Wiley
Badger & Banchero	Introduction to Chemical Engg.	Tata McGraw Hill

CH-5201   HEAT TRANSFER

L T P   **Credits:5**
3 2 0

Unit –I

Modes of Heat Transfer - Conduction: Review of Fourier's Law, one-dimensional heat conduction through composites having plane wall, spherical & cylindrical geometry, Steady state heat flow with heat source through plane wall and cylindrical surface, Thermal conductivity of materials, Optimal thickness of insulation, Fins and their applications, Unsteady-state conduction; Lumped heat capacity system, semi-infinite solid and Heisler chart.

(10 Hrs)

Unit –II

Convection: Free and forced convection, Concept of thermal boundary layer, concept of overall heat transfer coefficient for laminar and turbulent flow, Heat transfer inside & outside tubes with significance of Nusselt, Prandlt, Reynold, Biot, Fourier and Peclet number, Modeling of convective heat transfer coefficient by using dimensional analysis.

(10 Hrs)

Unit –III

Radiation: Distribution of radiant energy, Definition of emissivity, absorpitivity, Reflectivity and Transmissivity, concept of Black and Grey bodies, Planck's Law of monochromatic radiation, Kirchhoff's Law, Wein's displacement law, Stefan-Boltzmann law, definition of intensity of radiation, Radiation formula for radiation exchange between simple bodies, two parallel surfaces and between any source and receiver.

(10 Hrs)

Unit –IV

Boiling, Condensation, Heat Exchangers and Evaporators: Drop wise and Film wise condensation of pure and mixed vapors, Nucleate & Film boiling, Review of correlations of heat transfer, Theory & design of Double Pipe Heat Exchanger, Shell and Tube Exchangers, Selection of passes of 1-2, 2-4 Shell-and-Tube Heat Exchangers, Temp. Correction factor for shell & tube exchangers, Theory of plate type heat exchanger, Reboiler and Condensers, Counter Current dry contact condenser, parallel current-wet contact condensers, Theory and design of single effect evaporators, Various types of evaporators: Standard vertical tube evaporator, basket type vertical evaporator, forced circulation evaporator and horizontal tube evaporators. Various feed arrangements in multiple effect evaporators.

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Holman, J.P.	Heat Transfer	McGraw Hill
Kreith	Principles of Heat Transfer	Harper & Row
Reference Books		
McAdams	Heat Transmission	McGraw Hill
McCabe & Smith	Unit Operations of Chemical Engg.	McGraw Hill
Kern, D.Q.	Process Heat Transfer	Tata McGraw Hill
Incropera & Dewitt	Fundamentals of Heat and Mass Transfer	John Wiley
Rao, YVC	Heat Transfer	University Pub.

CH-5202   CHEMICAL PROCESS INDUSTRY

L T P   **Credits:4**
3 1 0

Unit –I
CERAMIC INDUSTRIES: Basic Raw Materials, Chemical conversion, Manufacture of porcelain & building bricks, Chemical & Physical properties & industrial applications of refractories.

(07 Hrs)

Unit-II
ELECTROLYTIC INDUSTERIES AND ELECTROTHERMAL INDUSTERIES: Uses of Aluminum, Magnesium & sodium as electrolysis, Manufacture, Physical & Chemical properties & industrial use of fused Aluminum, Calcium Carbide & Silicon Carbide.

(12 Hrs)

Unit-III
DYES AND ALCOHAL & BEVERAGES: Classification of dyes, manufacture of dyes, various physical & chemical properties of dyes & their industries uses, Production of Ethyl Alcohol & Beer.

(10 Hrs)

Unit-IV
PHARMACEUTICAL INDUSTRIES: Manufacture of the following drugs: Salicylic acid methyl & alicylate, Darvon, Penicillin, Erythromycin and Streptomycin.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Shereve & Brink	C.P.I.	McGraw Hill
G.N. Pandey	A Text Book of Chemical Tech., Vol.I&II	Vikas Publishing Ltd.
Reference Books		
Gopal Rao	Outlines of Chemical Technology	East West Press
Jain & Jain	Engineering Chemistry	Dhanpat Rai & Co.

CH-6101   MASS TRANSFER

L T P   **Credits:4**
3 1 0

Unit –I
Introduction: Classification of Mass Transfer Operations, choice of separation methods, Design principles.
Gas-Liquid Operation and Gas Absorption: Tray Tower: Shell and trays, Tray spacing, Tower Diameter, Downspouts, Weirs, Tray efficiency, Point efficiency. Packed Tower: Packing Random & Regular, Packing supports, Liquid distribution, Entrainment Eliminators, Countercurrent flow of liquid and gas through packing, Flooding & Loading, Pressure drop for single phase flow, Mass transfer coefficient for packed tower, Liquid holdup.
Equilibrium solubility of gases in liquids: Two component systems, Multi component systems, Ideal solution, Non ideal solution, Solvent selection, One component transfer material balance: Counter flow, Minimum Liquid-Gas ratio for absorber, Co-current flow. Counter current multistage operation one component transfer, concept of absorption factor 'A', Non-isothermal operation, real trays & tray efficiency. Continuous contact equipment: Concept of overall transfer coefficient and transfer unit, Graphical construction for transfer unit, overall height of transfer unit

(12 Hrs)

Unit –II
Distillation: Vapour Liquid Equilibria, Txy & Pxy diagram, Relative volatility, Ideal solution Raoult's Law, Positive Deviation from Ideality, negative deviation from ideality. Enthalpy concentration diagram (Hxy), Single stage operation, Flash vaporization, Differential or simple distillation, Rayleigh's Equation, Differential condensation, constant relative volatility. Continuous rectification binary system: The fractionation operation, Overall enthalpy balance. Multistage (Tray) Towers: The method of Ponchon-Savarit, Feed Tray location, Minimum Reflux Ratio & Optimum Reflux Ratio, Reboilers & Condensers, Use of open steam. The method of McCabe & Thiele: Assumptions, Equation for minimum Reflux Ratio & Optimum Reflux Ratio, Tray efficiencies. Continuous-Contact Equipment (Packed Towers): The transfer Unit, Azeotropic & Extractive Distillation

(12 Hrs)

Unit –III
Extraction and Leaching: Liquid Equilibria, Equilateral Triangular coordinates, System of three liquids - One pair partially soluble, system of three liquids - two pair partially soluble, system of two partially soluble liquids and one solid, other coordinates, effect of temperature & pressure, choice of solvent. Stage wise contact: Single stage extraction, Multistage crosscurrent extraction, continuous counter-current multistage extraction, Stage efficiency. Stage type extractor & continuous contact extractor
Unsteady state leaching: Percolation tank, Batch settling, Steady state continuous operation: Agitated vessels, Thickeners, Continuous counter current decantation (CCD), classifiers. Method of calculation: Practical equilibrium, single stage leaching, Multistage cross current leaching, Multistage counter current leaching

(10 Hrs)

Unit –IV
Adsorption: Type of adsorption and nature of adsorption, Adsorption Equilibria: Single gases and vapors, Vapor and gas mixture, Binary gas or vapour mixture, both component appreciably adsorbed, Effect of temperature and pressure, Freundlich & Langmuir Isotherm. Stage wise operation Single stage adsorption, Multistage cross-current adsorption,

continuous counter-current multistage adsorption, Application of freundlich isotherm, steady state moving bed adsorber, unsteady state fixed bed adsorber.

Drying : Equilibrium: Insoluble solid, Hysteresis, and Soluble solid, Batch drying, Rate of batch drying, Rate of drying curve, Time of drying, Cross circulation drying, Through circulation drying, Continuous Drying, drying equipments

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Treybal Robert	Mass Transfer Operations	McGraw Hill
Sherwood, Thomas ,P. R.Wilkes	Mass Transfer	McGraw Hill
Reference Books:		
Chattopadhyay, P	Unit Operations of Chemical Engg. Vol. II	Khanna Publishers
Badger & Banchero	Introduction to Chemical Technology	McGraw Hill
Welty, Wicks & Wilson	Fundamentals of Momentum, Heat & Mass Transfer	John Wiley, 3rd Ed
Skelland	Diffusion Mass Transfer	John Wiley

CH-6102   CHEMICAL ENGINEERING THERMODYNAMICS

L T P   **Credits:5**
3 2 0

Unit –I
Introduction and Thermodynamic Properties of Fluids: Review of Laws of Thermodynamics and their applications, volumetric properties of fluids, Heat effects, Properties of Homogeneous mixtures; Partial molar properties, Chemical Potential & its applications, Excess properties & their applications

(10 Hrs)

Unit –II
Phase Equilibrium: Importance of phase equilibrium in Process Industries; vapour liquid equilibrium for miscible, partially miscible and immiscible systems and their phase diagrams; vapour Liquid Equilibrium at moderate pressure; Gibbs-Duhem equation, Activity coefficients from experimental data, Margules, Vanlaar and Wilson equations. Bubble point and Dew point calculations, Azeotropic VLE calculations at low & high pressure, analysis of multi-component and multiphase system

(12 Hrs)

Unit –III
Refrigeration and Liquefaction: Review of various cycles of refrigeration & liquefaction cycles (single stage), refrigeration and liquefaction cycles (multiple stage)

(10 Hrs)

Unit –IV
Chemical Reaction Equilibria and Applications of Thermodynamics to Various Operations: For two phase & multiple phase multi-component systems. Thermodynamic analysis of distillation, evaporation and condensation processes, minimum work of separation and thermodynamic efficiency of separation

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Smith & VanNess	Introduction to Chemical Engineering Thermodynamics	McGraw Hill
Kyle	Chemical & Engineering Process Thermodynamics	Prentice Hall Ltd.
Narayanan, K.V.	Chemical Engg. Thermodynamics	Prentice Hall Ltd.
Reference Books:		
Dodge	Chemical Engg. Thermodynamics	-do-
Rao, YVC	Chemical Engineering Thermodynamics	University Publications

CH-6103   INTRODUCTION TO POLYMER SCIENCE & TECH.

L T P   **Credits:4**
3 1 0

Unit -I
Introduction: Concepts of polymers, Classification of polymers based on: structures, configuration, application, tacticity, crystallinity, mode of formation, Poly dispersity and molecular weight distribution, Concept of Mn, Mz, Mv and Mz and measurement techniques, Functionality principle, Glass transition temperature and its measurement, Theory of polymer solutions: solubility parameter, Mark-Houwink-Sakurda equation.

(10 Hrs)

Unit -II
Polymerization: Chain growth polymerization: mechanism and kinetics of free radical, anionic, cationic and co-ordination polymerization, initiator efficiency, types of initiation reactions, auto acceleration chain transfer agents, inhibition and retardation reactions.

(10 Hrs)

Unit –III
Step growth polymerization: Carother's equation, kinetics of step growth polymerization, cross-linking and gelation, Comparison between addition and condensation polymerization, Co polymerization: Types of co polymers, monomer reactivity ratio, block and graft copolymers.

(10 Hrs)

Unit –IV
Polymer Degradation And Techniques Of Polymerization: Polymer degradation (chain and random), Methods of degradation of polymers such as mechanical, thermal, photo, oxidative and bio degradation, Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization and its kinetics, Comparison of bulk, solution, emulsion and suspension polymerization techniques.

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Premamoy Ghosh	Polymer Science & Technology of Plastics and Rubbers	Tata McGraw Hill
Billmayer	Text Bool of Polymer Science	John Wiley
Flory	Polymer Chemistry	Cornell Uni.
Reference Books:		
Ferdinand Rodriguez	Principles of Polymer Systems	Tata McGraw Hill
Gowariker	Polymer Science	Wiley Eastern
E. Gurvelle	Polymer Science & Technology	Springad Verloq
Gupta, s. Kumar	Fundamentals of Polymers	McGraw Hill

CH-6104   INTRODUCTION TO PAPER TECHNOLOGY

L T P   **Credits:4**
3 1 0

Unit –I
Introduction: History of papermaking, world paper industry overview, Different grades of paper, Source of fibrous raw materials, Fiber characteristics and suitability for woody and non-woody sources, Recycled fibers.

(10 Hrs)

Unit –II
Pulp Production: Debarking, chipping, chip handling and storage, Depithing of baggasse, Introduction of different pulping methods, Brown stock washing (general description without mathematical analysis), An overview of pulp bleaching.

(10 Hrs)

Unit –III
Brief introduction to pulp mill machinery and equipments, Introduction to Chemical Recovery, Introduction to Paper Industry Automation

(08 Hrs)

Unit –IV
Paper Making: Stock preparation: Mechanical Treatment; Introduction to non-fibrous additives, Introduction to fourdrinier and twin wire forming, Sheet pressing, Multi cylinder and Yankee drying, Calendaring and post machine operations, An introduction to different grades of paper, Brief description of machinery and equipments

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Smook	Handbook for Pulp and Peper Technology	TAPPI
Kocurek	Pulp & Paper manufacture Vol. 1	TAPPI
Macdonald	Pulping of Wood, Vol. 1	TAPPI
Reference Books:		
Kourek	Pulp & Paper manufacture	TAPPI
Casey	Pulp & Paper Chemistry and Chemical Technology, Vol. 1	Wiley

CH-6201   CHEMICAL PROCESS INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit –I

Introduction: Process Instrumentation diagrams for some typical units like reactors and evaporators. Importance of instruments in Chemical Process Industries, Classification of instruments, Static and Dynamic Characteristics of Instruments, methods of sensing, transducers, difference in transducers and sensors.

(12 Hrs)

Unit –II

Temperature Measurement: Resistance Thermometer, Thermocouple, Optical and Radiation pyrometer.

(10 Hrs)

Unit –III

Pressure, Flow & Level Measurements: Manometers, Bourdon gauge, Macleod gauge, Vacuum and Pressure Transducers, LIQUID LEVEL measurement- direct and differential method and Flow measuring devices.

(10 Hrs)

Unit –IV

Miscellaneous Measurements: Measurement of Nuclear Radiation, Instruments of Gas Analysis, Viscosity, Conductivity, Humidity and pH value, industrial weighing and feeding systems, Amplification, automatic gain amplifiers.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Eckman, D.P.	Industrial instrumentation	Wiley Eastern
Weber	Introduction to Process Dynamics & Control	John Wiley
Reference Books		
Harriott & Peter	Process control	Tata McGraw Hill
Coughanour	Process Systems Analysis & Control	McGraw Hill
Pollard	Process Control for chemical and allied industries	Heinnemann

CH-6202   CHEMICAL REACTION ENGINEERING-I

L T P   **Credits:4**
3 1 0

Unit-I
Kinetics Of Homogeneous Reaction: Concept of Reaction rate, Rate Equation, Single & Multiple Reactions, Elementary and Non-elementary Reactions, Molecularity and Order of Reactions, Concept of Rate Constant k, Representation of Reaction Rate. Determination of reaction rate from given mechanism and from experimental data.

Single Ideal Reactors: Ideal Batch Reactors—Design Equation, Application of Batch Reactors Continuous Reactors----Concept of Space Time, Space Velocity, Performance Equations of Steady-state Mixed Flow Reactors and Plug Flow Reactors, Concept of Holding Time.

(12 Hrs)

Unit-II
Design For Single Reactions: Size comparison of Single Reactors--- Batch Reactors, Mixed Flow Reactors, Plug Flow Reactors. Multiple Reactor Systems-----Plug Flow Reactors in Series /or in Parallel, Equal size Mixed Reactors in series, Mixed Flow Reactors of Different Sizes in Series, Reactors of Different types in Series, Recycle Reactors, Autocatalytic Reactions.

(10 Hrs)

Unit-III
Design For Multiple Reactions: Reactions in Parallel—Qualitative Discussion About Distribution, Quantitative Treatment of Product Distribution and of Reactor Size, Reactions in Series, Series Parallel Reactions.

(10 Hrs)

Unit-IV
Steady State Of Non-Isothermal Reactor Design: Concept of adiabatic and non-isothermal operation, energy balance equation for batch SCTR and PFR and their applications for design of reactors, Multiple steady states.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Levenspiel	Chemical Reaction Engg.	John Wiley
Fogler, Scott	Elements of Chemical Reaction Engg.	Prentice Hall India
Reference Books		
Smith	Chemical Engg. Kinetics	McGraw Hill
Hougen & Watson	Chemical Process Principle	Asia Publishing House

CH-6203   PROCESS EQUIPMENT DESIGN

L T P   **Credits:5**
3 2 0

UNIT-I
Design Preliminaries: Introduction, Nature of design, Codes and standards, Equipment selection and specification.
Piping Design: Piping classification, important fittings and their use, symbols, layouts and color codes for pipe lines, process piping design and pipe size selection

(08 Hrs)

UNIT-II
Heat Transfer Equipment: Process design calculations for heat exchange equipment: Shell and Tube heat exchangers-general design considerations, estimation of heat transfer coefficients and pressure drop by Kern's and Bell's methods, Condensers and reboilers design, Plate type heat exchanger design, Specifications and sketches of heat transfer equipment.

(12 Hrs)

UNIT-III
Mass Transfer Equipment: Process design calculations for mass exchange equipment: Tray towers, types of plate contractors, sieve tray layout and hydraulic design, column diameter and height. Packed towers, column internals, types of packing, general pressure drop correlation, column diameter (capacity) and prediction of height of transfer units (HTU).

(12 Hrs)

UNIT-IV
Factors Influencing the Design of Vessels, Criteria in Vessel Design, Design of Cylinderical and spherical vessels under internal pressure, IS 803-Strong Tank Design, Design of thick walled high pressure vessels, design of heads and closures, design of tally vertical vessels.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Sinnot R.K.	Coulson & Richardson's Chemial Engg	Elsevier
Bhattacharya B.C.	Int. to Chemical Equipment Design	CBS
Reference Books		
Lloyd E. Brownell & Edwin H. Young	Process Equipment Design	Wiley Publishing
Ludwig E. E.	Applied Process Design Vol. 2	Gulf Publishing Company
Douglas J. M.	Conceptual Design of Chemical Process	McGraw-Hill

CH-6204   POLYMER MATERIAL TECHNOLOGY

L T P   **Credits:5**
3 2 0

Unit –I
Fibers: Properties and applications of fibers: Cellulosic, Nylons, Acrylic, Vinyl and Vinyledene Glass fiber, Carbon fiber, Aramid fiber.

(10 Hrs)

Unit –II
Plastics: Synthesis, properties and applications of LDPE, HDPE, LLDPE, PP, PS, PVC, PMMA, ABS, Nylons (6, 66, 6:10), PF, UF, MF, Epoxy Resins, Silicon, Poly acetal, Polycarbonate, Poly urethane, Poly ethylene Terephthalate (PET), PTFE, Cellulose Acetate, Cellulose Nitrate, and Furan resins.

(12 Hrs)

Unit –III
Rubbers: Structure, properties and applications of Natural Rubber, Latex and its uses in manufacturing of articles), Poly chloroprene, Silicon rubber, SBR, Nitrile rubber, Butyl rubber, EPDM, Poly isobutylene rubber

(10 Hrs)

Unit –IV
Miscellaneous Polymers and Introduction to Polymer Alloys, Blends and Composites: Biodegradable polymers, Conductive polymers, Heat resistance polymers.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Joel R. Fried	Polymer Science & Technology	PHI
Brydson	Rubber Chemistry	Elsevier Appl.
Reference Books		
Ferdinend & Rodrigues	Principles of Polymer Systems	TMH
Gowariker	Polymer Science	Wiley Eastern

CH-6205   PULPING PROCESSES

L T P   **Credits:5**
3 2 0

Unit –I
Chemistry And Morphological Characteristics Of Raw Materials: Structure, Physical properties, composition and chemical properties of different raw materials, Morphological characteristics.

(10 Hrs)

Unit –II
Chemical Pulping: Alkaline Pulping Processes: The soda process: its advantages and disadvantages, The Kraft process, Composition and analysis of Kraft pulping liquors, Chemistry of delignification, Pulping additive like anthraquinone, poly sulfide, Different side reactions involving cellulose and hemicelluloses, Study of the batch and continuous versions, Effect of various parameters like the active alkali charge, chip size, liquor to wood ratio, time to temperature, time at temperature, the 'H' factor and kappa number, Construction and working of different types of digesters, digester safety, Recent developments such as rapid displacement heating, super batch cooking.

(15 Hrs)

Unit –III
High Yield Pulping: Introduction to Mechanical Pulping, refiner mechanical pulping and its variations, principle and operation of refiners, The cold soda process, sulfite based semi chemical pulping process, Thermo mechanical and chemi thermo mechanical pulping.

(10 Hrs)

Unit –IV
Sulfite Pulping Technology Material And Environmental Aspects: Brief introduction, utilization & scope Brief study of digester room emissions, comparison of sulfur and non-sulfur processes. Stream pollution from pulping processes.

(07 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Kocurrek	Pulp & Paer Manufacture Vol. 1,3-5	TAPPI
Sjostrom E	Wood Chemistry Fundamentals and Applications	Academic Press
Reference Books		
Casey	Pulp and Paper Chemistry and Chemical Technology, Vol. 1	Wiley
Macdonald	Pulping of Wood, Vol. 1	TAPPI

CH-7101   PROCESS DYANMICS & CONTROL

L T P   **Credits:4**
3 1 0

Unit –I
Basic Concepts: Laplace transformations and transfer function. Generalization of equations, Linear closed loop, open loop system.

(10 Hrs)

Unit –II
Systems & Frequency Response: Interacting and non-interacting systems and dead time First and higher order systems controllers and their transfer functions, Transient and Frequency responses.

(10 Hrs)

Unit –III
Stability Criteria & Methods: Stability as a basis of design; Roult array test, Root Locus method and Bode plot, Nyquist criteria.

(12 Hrs)

Unit –IV
Process Control: Introduction to advance control techniques such as Feed Forward- feed back and Cascade, Servo and Regulatory control and adaptive control.

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Coughanour	Process System analysis	McGraw Hill
Stephamoplous	Chemical Process control	Prentice Hall
Reference Books		
Weber	Introduction to Process Dynamics & Control	John Wiley
Hamott Peter	Process Control	McGraw Hill

CH-7102   CHEMICAL REACTION ENGINEERING-II

L T P   **Credits:4**
3 1 0

Unit-I
Non-ideal Flow Reactors: Residence Time Distribution Of Fluid In Vessels, Conversion Directly From Tracer Information, Models For Non-Ideal Flow, Dispersion Model (Dispersed Plug Flow)

(10 Hrs)

Unit-II
Fluid-Particle Reactions: Rate Equations For Heterogeneous Reactions, Contacting patterns For Two- Phase Systems, Considerations of Different Possible Models, Application to Design.

(12 Hrs)

Unit-III
Fluid-Fluid Reactions: Determination of Rate Equations, where Reaction is taking place along with Mass Transfer, Concepts of Enhancement Factor (E), Film Conversion Parameter (M), Clues to the Kinetic Regime from Experiment, Slurry Reaction Kinetics, Application to Design

(10 Hrs)

Unit-IV
Solid Catalysed Reactions: Classification of catalysts, Preparation and Physical Characteristics of solid catalyst, Concept of Physical and Chemical Adsorption, Kinetics of Solid Catalyzed gas phase Reaction, Langmuir- Hinshelwood rate equation.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Levenspiel	Chemical Reaction Engg.	John Wiley
Fogler, Scott	Elements of Chemical Reaction Engg.	Prentice Hall India
Reference Books		
Smith	Chemical Engg. Kinetics	McGraw Hill
Hougen & Watson	Chemical Process Principle	Asia Publishing House

CH-7103   TRANSPORT PHENOMENON

L T P   **Credits:5**
3 2 0

Unit –I
Introduction To Transport Phenomena: Transport Phenomena and Unit Operation, Equilibrium and Rate Processes, Fundamental variables and units, The analogy between Heat, Mass & Momentum Transfer, Concept of Thermal Conductivity, Diffusion Coefficient & Viscosity.

(10 Hrs)

Unit –II
Momentum Transport: Viscosity & Mechanism of Momentum Transport, Newton's Law of Viscosity, Non-newtonian Fluids, Pressure & Temperature dependence of viscosity, Velocity distributions in laminar flow: Shell momentum balance, Flow of a falling film, Flow through a circular tube, flow through an annulus, Adjacent flow of two immiscible fluids, Creeping flow around a solid sphere, The equation of Change for isothermal system, The equation of continuity, the equation of motion, the equation of mechanical energy.

(10 Hrs)

Unit –III
Energy Transport: Thermal conductivity and mechanism of energy transport. Fourier's Law of Heat Conduction, Temperature & Pressure dependence of thermal conductivity in Gas and Liquids. Temperature distribution in solids and in Laminar Flow, shell energy balance, Heat conduction with an electrical Heat source, Heat conduction with a nuclear heat source, Heat conduction with a viscous heat source, heat conduction with a chemical heat source, Heat conduction through composite walls (addition of resistances), Heat conduction in a cooling fin.

(10 Hrs)

Unit –IV
Mass Transport And Transport Property: Diffusivity and Mechanisms of Mass transport, definition of concentration velocities, Mass fluxes, Fick's law of diffusion, temperature and pressure dependence of mass diffusivity. Concentration distribution in solids and in Laminar flow, shell mass balance, diffusion through a stagnant gas film, diffusion with homogenous chemical reaction, diffusion with heterogeneous chemical reaction, Measurement of Transport properties, viscosity measurement, Thermal conductivity measurement, diffusion coefficient measurement. Non-Newtonian phenomena: a) Rheological characteristics of materials, Time independent behavior, Time dependent behavior, visco-elastic-behavior. B) Rheological measurement, capillary viscometer, Rotational viscometers.

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Bird, Stewart & Lightfoot	Transport Phenomena	John Wiley
Welty, Wicks and Wilson	Fundamentals of Momentum, Heat & Mass Transfer, 3rd Edition	John Wiley

CH-7104   POLYMER TESTING AND CHARACTERIZATION

L T P   **Credits:4**
3 1 0

Unit-I
Basic Concepts, Mechanical, And Thermal Properties: Specification and standards, Significance of standards, Professional Testing Organizations
Tensile testing, Flexural properties, Compressive properties, Creep properties, Stress relaxation, Impact properties, Shear strength, Abrasion, Fatigue, Hardness Resilience test.
Short term tests: Heat Deflection Temperature (HDT), Softening temperature, Torsion pendulum. Long term tests: Long term heat resistance test, VL temperature index, Thermal conductivity, and Brittleness temperature.

(12 Hrs)

Unit –II
Electrical, Chemical And Optical Properties: Dielectric strength, Dielectric constant and dissipation factor, Electrical resistance test, Arc resistance.
Immersion tests, Strain resistance of plastics, Solvent stress cracking resistance, Environmental test cracking resistance (ESCR).
Refraction Index, Luminous transmittance, Haze, color, seculars gloss.

(10 Hrs)

Unit-III
Material Characterization And Miscellaneous Tests: For Thermoplastics: MFI, Rheometer tests (Capillary, cup and cone and torque rheometer) Viscosity tests (Dilute solution viscosity measurement), Size exclusion or GPC.
For thermo sets: Viscosity, Apparent density, and Bulk factor measurement.
Flammability test, Water absorption and moisture analysis, Plasticizer absorption test

(10 Hrs)

Unit –IV
Thermal Analysis And Spectroscopic Techniques: Identification And Analysis Of Plastic Materials, Differential scanning calorimetry, Thermo gravimetric analysis, Thermo mechanical analysis
Basic principles and applications of UV, IR, NMR in polymers
Chemical and thermal analysis for identification of polymers, Application of NDT in polymers

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Vishu Shah	Hand Book of Plastics: Testing and Technology	John Wiley & Sons
Ghosh, P	Polymer Science & Technology of	Tata McGraw Hill
Reference Books:		
Billmeyer	Textbook of Polymer Science	Interscience
Gowadikar	Polymer Science	New Age
Gupta, Kumar	Fundamentals of Polymer Science	McGraw Hill

CH-7105　　　POLYMER RHEOLOGY & PROCESSING

L T P　　　　　　　　　　　　　　　　　　　　　　　　　　**Credits:5**
3 2 0

Unit –I
Introduction To Polymer Rheology, Mechanical Properties: Stress and Strain, Stress and strain behavior, Viscosity, Newtonian and non-Newtonian fluids, Visco elastic behavior, and time temperature super position principle, Effect of molecular weight, Temperature, Pressure on rheology.
Visco elasticity – Maxwell and viogt model, visco elastic behavior Creep, Stress relaxation, Effect of molecular weight, Effect of crystallinity, Effect of fillers.

(14 Hrs)

Unit –II
Viscous Flow & Rheometry: Dilute solutions and intrinsic viscosity, Effect of concentration, molecular weight, temperature and pressure, Models for non-Newtonian flow, Mark-Houwink- Sakurada equation, melt fracture, Rheometeric characterization of polymer solution and melts. Die entry defects and their correction (Bagley correction etc.), Die exit defects: (die swelling, warp age, bamboo) their causes and rectification

(10 Hrs)

Unit –III
Polymer Processes: Complete process description for manufacturing of extruded, Injection blow, rotational molded products, Casting, calendring, vacuum forming, compression & transfer molding processes

(10 Hrs)

Unit –IV
Concept of twin screw extruder, RIM, stretch blow molding, co-extrusion, spinning techniques for fibers, Polymer additives & compounding, Common faults & their removal in above processes

(08 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Fried	Polymer Science & Technology	Prentice Hall
R.S. Lenk	Plastic Rheology	Wiley
Reference Books:		
P.J. Flory	Principle of Polymer Chemistry	Cornell Uni.
F. Rodriguez	Principle of Polymer Systems.	Tata McGraw Hill
Gupta, Kumar	Fundamentals of Polymer	McGraw Hill

CH-7106   WASHING, BLEACHING & STOCK PREPARATION

L T P   **Credits:4**
3 1 0

Unit –I
Washing, Screening & Cleaning : Importance of washing & details of washing processes, lignin removal in washing, brown stock washing systems, performance of washers, Displacement ratio, Norden efficiency, dilution factor, washing loses, washing equipments, Types and mechanism of screening, types & theory of centrifugal cleaners, combination of screens and centrifugal cleaners for developing process flow sheets

(12 Hrs)

Unit –II
Bleaching: Science of bleaching & its measurement (brightness, brightness reversion); role of bleaching in paper making for different grades of paper, Single and multistage bleaching processes; chlorination, extraction, hypochlorite, chlorine dioxide, oxygen, ozone, peroxide bleaching stages, Bleaching for non-wood fibers and secondary fibers, Usage & preparation of hypo chlorite, chlorine-dioxide and peroxide and their analysis, Brief study of bio-bleaching, Safety parameter.

(10 Hrs)

Unit –III
Stock Preparation: Flow diagram of stock preparation, usage of hydropulper, agitators in stock chests, deflaker, utilization of back water & fresh water in different sections. Beating & refining of pulp, its effect on run ability & final paper properties, difference between beaters and refiners, types of refiners and differences, working principles of refiners & beaters

(10 Hrs)

Unit –IV
Analysis of beating & refining based on difference in raw material (e.g. softwood, hardwood, non wood materials), power consumption optimization, Internal sizing; different sizing agents; mechanism of sizing with rosin; concepts of neutral and alkaline sizing use of AKD & ASA, Other chemicals used in paper making, addition of fillers & their effect on paper properties, Wet and dry strength additives, Retention & drainage aids, dyes, pigments, deformers

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Singh, RP	Bleaching of Pulp	TAPPI
Kocurek	Pulp & Paper Manufacture, Vol. 5,7	TAPPI
Reference Books:		
Macdonald	Pulp & Paper Manufacture Vol 1,3	TAPPI
Casey	Pulp & Paper Chemistry & Chemical Technology, Vol. 2,3	Wiley
Smook	Handbook for Pulp and Paper Technology	TAPPI

CH-7107   CHEMICAL RECOVERY PROCESSES

L T P   **Credits:5**
3 2 0

Unit -I

Introduction: Introduction to kraft/soda recovery cycle, Impact of pulping on chemical recovery process.

Black Liquour Properties & Its Effect On Recovery Operation: Chemical and rheological properties of black liquor and their effect on evaporator operations, recovery of by-products, evaporator scales overview of liquid effluents & gaseous emissions; black liquor characteristics influencing furnace operations.

(10 Hrs)

Unit -II

Concentration And Incineration Of Black Liquor: Black liquor evaporation; multiple effect evaporation, types of evaporators used in paper industries and auxiliary equipments, direct contact evaporators, finisher effects, and exclusion of DCE.

Process chemistry, types of recovery boiler and accessories, effect of design and operating parameters; combustion air and its distribution, fire side deposits, their effect on performance and control measures, Suspended particulate matter & gaseous emissions and their control, recovery of fume particle, Operation and types of ESP

(12 Hrs)

Unit –III

Causticizing Of Green Liquor: Green liquor clarification, slaking & causticising reactions, variables affecting its efficiency, White liquor clarification and equipment details, mud washer, calculation of soda loss in lime sludge. Design calculations of clarifiers, slakers, causticizers and mud filters.

(10 Hrs)

Unit –IV

Lime Mud Reburning & Lime Recovery And New Chemical Recovery System: Process description, lime kiln details, effect of variables, overview of air pollution and its control.

Process description & salient features of the new recovery processes such as DARS, WAO, fluidized bed recovery, gasification of black liquor, instrumentation controls used in recovery

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Kocurrek	Pulp & Paper Manufacture, Vol. 5	TAPPI
Smook	Handbook for Pulp & Paper Technology	TAPPI
Reference Books:		
Macodonald	Pulping of Wood, Vol. 1	TAPPI
Casey	Pulp & Paper Chemistry & Chemical Technology, Vol. 2,3	Wiley

CH-7201   PLANT DESIGN AND ECONOMICS

L T P   **Credits:3**
3 0 0

Unit-I
General Design Consideration: Health & Safety consideration, environmental protection, plant location, plant layout, plant operation and control.
Process Design Development: Process creation design from diagram, equipment design & specification, flow sheet synthesis and development.

(12 Hrs)
Unit-II
Analysis and cost estimation: Cash flow for industrial operations, factors affecting investment and production cost, estimation of capital investment, cost indexes, estimation of total production cost.

(10 Hrs)
Unit-III
Time Value of Money and risk in investment, discounting, cost equivalence, analysis of cost in a Chemical Plant, depreciation and different method in calculating it, break even points

(10 Hrs)
Unit-IV
Profitability, alternative investment and replacement.
Optimum deign and its strategy, scale up criteria and regime concepts.

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Richardson & Coulson	Chemical Engineering Design Vol. 6	Butterworth-Neinemann
Peters & Timmerhaus	Plant Design & Economics for Chemical Engineers	McGraw Hill
Reference Books:		
James & Douglas	Conceptual Design of Chemical Processes	McGraw Hill
Perry & Chilton	Chemical Engineers Handbook	McGraw Hill
Anil Kumar	Chemical Process Synthesis and Engineering Design	McGraw Hill

CH-7203 MODELING & SIMULATION

L T P **Credits:3**
3 0 0

Unit –I
Fundamentals: Introduction and Simulation Examples: Types of transport phenomenon based model, mathematical based simulation model. Uses of Mathematical model, Principles of formulation, fundamental Laws, continuity equitation, Energy equation, equation of motion, transport equation, Equation of state, Equilibrium, Chemical Kinetics.

(08 Hrs)

Unit-II
Examples Of Mathematical Models Of Chemical Engineering Systems: series of isothermal constant hold up CSTR's CSTR's with variable hold ups, Two heated tanks, Gas Phase pressurized, CSTR, non isothermal CSTR, single component, Multi component flash vaporizer drum, Batch distillation with hold up, Ph system, equilibrium constant, Titration curve method

(10 Hrs)

Unit-III
Numerical Methods (Iterative Convergence Methods): Interval halving, Newton raphson method, False Position, Explicit convergence method, weignsten, Muller method, Numerical integration algorithm; Euler method, Runga-Kutta Algorithm, Implicit methods

(10 Hrs)

Unit-IV
Simulation Examples: Gravity flow tank, Three CSTRs in series, Non-isothermal CSTR, Binary distillation column, Multi-component distillation column, Batch reactor, Biochemical reactors and absorption

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
B.Wayer	Chemical Engineering Process Dynamics	Prentice Hall
Bequette	Analysis and Simulation	Prentice Hall
Leubegr	System Modeling & Simulations Control for Chemical Engineers	PHI
Reference Books:		
Chawla	Process Modeling & Simulation	McGraw Hill

CH-7204   POLYMER REACTOR DESIGN

L T P   **Credits:4**
3 1 0

Unit-I
Design Principles, design parameters of polymerization reactors, Non elementary reactions, free radical polymerization kinetics, modeling of a chain polymerization reactor. Related design problems as case studies

(10 Hrs)

Unit-II
Kinetics of step growth polymerization, Design factors of step growth polymerization reactors, modeling of step growth reactors, Related problems as case studies

(10 Hrs)

Unit-III
Average molecular weight, molecular weight distribution, properties of distribution, components of distribution, flory weight fraction and mole fraction distribution. The implications of flory distribution in reactor design, Related problems as case studies

(10 Hrs)

Unit-IV
Ionic chain polymerization and its kinetics, design parameters, molecular weight distribution, related problems as case studies

(10 Hrs)

Recommended Books:

Text Books:

Title	Author	Publishers
Advanced Polymer Chemistry: A problem solving guide	Manas Chanda	Marshal Dekkar Inc.
Fundamentals of Polymers International Ed. 1990	Anil Kumar & Rakesh K. Gupta	McGraw Hill
Polymer Reactor Engineering, First Ed. 1994	C. McGreavy	Blackie Academic and Professional,

Reference Books:

An introduction to Polymer	Charles	Rammond B. Seymquer
Chemical Reaction Engg.	Octave Levenspiel	Wiley International Ed.
Elements of Chemical Reaction Engineering	Fogler, H.S.	PHI

CH-7205   POLYMER PRODUCT DESIGN

L T P   **Credits:3**
3 0 0

Unit –I
Introduction and Basic design parameters for plastic molded parts: Designing steps for polymer product, Designing the part for special emphasis on structural consideration/ engineering application, appearance, mould ability, Threads, Holes, Fillets, Taper or Draft, Warpage, Wall thickness, Ribes & Bosses, Undercuts, Inserts, Shrinkage, Tolerance

(12 Hrs)

Unit –II
Injection mold design: Types of molds: hot runner, insulated runner, two and three plate mold, Feed system (sprue, runner and gate design), Mold cooling: Various circuits for core and cavity and calculation of cooling cycle, Types of ejector system and calculation of ejector and clamping force, Parting line design (flat and non flat), Weld line, Venting, Material of constriction for mold

(10 Hrs)

Unit –III
Extruder and transfer mold design: Classification of extruder dies based on direction of flow, Die geometry, Types of compression and transfer molds

(10 Hrs)

Unit –IV
Rubber product Design: Design of common rubber products such as Tyre, Cable, Belt (V-belt and conveyor belt), Hose, Vibration isolator, and Bridge bearing

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Crawford	Plastic Engineering	Pergaman Press
Reference Books:		
Dyson	Engineering Polymers	Chapman & Hall
Powell	Engineering with Polymers	-do-
Smith	Manufacture of Plastics	Van Nostrand
Morton Jones	Polymer Process	Chapman Hall

CH-7206   PAPER MACHINE OPERATIONS

L T P   **Credits:4**
3 1 0

Unit –I

Sheet Formation And Consolidation: Approach flow system, consistency regulation, constant level box, stock distribution, head box types & role in paper making, Theory and measurement of sheet formation, Principle, working & calculation of different drainage elements on four driner wire like breast roll, forming board, couch roll table rolls, foils, and vacuum boxes. Wire design & its type, effect on sheet formation. Different types of paper machines (twin wire top former etc.), Types & theory of pressing, types of press felts & their structure, functions of press felts, basic calculation on press section.

(12 Hrs)

Unit –II

Drying: Theory of paper drying on multi-cylinder and Yankee dryer, rate of drying and affecting parameters, Hoods, their types, purpose and effect on drying, dryer felts, special dryer systems like flakt, radiation etc. condensate removal system, pocket ventilation

(10 Hrs)

Unit –III

Surface sizing processes, requirements and chemicals used with paper properties developed. Paper m/c drive and methods of speed control, safety parameters on paper m/c. Review of paper testing and process properties relationships, different paper defects and their remedies

(10 Hrs)

Unit –IV

Finishing: Working of winder, rewinder, cutters, coating, machine calendaring & super calendaring, Finishing plant defects of paper

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Kocurek	Pulp and Paper manufacture Vol. 7,8 & 10	TAPPI
Smook	Handbook for Pulp and Paper Technology	TAPPI
Reference Books:		
Macdonald	Pulp & paper manufacture Vol. 1 & 3	TAPPI
Casey	Pulp & Paper Chemistry & Chemical Tech. Vol. 2,3	Wiley

CH-7207   PAPER PROPERTIES AND TESTING

L T P   **Credits:3**
3 0 0

Unit –I
Introduction and Surface Properties: Paper properties in relation to end use of paper, physical and structural properties of paper, two sidedness, bi-directionality, basis weight, curl, and porosity, Smoothness, wax picks test, cleanliness (dirt count), and printability

(08 Hrs)

Unit –II
Mechanical and Optical Properties: Stress strain relationship, tensile strength, tear strength, burst strength, folding endurance, testing of boxboards edge crush, concord crush, compression testing, impact testing, ply strength testing.
Light sheet interaction: the conic photometric curve for reflected light, Various reflectance, brightness, opacity, gloss and color of paper, The kubelka munk theory

(14 Hrs)

Unit –III
Interaction Of Paper With Fluids: Dimensional stability of paper with varying relative humidity, sizing & its measurement (cobb test, Williamson oil penetration test, klemn test), Penetration of non-aqueous fluids (oils and grease), effect on paper properties and end uses

(10 Hrs)

Unit –IV
Properties And Specifications Of Different Grades Of Paper & Paper Board: Writing and printing papers (cream wove, surface sized maplitho, copier, bond, magazines, posters &newsprint), Packaging grades (kraft, liquid packaging, grease proof & glassine papers), tissue paper, electrical grades paper, Hercules size test

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
Casey	Pulp & Paper Chemistry & Chemical Technology, Vol. 3	Wiley
Rance	Handbook of Paper Science, Vol. 1 & 2	Elsevier
Reference Books:		
Kocurrek	Pulp & Paper Manufacture	TAPPI
Smook	Handbook for Pulp & Paper Technology	TAPPI

CS-5101 OBJECT ORIENTED PROGRAMMING

L T P   **Credits-3**
3 0 0

UNIT-I

Programming Techniques: Steps in development of a program, Brief discussion of Flow chart, algorithm development & program debugging. Procedural & Applicative Programming, Functional & Logic Programming, Structured programming, Object oriented Programming.
Program Structure : Character set, comments, data types, logical, relational & binary operators, variables ,constants, Standard I/O statements, Expressions. Automatic conversion & casting in data types.

(12 Hrs)

UNIT II

Flow control: If-Else,Nested if, Goto, Switch, Break, continue, while, do-while, for loop.
Functions & Arrays: Void functions, function declaration, parameter passing, call by value, call by reference, return statement Function Overloading. Friend Functions. Virtual functions, Declaration & Initialization of arrays, Accessing array elements, Array of structures, two dimensional & multi dimensional arrays.

(13 Hrs)

UNIT III

Structures & Scope : Declaration of a structure, Initialization, accessing structure members, nested structures, structures as function arguments, Typedef, unions Enumerated data, Block, Local & Global variables, Auto Static & External Variables.
Objects & Classes: Classes & objects in C++, Accessing data & member functions, private & public qualifiers, # include, #define & #undef directives Base & derived classes, multiple inheritance, constructors in derived classes, constructors in multiple inheritance, Operator overloading.

(13 Hrs)

UNIT IV

Pointers in C++ : Pointers, Pointers as function argument, Pointer as a structure member, Pointer arithmetic in objects and classes, pointers and strings, pointers to objects.
File I/O: Opening & closing a file, Reading & writing a file. Random access files. Updating data in random access files. Exception handling, Throwing of a function or an object as an exception, Multiple catch statements.

(10 Hrs)

Recommended books:

Title	Author(s)	Publisher
	Text	
Let us C++	Yashwant kanetkar	
Turbo C++	Robert Lafore	
	Reference	
Thinking in C++	P B Mahapatra	
Complete Reference C++		TMH

CS-5102 PROGRAMMING METHODOLOGY

L T P   **Credits-4**
3 1 0

UNIT-I
Programming Techniques: Steps in development of a program, Brief discussion of Flow chart, algorithm development & program debugging. Procedural Programming, Functional Programming, Structured programming ,Object oriented Programming.
Program Structure: Character set, comments, data types, logical, relational & binary operators, variables, constants, Standard I/O statements, Expressions, Automatic conversion & casting in data types.
Flow control : If, If-Else, Nested if, Goto, Switch, Break, continue, while, do-while, for loop.
(12 Hrs)

UNIT-II
Functions & Arrays: Void functions, function declaration, parameter passing, call by value, call by reference, return statement Function Overloading . Friend Functions, Virtual functions, Declaration & Initialization of arrays, Accessing array elements, Array of structures, two dimensional & multi dimensional arrays.
(12 Hrs)

UNIT-III
Structures & Scope: Declaration of a structure, Initialization, accessing structure members , nested structures, structures as function arguments, Typedef, unions Enumerated data, Block Local & Global variables , Auto Static & External Variables.
Objects & Classes: Classes & objects in C++ , Accessing data & member functions ,private & public qualifiers , # include ,#define & #undef directives, Base & derived classes , multiple inheritance ,constructors in derived classes , constructors in multiple inheritance. operator overloading .
(12 Hrs)

UNIT-IV
Pointers in C++ : Pointers, Pointers as function argument, Pointer as a structure member, Pointer arithmetic in objects and classes ,pointers and strings, pointers to objects .

File I/O : Opening & closing a file, Reading & writing a file . Random access files. Updating data in random access files, Exception handling, Throwing of a function or an object as an exception ,Multiple catch statements.
(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Turbo C++	Robert Lafore	Pearson India
Let Us C++	Yashwant Kanetkar	BPB
Reference		
Thinking In C++	P B Mahapatra	PHI

CS-5103   DISCRETE MATHEMATICAL STRUCTURE

L T P   **Credits-4**
3 1 0

UNIT-I
Sets and Propositions: Introduction, Combinations of sets, Finite and infinite sets, Mathematical induction, Principle of inclusion and exclusion, Multisets, Ordered sets, Propositions.
Basic Principles of counting: Counting Principles, Basics of counting, Pigeonhole Principle, Permutations, Combinations, Generation of permutations and combinations, Discrete probability, Conditional probability, Information and mutual information.

(12 Hrs)

UNIT-II
Relations and Functions: Introduction, A relational model for data bases, Properties of binary relations, Equivalence relations and partitions, Partial ordering relations and lattices, Chains and antichains, a job scheduling problem.
Graphs and Planer Graphs: Introduction, Basic terminology, Multigraphs and weighted graphs, Paths and Circuits, Shortest paths in weighted graphs, Eulerian paths and circuits.

(12 Hrs)

UNIT-III
Recurrence Relations and Recursive Algorithms: Introduction, Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions, Solutions by the method of generating functions, Recirsive definitions, Recursive algorithms.

(12 Hrs)

UNIT-IV
Groups, rings and Boolean algebra: Group rings and Boolean algebra: Binary operations, semi groups and monoids, integers, groups, subgroups, rings and fields, Isomorphism, homomorphism, Lattices and algebraic systems, principle of duality, distributive and complemented lattices, Boolean lattices and Boolean algebra.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Text		
Discrete Mathematics & its Application	K.H. Rosen	McGraw-Hill
Elements of Discrete Mathematics	C.L.Liu	McGraw-Hill
Reference		
Discrete structure of Computer science	Levy	Wiley Eastern
Elements of Discrete	Levis	McGraw-Hill
Maths Foundation of Discrete Maths	Joshi	Wiley Eastern

CS-5104   DIGITAL LOGIC DESIGN

L T P   **Credits-4**
3 1 0

UNIT-I
Number Systems And Codes: Number systems, binary number system, octal number system, hexadecimal number system, signed and unsigned numbers, different type of codes, binary operations- addition, subtraction, multiplication, division, 1s and 2s complement of a number..

(12 Hrs)

UNIT-II
Logic Circuits: Introduction to AND, OR, NOT, NAND, NOR gates. Introduction to Boolean algebra and Boolean variables , AND, OR, NOT, NAND, NOR, gates and inverter, MIN-TERM and MAX-TERM realization, MAX_TERM representation, logical functions using Karnaugh map and Quine-macluskey methods, Plotting, Labeling and Reading the K-map, Don't care Map entries, Map reduction resulting in Product -of-sum expressions, minimization and combinational design, Multiplexers, de-multiplexers, encoders, decoders, adders, subtractors, parity generators, parity checkers, code converter.

(12 Hrs)

UNIT-III
Sequential Circuits: Basic concepts, Flip-Flops, Analysis of RS, Master slaves, T and D Flip-flops, Design of sequential circuits form state diagram, Introduction to programmable logic arrays (PLAs), Programming Array Logic (PAL).

(12 Hrs)

UNIT-IV
Registers And Counters: Introduction, Designing of series and parallel registers, Designing of synchronous and asynchronous counters, designing of up and down counters, ring counters.
Semiconductor Memories: Introduction, memory organization, classification and characteristics of memories, sequential memories, read only memories, read and write memories, content addressable memories, , charged coupled device memory.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
An engineering approach to Digital design	William I. Fletcher	Prentice-Hall
Digital design: principles and practice package	J. F. Wakerly	Pearson Edu
Reference		
Digital Design	M. Morris Mano	PHI
Digital Principles & Applications	Malvino & Leech	TMH

CS-6101   RELATIONAL DATABASE MANAGEMENT SYSTEM

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction To Database Concepts: Difference between Database and non database system, Data independence, 3 level architectures, components of a database system, Example of transaction processing, Advantages and disadvantages of Database system, Data Modeling, Data associations and Data relationships, ER Model;Design, issues, Mapping constraints, keys, ER diagram, weak entity sets, extended ER features, Design of an ER Database schema, Reduction of an ER Schema to tables.

(12 Hrs)
UNIT-II
Database Design: Integrity Constraints: Domain constrants, Referential integrity, entity integrity, functional dependencies, pitfully in Relational database design, Decomposition, Normalization using FD's MVD's and JD's Domain key normal form, Denormalization, Approaches to database design.

(12 Hrs)
UNIT-III
Relation Algerbra: SQL & Relational Calculus Query optimization, Introduction, overview of optimization process, expression transformation, Database statistics, A divide and conquer strategy, Implementing the relational operators.

(12 Hrs)
UNIT-IV
Transaction processing: Transaction Concept, Transaction state, Implementation of Atomicity, and durability, concurrent execution, serializability, Recoverability, implementation of isolation, transaction   definition in SQL.
Overview of Backup and recovery process: Failure classification, storage structure, Recovery and atomicity, Log based recovers, shadow paging, Recovery with concurrent transaction, buffer management, failure with loss of non volatile storage, Advanced recovery techniques.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Database system concepts	Korth, H. F. & A Silberchatz	MGHISE
Fourth Generation Languages	Martin, James	Prentice Hall
Reference		
Introduction to Database system .	Date. C.J.	Addison Wesley
Database Systems	Bipin Desai	TMH

CS-6102   MICROPROCESSOR AND APPLICATIONS

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction to 8-bit microprocessor architecture: Architecture of 8085 Microprocessor, memory and I/O interfacing devices MPU, 8085 Instruction Set, Instruction classification, Addressing modes of 8085, Timing diagram, Fetch Cycle, Execution Cycle, Instruction cycle and Machine cycle.

(12 Hrs)

UNIT-II
Introduction to 80-85/8080A Basic Instructions: Data transfer instructions, Arithmetic operations, logic operations, Programming examples like Looping, Counting, Sorting, Time Delay programs, Use of stack and subroutines, Code conversion, BCD to Binary, Binary to BCD, BCD arithmetic, ASCII to Hex and Hex to ASCII Conversion.

(12 Hrs)

UNIT-III
Interrupts: The interrupts of 8085, Restart instructions, Interrupts: Software and Hardware, Enabling, Disabling and masking of interrupts, Parallel Input Output and Interfacing applications, Basic interfacing concepts, interfacing output displays, Memory organization, Memory mapped I/O, I/O mapped I/O, I/O operations, Programmed I/O, Interrupt driven I/O, DMA. Interfacing of A/D and D/A converters.

(12 Hrs)

UNIT-IV
General Purpose Programming Peripheral Devices: Introduction to chips like 8255, Programming examples with 8255 I/O ports, 8253 Timer, Use of timer and wave form generation, 8279 Programmable key board/ Display interface, DMA controller 8257, 8259 A programmable Interrupt Controller.

Microprocessor Applications: Temperature Controller, Traffic light Controller, Comparison of 8-bit, 16-bit and 32-bit microprocessor, Introduction to Micro controller Evolution of 8031/8051 family micro controller.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Microprocessor Architecture. Programming and Applications with the 8085/8080A	R. S. Gaonkar	Wiley Eastern Ltd
Microprocessor Interfacing, programming & Hardware,	D.V. Hall	PHI.
Reference		
Introduction to Microprocessors	A.P. Mathur	Tata McGraw Hill
Microprocessor systems 8086 & 8080 family	Liu & Gibsion	PHI.
Introduction to 8086 Programming and interfacing	UffenBeck	PHI.
The 8051 Microcontroller and Embedded systems	Mazidi,& Mazidi	Pearson Edu

CS-6103   OPERATING SYSTEMS

L T P   **Credits-4**
3 1 0

UNIT-I

Operating System services: Operating System classifications, Single user, multi-user, simple monitor, batch processing, Multiprogramming, Multiprocessor systems, Multitasking, time sharing, real time operation system.

Processor Management: Process Overview, process states, multiprogramming, levels of scheduler and scheduling algorithms, multiple-processor scheduling, Process, Threads, Process Scheduling objects and techniques.

(12 Hrs)

UNIT-II

Memory Management: Partition, paging and segmentation; types of memory management schemes, virtual memory-demand paging, Page Replacement Algorithms, allocation Algorithms, Thrashing.

(12 Hrs)

UNIT-III

File Management: File supports, access methods, and allocation contiguous method, linked and index allocation; Directory, systems-single level, tree structured, cycle graph and general graph directory, file protection.

Resource Protection: Mechanism, policy and domain of protection, access matrix and its implementation, dynamic protection structure, protection problems, security.

(12 Hrs)

UNIT-IV

Deadlocks Characteristics: Prevention, avoidance, detection and recovery, Concurrent Process, Precedence graph, Berntein's condition, process hierarchy, critical section, semaphores, classical process co-ordination problems.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Operating System Concepts	Peterson, Silberschatz	Addison Wesley
Operating Systeems	Milenkovic	MacGraw Hill
Reference		
Operating systems – A systematic view	Davis,Rajkumar	Pearson
Operating systems	Dhamdhere	TMH
Operating systems	Deitel,Deitel,Choffnes	Pearson

CS-6104   COMPUTER NETWORKS

L T P   **Credits-4**
3 1 0

UNIT-I
Basic & Computer Networks: Need & Evolution of Computer Networks, Description of LAN, MAN, WAN and wireless Networks, OSI and TCP/IP models with description of Data Encapsulation & peer to peer communication, Comparison of OSI and TCP/IP, Basic terminology of computer networks - bandwidth, physical and logical topologies, Media – 10 base Z, 10base S, 10base T, 100baseTX, 100base FX, 1000baseLX and wireless. LAN & WAN devices – Router, bridge, Ethernet switch HUB, Modem CSU/DSU etc

(12 Hrs)

UNIT-II
Physical Layer: Representation, one bit on physical modem i.e. in wired network, optical Network and wireless N/W, Encoding / Modulation – Manchester Encoding, AM, FM and PM. Dispersion, Jitter, Latency and collision. Different types of Media – Shielded twisted pair, Unshielded twisted pair, Coaxial cable, Optical Fiber cable and wireless.

(12 Hrs)

UNIT-III
Data Link Layer: LLC and MAC sub layer, MAC addressing Layer 2 devices, Framing Error control and flow control. Error detection & correction CRC code block parity & checksum. Elementary data link protocol sliding window protocol, Channel allocation problem – static and dynamic. Multiple Access protocol – ALOHA, CSMA/CD Token bus Token ring, FDDI.

(12 Hrs)

UNIT-IV
Network Layer: Segmentation and autonomous system path determination, Network layer addressing, Network-layer data gram, IP addressed classes. Subnetting – Sub network, Subnet mark. Routing algorithm – optimality Principle, Shortest path routing, Hierarchical routing, Broadcast routing, Multicast routing, Routing for mobile host – Concatenated Visual circuits, tunneling Fragmentation and DHCP. Routing Protocol – RIP, IGRP, OSPF and EIGRP. Network layer in ATM Networks.

Transport Layer: Layer 4 Protocol TCP & UDP. Three-way hand shakes open connection. ATM AAL Layer protocol, Session Layer design issue, Presentation layer design issue, and Application layer design issue. Application layer Protocol, TELNET, FTP, HTTP, SNMP.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Computer Networks	Tanenbaum	PHI
Computer Networks and Their Protocols	Darix	DLA Labs
Reference		
Comp. Communication & Networks	Freer	East-West-Press
Data Communication and Networking	Forouzen	TATA McGraw Hill

CS-6201   SOFTWARE ENGINEERING

L T P   **Credits-4**
3 1 0

UNIT-I
Evolving role of Software: Characteristics, components, applications of S/W, A layered technology, S/W process Linear Sequential, Prototyping, RAD, Incremental, Spiral, Component assembly & S/W process & Project metrics.

(12 Hrs)

UNIT-II
S/W scope: Resources, estimation, decomposition techniques, empirical estimation models, Project scheduling, refinement of major tasks, scheduling project plan, Software reliability, S/W equality assurance plan, software quality standards (ISO/CMM). The system engineering hierarchy information engineering, information strategy planning, requirement analysis, analysis principles, Data modeling information flow structured analysis.

(12 Hrs)

UNIT-III
Data Dictionary: Software testing Fundamentals, Test Case design, White box testing, Basis path testing, Control structure testing, Black box testing, Activity network for conversion, Combating resistance to change.

(12 Hrs)

UNIT-IV
Post implementation review: Review plan, S/W maintenance and enhancement procedure. System security, Threats & control measures, disaster/recovery planning, ethics in system development, ethics codes & standard of behavior.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Software Engineering	Ian Somer Ville	Addison Wesley
Software Engineering	ROGER S.PRESSM	TMH
Reference		
An Integrated Approach to Software Engineering	Pankaj Jalote	
System Analysis & Design	ELIAS M AWAD,	
Software Engineering Principles	Richard Fairley	

CS-6202   SYSTEM SOFTWARE

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction: Definition and Role of System Software, Examples of System Software, Evolutions of System Software, System Software and Machine Architecture, Some common architectures – SIC, CISC and RISC Machines.

(12 Hrs)

UNIT-II
Assemblers: Basic assembler functions, Machine dependent Assembler features, Machine Independent Assembler features. Assembler Design Options: One Pass assemblers and Multi Pass Assemblers and Implementation.

(12 Hrs)

UNIT-III
Macro Languages & Macro Processors: Macroinstructions, arguments: Keyword and positional arguments, expansion different forms of Macros – macro defined inside another macro, nested macro calls etc., Macro Processor & Macro Pre- Processor, Macro Processor Design options: One Pass macro processor and Multi Pass macro processor and Implementation.

Loaders & Linkers: Basic Loader Functions, Machine dependent and Machine independent Loader features, Loader schemes: Compile & Go or Assemble & Go, General Loaders, Absolute loaders, subroutine linkages, relocating loaders, Direct Linking Loaders, Binders Linking Loaders, Overlays, Dynamic binders, Implementation of Loaders.

(12 Hrs)

UNIT-IV
Other common System Software's: Introduction and brief discussion on Editors: Types and Structure; Operating System: Definition and types e.g. single, multi -Tasking, multi – user (referring to MS-DOS,LINUX and UNIX); Device Drivers: Definition, role and types; Basic concepts of Compiler Design and it's Functions.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
System programming	Donovan, J.J.	McGraw-Hill
System Programming	Dhamdhere	TMH.
Reference		
Compiler construction for digital computers	Ullman, J.D.	Wiley-Eastern

CS-6203　ALGORITHM ANALYSIS & DESIGN

L T P　　　　　　　　　　　　　　　　　　　　　　　　　　　**Credits-5**
3 2 0

UNIT-I

Introduction: Algorithms; Analyzing Algorithms; Designing Algorithms, Mathematical Foundations, Growth of functions–Asymptotic notation, standard notations & common functions; Recurrences – substitution method, iteration method , recursion tree method,master method, Sorting and Order Statistics, Introduction; heapsort; Quicksort, selection sort,radix sort

(12 Hrs)

UNIT-II

Data Structures: Elementary Data structures; Hash Tables; Binary search Trees; Red-Black Tree Advanced Data Structures – B-Trees, Binomial Heaps, Fibonacci Heaps.

(14 Hrs)

UNIT-III

Advanced Design and Analysis Techniques: Dynamic Programming; Greedy Algorithms; Amortized Analysis.

(14 Hrs)

UNIT-IV

Graph Algorithms: Elementary Graph Algorithms; Minimum Spanning Trees; Single – Source shortest path; All pairs shortest paths; Maximum flow, Overview of String Matching Algorithm, Overview of NP-Completeness Problems.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Introduction to Algorithms	Coreman	PHI
Algorithm Analysis & design	Harwitz and Sahni,	Galgotia Publications
Reference		
The Design and Analysis of computer Algorithms,	Aho, Hopcroft,Ullman	Pearson

CS-7101   COMPUTER GRAPHICS

L T P   **Credits-4**
3 1 0

UNIT-I

Overview of graphics systems: Display devices, physical input and output devices: storage tube graphic displays, Raster Refresh, Plasma Panel Displays, Liquid Crystals.
Output Primitives: Point plotting, Line Drawing algorithms – DDA algorithms, Bresenham's Line algorithm, Area filling – Scan Line algorithm, flood-fill algorithm, Circle-Generating algorithms.

(12 Hrs)

UNIT-II

Two-dimensional Transformations: Basic transformations-translation, scaling, rotation, Matrix representation and homogenous coordinates, composite transformations-scaling relative to a fixed pivot, rotation about a pivot point, general transformation equations, other transformation-reflection, shear.
Windowing and Clipping Techniques: Windowing concepts, Clipping algorithms-Line clipping – Cohen-Sutherland algorithm, Area clipping, Text clipping, Blanking, Windows-to-View port transformation.

(12 Hrs)

UNIT-III

Three Dimensional Graphics and Transformations: Coordinate systems and Display techniques, Representations-Polygon surfaces, Curved surfaces-Bezier and B-spline curves, Transformation – translation, scaling rotation, rotation about an arbitrary axis, other transformations-reflections, shear and 3-D viewing projections, 3-D clipping – viewport clipping.

(12 Hrs)

UNIT-IV

Hidden-Surface and Hidden-Line Removal: Back-face removal, Depth-buffer method, Scan-line method, Depth-Sorting method i.e. Painter's algorithm, Hidden-Line elimination.

Shading (Overview): Modeling Light sources, illumination models: diffuse reflections; diffuse reflectors, Specular reflectors, Attenuation, Refracted light, Half toning, Surface Shading methods(overview)Rendering Methods:Constant Intensity method, Gouraud Shading, Phong – Shading.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Principles of Interactive Computer Graphics	Newman, Sproul,	McGraw Hill
Computer Graphics ,	Hearn & Baker ,	PHI
Reference		
Computer Graphics – A Programming Approach	Steven Harrington	McGraw Hill

CS-7102   ARTIFICIAL INTELLIGENCE

L T P   **Credits-4**
3 1 0

UNIT-I
Artificial Intelligence: Problem, Technique – An Introduction.
Problems: Problem spaces, search, Heuristic search techniques – An Introduction.

(12 Hrs)

UNIT-II
Issues of knowledge Representation Issues, Predicate logic knowledge using Rules, symbolic . Reasoning & statistical reasoning – An knowledge Representation.

(12 Hrs)

UNIT-III
Weak slot & strong slot & (Filter Structure): Game Playing, Planning, Understanding – learning, common sense & Natural language processing.

(12 Hrs)

UNIT-IV
Parallel & distribution AI: connectionist models, Expert systems & perception & Action.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Artificial Intelligence	Elaine Rich & Kevin, Knight	Tata McGraw – HIV edition.
Artificial Intelligence	Patrick Winston	
Reference		
Artificial Intelligence	Luger	

CS-7103   THEORY OF COMPUTATION

L T P   **Credits-4**
3 1 0

UNIT-I

Finite Automata & Regular Languages: Finite state systems, Deterministic, non deterministic finite automata, equivalence of deterministic and non-deterministic finite automata, Finite automates with & without $\in$-moves, 2 way finite automata with output, equivalence of Mealy and Moore machines.

(12 Hrs)

UNIT-II

Properties of Regular Sets: The pumping lemma for regular sets, closure properties of regular sets, decision algorithms of regular sets, The Myhill-Nerode Theorem & minimization of finite Automata.

Context free grammars: Introduction to context free grammers, derivation trees, top-down & bottom up parsing methods, ambiguous context free grammars, chomsky and Greibach normal forms.

(12 Hrs)

UNIT-III

Pushdown Automata: Deterministic and Non-deterministic pushdown automata, Equivalence of context free languages and sets accepted by pushdown automata, Determinstic context free languages.

Properties of Context free Languages: The pumping Lemma for context free languages, closure properties of context free languages, decision algorithms for context free languages, Coke-Kasmi-Young algorithm.

(12 Hrs)

UNIT-IV

Turning Machines: Introduction to turing Machines, Deterministic, non-deterministic, two way infinite tape, multi tape, Constructions of turing Machines for n!, n*n. Post Correspondence problem, Unsolvability of the halting problems.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Introduction to automata theory Languages & computation ,	Hopcraft,Ullman,	Narosa Publications
Theory of Computer science ,	EV Krishnamurthy,	East-west press
Switching circuits & FSM ,	ZVI Kohavi,	TMH publications
Reference		
Elements of the theory of computation	H.R. Lewis	Prentice-Hall
Formal Language	A.K. Salomaa	Acsd. Press

CS-7201   ADVANCE COMPUTER ARCHITECTURE

L T P   **Credits-4**
3 1 0

UNIT-I

Introduction to Parallel Processing: Evolution of Computer Architecture, Parallelism in Uniprocessor systems, Parallel Computer Structures, Architectural Classifications schemes, Multiprocessors and Multicomputers, Multivector and SIMD Computers, Parallel processing applications.

Memory and Input-Output Subsystems: Hierarchical Memory structure, Virtual memory system, Memory Allocation and Management, Cache Memories and Management, Input-Output Subsystems.

(12 Hrs)

UNIT-II

Pipelining and Vector Processing: Pipelining, Instruction and Arithmetic Pipelines, Principles of Designing Pipelined Processors, Vector Processing Requirements.

Pipeline Computers and Vectorization Methods: Vector Super Computers, Scientific attached Processors, Architecture of Cray-I, Pipeline Chaining and Vector Loops, Vectorization and Optimization Methods.

(12 Hrs)

UNIT-III

Structures and Algorithms for Array Processors: SIMD Array Processors, SIMD Interconnection Networks: Static & Dynamic Networks, Mesh Connected Network, Cube interconnection networks, Parallel Algorithms for Array Processors: SIMD matrix multiplication, Parallel sorting for array processors, Associative Array Processing.

(12 Hrs)

UNIT-IV

Multi processor Architecture and Programming: Functional Structures, Interconnection Networks: Multi stage networks for multiprocessors, Parallel Memory Organisation, Multiprocessor Operating Systems, Exploiting Concurrency for Multiprocessing.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Computer Architectures and Parallel Processing	Hawang Kai, Briggs F.A.	McGraw-Hill
Advanced Computer Architecture	Kain Richard Y.	PHI
Reference		
Advanced Computer Architecture	Hwang Kai	McGraw-Hill
Computer System Architecture	Mano M.	PHI

CS-7202   COMPILER DESIGN

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction: Introduction to compliers, translators; lexical & Syntax analysis, Intermediate code generation optimization, bookkeeping, error handling, regular expressions, finite automata.
Parsing: Context free grammar, Derivation & Parse Trees, parsers: shift reduce, operator precedence, top down predictive, efficient parsers; LR parser, LR(O), SLR, LALR, implementation of parsers.

(12 Hrs)

UNIT-II
Syntax Directed Translation: Different schemes & implementation, immediate code, Parse trees, syntax-trees, three address code, quadruples triple, translation of assignment statements, Boolean expressions, postfix notation any parser.

(12 Hrs)

UNIT-III
Error   Detection & Recovery: Errors, Lexical-phase errors, syntactic-phase errors, semantic errors.
Code Optimization: Sources of optimization, loop optimization DAG representation of basic blocks, Value number & algebraic laws, Global data-flow analysis, Dominators, Reducible flow graphs, loop invariant computations, Induction variables eliminations, Backward flow problems.

(12 Hrs)

UNIT-IV
Code Generation: Object programs, problems in code generation, Register allocation & assignment code generation from DAG's.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Principles of Compiler Design	Alfred V. Aho, J.D. Ullman	Narosa Publishing
Compiler Construction	D.M. Dhamdhere	Macmillan India Ltd.
Reference		
Compiler Principles Techniques Tools	A.V. AHO, Ravi Sethi J.D. Ulliman	Addison Wcsley

EC-5101   COMMUNICATION SYSTEMS

L T P   **Credits:4**
3 1 0

Unit-I
Review of Communication Engg.: Introduction, AM, FM, their side bands, comparison, sampling theorem, different pulse modulation techniques5- PAM, PWM, PPM and PCM, FDM, TDM. Introduction to Fourier series and Fourier transform of periodic signals. Transfer functions and properties of practically realizable filters.

(12 Hrs)

Unit-II
Radio Transmitters: Block diagram explanation of low and high level AM transmitter, AM broadcast transmitter, DSB transmitter, SSB transmitter and Independent sideband transmitter, block diagram explanation of reactance tube and Armstrong FM transmitters, Stereophonic FM broadcast transmitter.

(12 Hrs)

Unit-III
Radio Receiver: AM diode detector, characteristics of radio receiver: sensitivity, selectivity, fidelity and image rejections, classification of radio receivers, TRF receiver and super heterodyne receiver, block diagram explanation of AM receiver, AM receiver using PLL, DSB and SSB receiver, Independent sideband receiver, AM broadcast receiver, noise in AM systems, FM detection, block diagram explanation of FM receiver and stereophonic FM broadcast receiver, noise in FM systems.

(12 Hrs)

Unit-IV
Television Engineering: Principle of camera, introduction of picture tube, scanning, frame, field, sync video signal, vestigial sideband transmission, block diagram of TV receiver and working, TV transmitter.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Radio and TV Engg	G. K. Mittal	Khanna Publisher
Electronic Communication systems	Kennedy	MacGraw Hill
Monochrome and Colour TV	R. R. Gulati	Dhanpat Rai & Sons

Reference Books

Title	Author	Publisher
Principles of Communications	Taub & Schilling	MacGraw Hill

EC-5102   NETWORK ANALYSIS & SYNTHESIS

L T P   **Credits:4**
3 1 0

Unit-I
Basic of Circuit Analysis : Basic two terminal circuit elements, Linear time invariant passive elements (resistor, capacitor and inductor), Ideal voltage and current source, Energy concepts in two terminal element, Concept of mutual inductance and coupling coefficient, Ideal Transformer, Gyrator.
Network Theorems: Introduction, Kirchoff's Law, Nodal and Loop analysis, Super Matrix method, Position theorem, Reciprocity theorem, Thevenin theorem, Norton theorem, Millman's theorem, Maximum power transfer theorem, Substitution theorem, Compensation theorem, Tellegne's theorem (for both AC and DC excitations.
(12 Hrs)

Unit-II
Resonance And Magnetically Coupled Circutis: Introduction, Series resonance, Parallel resonance, Magnetically coupled circuits, Simple series and parallel circuits, Dot convention.
TWO-PORT NETWORKS: Introduction to single and two port networks, Parameters of two port networks, z, y, h and A, B, C, D parameters, Relationship among different parameters, Series and parallel connections of two-port networks.
(12 Hrs)

Unit-III
Laplace Transform and Its Application: Review of Laplace transform, Solution of network problems using Lapalce transform.
Network Functions And Synthesis: Network functions for one-port networks and two-port networks, Procedure for finding network functions for two-port networks, Poles and zeros of network functions, Restrictions on locations of poles and zeros in driving point functions and transfer functions, Positive real functions, Synthesis of dissipative networks, Foster and Cover form realization.
(12 Hrs)

Unit-IV
Attenuator And Filters: Introduction, Types of attenuators: t-type, pi-type, L-type, ladder type, balanced type, Insertion loss, Concept of Neper and decibel, Characteristic impedance of symmetrical networks, Propagation constants, Hyperbolic symmetry, properties of symmetrical networks, Filter fundamentals, Pass and stop band, Behavior of characteristic impedance, Constant K-low and high pass filters, m-derived T-section, M-derived P-section, Variation of characteristic impedance over the high and low pass band filters, Band pass filters, band elimination filters, filter circuit design and filter performance.
(12 Hrs)

RECOMMENDED BOOKS :
Text Books

Title	Author	Publisher
Networks and Systems	D-Roy Choudhary	Wiley Eastern
Network Analysis	Umesh Sinha	Satya Prakashan

Reference Books

Networks and Analysis	Van Valkenburg	PHI

EC-5201   ANALOG ELECTRONIC CIRCUITS

L T P   **Credits:4**
3 1 0

Unit-I
Transistor Amplifiers: Transistor biasing, stability factors, h- parameters, h- parameter equivalent circuits, analysis of CE, CC and CB configurations, BJT amplifiers, frequency response of R-C coupled amplifier, cascaded amplifier, transformer and direct coupled amplifiers, JFET, MOSFET characteristics, principle of operation, FET as amplifier.

(12 Hrs)

Unit-II
Transistor At High Frequencies: Hybrid PI model and high frequency analysis of transistor amplifiers, gain-bandwidth product, Miller's theorem, common source and common drain amplifiers at high frequencies, multi-stage amplifiers, frequency response, distortions and noise in amplifiers.

(12 Hrs)

Unit-III
Feedback Amplifiers: General theory, classification, advantages and disadvantages of negative feedback, current-series, current-shunt, voltage-series, voltage-shunt feedback amplifier.
Oscillators: Criteria for oscillation, description of circuits and working of tuned oscillator, Collpits, Hartley, R-C phase shift, L-C, crystal oscillators.

(12 Hrs)

Unit-IV
Multivibrators: Multivibrators, astable, monostable, bistable multivibrators, Schmitt trigger, design of these circuits using transistors.
Power Ampifiers: Tuned voltage and power amplifiers, classification, single ended power amplifier, harmonic distortion, push-pull amplifier, thermal stability and stability factor, analysis of class-A and class-B power amplifiers, complementary symmetry push-pull amplifier, power dissipation and heat sink, conversion efficiency.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Integrated electronics-Analog and Digital circuits and Systems	Millman and Halkias	MacGraw Hill
Electronic Circuits-Discrete and Integrated Reference Books	Schilling and Belove	MacGraw Hill
Pulse, Digital and Switching Waveforms	Millman and Taub	MacGraw Hill
Electronic Devices and Circuits	Mottershed	MacGraw Hill

EC-5202 DIGITAL SYSTEM DESIGN

L T P   **Credits:4**
3 1 0

Unit-I
Introduction: Problem formulation and design of combinational circuit using K-map, arithmetic circuits, encoders/decoders, multiplexers/demultiplexers, code converters, implementations of circuits using multiplexers, decoders, ROM, PLA and PAL.

(12 Hrs)

Unit-II
Synchronous Sequential Circuits: The finite state machine, design of single multimode and ring counters, Mealy state diagram, Moore state diagram, state transition tables, state reduction techniques, state assignments, synthesis of sequential circuits, the algorithm state m/c, ASM charts, ASM tables, linking of ASM modules.

(12 Hrs)

Unit-III
Asynchronous Sequential Circuits: Races, hazards, asynchronous, state diagrams, primitive flow tables, state reductions and row merging, design of asynchronous state.
Programmable Logic Design: Introduction to PLDs, CPLDs and FPGAs. Applications of VHDL to FPGA design.

(12 Hrs)

Unit-IV
Introduction To VHDL: Overview of digital design with VHDL, hierarchical modeling concept, entities, entity declaration, architecture of entities, functional description, configuration of entities, gate level modeling, data flow behavioral modeling, modeling of digital designs, creating test benches, modeling of state machines using VHDL, standard VHDL packages.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
VHDL	J. B. Bhaskar	PHI
Digital System Design	Fletcher	PHI
Reference Books		
Digital System	Hill and Peterson	John Wiley
Electronic system Design	Richard S	McGraw Hill

EC- 5203   SIGNALS & SYSTEMS

L T P   **Credits:4**
3 1 0

Unit-I
Introduction: Definition of signals and systems, Elementary signals, Classification of signals, Properties of systems.

(12 Hrs)

Unit-II
Fourier Series Representation Of Signals And Its Applications: Fourier series representation of continuous-time and discrete-time periodic signals, Properties of continuous-time and discrete-time Fourier series, LTI systems.
Fourier Transform : Continuous-time Fourier transform of periodic and aperiodic signals, Properties of continuous-time Fourier transform, Discrete-time Fourier transform of periodic and aperiodic signals, Convolution.

(12 Hrs)

Unit-III
Random Signal Theory: Continuous random variables, Statistically independent random variables, Examples of probability density functions, Density functions with discrete components, random process and types, Ergodic process, Auto and cross correlation functions.

(12 Hrs)

Unit-IV
Sampling: Sampling theorem, Reconstruction of a signal from its samples using interpolation, Effect of under sampling, Discrete-time processing of continuous-time signals, Sampling of discrete-time signals
(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Title	Title
Signals and Systems	Simon Haykin and Barry Van Veen	John Wiley and Sons, Inc.
Communication Systems	Lathi	Wiley

Reference Books

Title	Author	Publisher
Signals and Systems	Alan V. Oppenheim and Alan S. Willsky	Pearson Education

EC-6101   LINEAR ICs AND APPLICATIONS

L T P   **Credits:4**
3 1 0

Unit-I
Operational Amplifier Fundamentals: Block diagram representation of typical OP-AMP, Differential amplifier, buffer, level translator and output driver. Block diagram, specifications, ideal op-amp, emitter coupled differential amplifiers, transfer characteristics of differential amplifiers, definition of inverting, non-inverting inputs, differential voltage gain, input & output offset voltage, input offset current, input bias current, temperature drift of input offset voltage and current, CMRR, PSSR, slew rate familiarization with 741, offset null adjustments, measurement of op-amp parameters, frequency response op-amp.

(12 Hrs)

Unit-II
OP-Amp Applications: Frequency response and frequency compensation, use of op-amp as inverter, scale changer, adder, subtractor, difference amplifier, summer amplifier, differentiator, integrator, Schmitt trigger, log and antilog amplifiers, instrumentation amplifiers, applications in analog computer and function generator, sample and hold circuit, buffer amplifier.

(12 Hrs)

Unit-III
Active Filters and Oscillators: Active filters, first order and second low pass and high Butterworth filter, Higher order filters, band pass filters, band reject filters, all pass filters phase shift oscillator, Wein bridge oscillator, quadrature oscillator, square wave generators, triangular wav generator, saw tooth wave generator, voltage controlled oscillator.

(12 Hrs)

Unit-IV
Timer ICs and Regulators: Block diagram (NE555), working, uses as monostable and astable multivibrator, concept of regulation, 723 voltage regulator, three terminal voltage regulators (positive, negative, variables) applications, commercial voltage regulators ICs, universal active filter, switched capacitor filter, phased locked loop.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Linear integrated circuits	JAIN & CHAUDHARY	Tata Mcgraw
Op-amp & Linear Integ. Ckts	GAEKWAD	PHI

Reference Books

Title	Author	Publisher
Op-amp & Linear Integ. Ckts	COUGHLIN	PHI
Integrated Electronics	MILLMAN & HALKIES	Tata Mcgraw

EC-6102   MICROPROCESSOR AND MICRO CONTROLLER

L T P   **Credits:4**
3 1 0

Unit-I
Architecture of a microprocessor (with reference to 8086 microprocessor): CPU Architecture, internal operation, Addressing modes, Instruction execution timing. 8086 pin diagram and 8086 signals, Basic 8086 configuration, Minimum and Maximum modes of operation, various techniques to decode 8086 address space.

(12 Hrs)

Unit-II
Programming using 8086 microprocessors: 8086 programming, Arithmetic instructions, Binary arithmetic, Packed BCD arithmetic, Unpacked BCD arithmetic, Branch instructions, Conditional branch and Unconditional branch instructions, Loop instructions, NOP, HLT, Flag manipulation instructions, Logical instructions, Shift and rotate instructions, Directives and operators, Linking and relocation, Stacks, Procedures, Interrupt and interrupt routines, Macros, Program design, byte and string instructions, multiprogramming, Multitasking.

(12 Hrs)

Unit-III
Micro controller Architecture: Comparison of micro controller based design over microprocessor based design, Advantages of micro controller based systems, 8051 micro controller architecture, pin diagrams and signals, special function register, interfacing of 8051 with RAM, ROM, A/D and D/A etc.

(12 Hrs)

Unit-IV
8051 Programming: 8051 instructional set, addressing modes, programming of 8051.
(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
The 8051 microcontroller architecture, programming	Ayala	Penram international Publishing(I)PvtLtd.
Microprocessor applications and interfacing 8086	Hall D.V.	Mc Graw Hill
Reference Books		
The 8086 microprocessor programming and interfacing the PC	Kenneth J. Ayala	Thomson
Microprocessors Theory and applications	M. Rafiquzzaman	PHI

EC- 6103   DIGITAL COMMUNICATIONS

L T P   **Credits:4**
3 1 0

Unit-I
Review To Random Variables And Processes: Random variables: commutative distribution function, probability density function (pdf), average value and variance of random variables. Tchedbycheffs inequality, Gaussian pdf, Rayleigh pdf. Mean, variance and pdf of the sum of random variables. Correlation between two random variables. Random processes: Introduction classification, correlation, and auto correlation. Power spectral density (PSD) of a sequence of random pulses. PSD of digital data.

(12 Hrs)

Unit-II
Formatting And Source Coding: Introduction, concept of amount of information, entropy and information rate. Shannon's theorem, channel capacity, capacity of a Gaussian channel, BW-S/N trade off., sampling, quantization, quantization error, quantization noise, companding, PCM, delta modulation, adaptive delta modulation.
Line Coding Schemes: Introduction, properties, general method for derivation of power spectral density of a broad class of digital signals, ON-OFF signaling, polar signaling, bipolar and split phase (or Manchester) signaling and comparison among them pulse shaping. Nyquist' first, second and third criterions for zero ISI, introduction to equalizer and eye diagram, Derivation of error probability for polar signaling in AWGN.

(12 Hrs)

Unit-III
Modulation Schemes: Introduction generation, reception, spectrum, and geometrical representation and effort probability (in AWGN) of BPSK, binary differential phase shift keying (BDPSK), QPSK, MPSK, QAM, BFSK, and MSK.

(12 Hrs)

Unit-IV
Digital Reception: Introduction base band signal receiver, probability of error, optimum filter, matched filter and its probability of error, coherent system of signal reception (correlation receiver) BPSK: effect of imperfect phase synchronization and imperfect bit synchronization on probability of error in AWGN, use of signal space for calculation of error probability for BPSK, BFSK, QPSK. Relationship between bit error rate (BER) and symbol error rate (SER). Block diagram of digital communication system and function each block.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
BP Lathi	Modern Analog and Digital Business and Promotion Communication Beauro	Wiley

Reference Books

Title	Author	Publisher
Bruce Carlson	Communication systems	McGraw Hill
S. Haykins	Digital Communications	Wiley

EC-6104   EMF AND TRANSMISSION LINES

L T P   **Credits:4**
3 1 0

Unit-I
Static Electric Field: Forge between point charges, coulombs law, electric field intensity, super position, electric scalar potential, charge density, gradient of potential, electric flux, gauss law, application of gauss law, energy in capacitor in energy density, flux density, divergence, Maxwell's divergence equation, current density, continuity equation, current and field in boundary.

(12 Hrs)

Unit-II
Static Magnetic Field: Current density in a conductor, force on moving charge and current element, Biot-savartlaw, magnetic flux, , magnetic flux density, amperes law, Maxwell equation, magneto static potential, Maxwell current equation, vector potential, energy in inductor, energy density, boundary relation in magnetic fields.
Time Varying Fields: Faraday's law, moving conductor in a magnetic field, stores theorem, Maxwell equation from Faraday's law, displacement current, Maxwell's equation from amperes law, free space, Maxwell equation for free space

(12 Hrs)

Unit-III
Wave Transmission: Maxwell equations, plane waves, EM wave in a homogeneous medium, uniform plane wave equation for a conducting medium, sinusoidal time variations, reflection coefficient, wave equations for waves in space, plane waves at interfaces, group velocity, phase velocity, power and energy relations, pointing vector, linear elliptical and circular polarization oblique incidences, Brewster angle, Reflection of wave dielectric conductor.

(12 Hrs)

Unit-IV
Transmission Lines: Introduction, basic principals, termination lines with load, voltage and current distribution, characteristic impedance, propagation constant attenuation constant, phase constant, reflection coefficient, VSWR, open and short circuited transmission lines and their impedances, stub matching, types of high frequency transmission lines, smith charts.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Field theory	Gangadhar	Khanna

Reference Books

Title	Author	Publisher
EM waves & Radiating	Jordan	Prentice Hall
Electromagnetic	Karus	Mcgraw Hill
Electromagnetic	Hayt	Mcgraw Hill

EC-6201   INDUSTRIAL ELECTRONICS & APPLICATIONS

L T P   **Credits:4**
3 1 0

Unit I
Controlled Switches: Thyristor family, SCR-steady state and transient characteristics, gate protector circuits, comparison for Thyristor and power transistors as power devices, operation of thyristor in series and parallel, commuation process.

(12 Hrs)

Unit II
Chopper and Voltage circuits: Design of simple DC/ DC Conversion circuits, introduction to power MOSFETS, single phase and 3-phase controlled rectifiers, design of linger circuits, AC voltage regulators.

(12 Hrs)

Unit III
Invertor: Various types of invertors and their principle of operation, voltage and frequency controlling methods, effect of load inductance, cyclo convertor.

(12 Hrs)

Unit IV
Convertor: Line commutated circuits, input and output characteristics of bridge circuits, effect of source impedance, load impedance interphase reactor control, commutation with capacitor source impedance. Comparison of invertor and cyclo convertor, principle of operation of chopper, voltage and current commutated choppers, AC&DC motor drives, closed loop speed and current control systems.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Power Electronics	P.S. Bimbra	Khanna
Power Electronics & Controls	Datta	Prentice hall

Reference Books

Title	Author	Publisher
Power Electronics	PC Sen	McGraw Hill
Thyristor and its application	Ramamoorthy	EW Press

EC-6202   MICROWAVE ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Microwave frequency spectrum, familiarization with bands and wavelength.
Microwave Components: Wave guides, wave guide coupling, ferrite devise faraday rotation, isolators, circulators, detector mounts, magic tee, frequency meter, cavity resonator, microwave filters, Directional couplers, loop directional couplers two hole directional couplers, phase Shifters, attenuators, introduction to S parameters.

(12 Hrs)

Unit II
Microwave Tubes: Problem with conventional tubes, limped elements at microwave frequencies velocity modulations, multi cavity, klystron, mathematical analysis of two cavity klystrons, performance, reflex klystron, mathematical analysis, repeller voltage, accelerating Voltage mode, frequency tuning, Magnetrons, constructional features of cavity magnetron cylindrical magnetron oscillations strapping, pushing and pulling traveling wave tube, Performance and application.

(12 Hrs)

Unit III
Semiconductor Microwave Devices: Transistors, integrated circuits, advantages of MIC"s varactor diodes, step recovery diode, frequency multipliers, parametric amplifier, basic principles tunnel diode, principles, Gunn effect, Gunn diode application, avalanche effect impatt diode, trappat diode, characteristics and application of avalanche diode, principle of pin diodes & its application, schottky barrier diode, backward diode.

(12 Hrs)

Unit IV
Microwave Integrated Circuits: Evolution of MICs, planner transmission line, lumped element of MICs, substrate for MIC, Hybrid technology, monolithic technology, strip line, micro strip line, strip like transmission line, Slot Line, losses in strip like transmission line, circuit design and applications: microwave network parameters, launching methods and transition, basic circuit element, filters, micro strip antenna.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Foundation of Microwave Engg.	R. E. Collin	McGraw-hill

Reference Books

Title	Author	Publisher
Strip line like transmission for MIC	Houl & Bhat	New age publishers
Microwave Filter, Impedance, matching N/W and coupling structures	Mathai, Young, Jones	McGraw-hill
Microwave laboratory manual	Sisodia	Wiley

EC-6203   ANTENNA AND WAVE PROPAGATION

L T P   **Credits:5**
3 2 0

Unit I
Basic Antenna Parameters: Radiation patterns, antenna beam area, antenna beam width, radiation intensity, gain, directive gain, power gain, directivity (D), antenna bandwidth, effective height, reciprocity theorem, self impedance, mutual impedance, radiation resistance, front to back ratio, antenna temperatures.
Retarded Potential: Radiation mechanism, radiation pattern, radiation power density, retarded vector potential, isotropic radiators, near field and far field concept, radiation from a half wavelength dipole, power radiated by a current element and its radiation resistance.

(12 Hrs)

Unit II
Wire Radiators In Space: Voltage and current distribution, asymptotic current distribution in dipole, analysis of linear wires elements, hatz dipole antenna, monopole radiators, resonant antenna, non-resonant antenna, long wire antenna.
Effect Of Ground On Antenna & Antenna Coupling: Ungrounded antennas, grounded antennas, different grounding systems & antenna losses, effects of antenna height, antenna coupling, antenna couplers, baluns, selection of feed points.

(12 Hrs)

Unit III
Directional Antennas: Dipole arrays, broadside array, end fire array, arrays of point sources, folded dipole and its applications, parasitic reflectors, parasitic directors, yogi uda array, turnstile antenna, array theorem, unit circles, antenna synthesis.
Special Purpose Antennas: Loop antenna, folded dipole antenna; log periodic antenna, parabolic reflector, helical antenna, slot antenna, discone antenna, horn antenna, babinet's principle and its applications, slot antenna.

(12 Hrs)

Unit IV
Propagation: Fundamentals of electromagnetic waves, propagation of waves, structure of atmosphere and its effects, structure of ionosphere and details of all layers, ground wave propagation, space wave propagation, sky wave propagation, critical frequency, maximum useable frequency, skip distance, multi-hop propagation, radio horizon, effect of earth's curvature, duct propagation, troposphere scatter propagation, fading

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Antennas	Kraus	Mc Graw Hill

Reference Books

Title	Author	Publisher
Electronic & Radio Engineering	Terman	Mc Graw Hill
Electronic Communication system	Kenned	Mc Graw Hill
Antennas	BALANICS	Mc Graw Hill

EC-7101   DIGITAL SIGNAL PROCESSING

L T P   **Credits:4**
3 1 0

Unit I
Discrete Time Signals And Systems: Classification of signals, transformation of independent variables, Concept of frequency in discrete time sinusoidal and harmonically related complex-exponential. Interconnection of systems, LTI systems: properties impulse response convolution sum, Response of LTI systems to arbitrary input; LTI systems characterized by linear constant coefficient difference equations, structure for realization of LTI system, recursive and non recursive realization of FIR systems.
Z – Transform: Introduction Z- transform pair, properties of ROC for Z transform, analysis and characteristics of LTI systems using Z- transforms. System functions for interconnection of LTI systems. Block diagram representation for causal LTI systems described by difference equations and rational system function.

(12 Hrs)

Unit II
Discrete Fourier Transform (Dft): Frequency domain sampling and reconstruction of discrete time signals, DFT inverse DFT, DFT as a linear transform, relation ship of DFT with other transforms, properties of DFT, use of DFT in linear filtering, filtering of long sequences, frequency analysis of signals, using DFT.
Fast Fourier Transform Algorithms: Direct computation of DFT, divide and conquer approach to computation of the DFT, radix- 2 DFT algorithms, use of FFT algorithm efficient computation of the DFT of two real sequences, and of the DFT of a 2N point real sequence.

(12 Hrs)

Unit III
Implementation Of Discrete Time Systems: Introduction, structures for FIR systems: Direct form, cascade form and lattice structure, structures for IIR systems: Direct form, cascade form, parallel form and lattice structures. Fixed point representation of numbers, errors resulting from rounding and truncation.
Design Of Digital Filters: General considerations, casualty and its implementations, characteristics of practical frequency selective filters, FIR and IIR filter design.

(12 Hrs)

Unit IV
Multirate Digital Signal Processing: Introduction, interpolation and decimation, filter banks and implementations.
Finite Precision Effects: Fixed point and Floating-point representations, Effects of coefficient unitization, Effect of round off noise in digital filters, Limit cycles.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Digital Signal Processing	Proakis and Monalaski	PHI

Reference Books

Title	Author	Publisher
Digital Signal Processing	Oppenheim	PHI
Theory and Application of DSP	Rabner and Gold	PHI

EC-7102   WIRELESS COMMUNICATION

L T P   **Credits:4**
3 1 0

Unit I
Introduction to Wireless Communication Systems: Performance Criteria, Voice Quality, Service Quality, coverage and required grade of service The Cellular Concept, co-channel interference, Frequency reuse, determining the frequency reuse distance, channel assignment strategies, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting, sectoring Mobile Radio Environment.

(12 Hrs)

Unit II
Mobile Radio Propagation: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, small scale multipath propagation, types of small-scale fading, fading effects due to Doppler spread, diversity techniques.

(12 Hrs)

Unit III
Modulation techniques: Introduction to linear modulation techniques, Minimum shift keying (MSK), Gaussian minimum shift keying (GMSK), OFDM, spread spectrum, correlation function, PN code generation, DS-SS, and FH-SS systems, performance of modulation schemes, RAKE receiver.

(12 Hrs)

Unit IV
Multiple Access Techniques: Frequency management, fixed channel assignment, non-fixed channel assignment, FDMA, TDMA, spread spectrum multiple access, space division multiple access, spectral efficiency, capacity of cellular system.
Concept of cellular communication: Basic wireless cellular system, mobile unit (MU), Base station, Mobile switching center, Introduction to GSM.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Wireless Digital Communication	Kamilo Feher	PHI, 2000
Digital Communication, 4th edition	J.G. Proakis	McGraw Hill2000

Reference Books

Title	Author	Publisher
Mobile cellular Tele-communication 2nd edition	William, C Y Lee	McGraw Hill, 2001
Wireless communication: Principles and practice", 3rd Indian reprint	Theodore S. Rappaport	Pearson, 2003

EC-7103   MICROELECTRONICS

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Classification, Scale thick film, Thin film and hybrid integrated circuits, hybrid IC Fabrication and component design, resistor, capacitor, and inductor, Design and fabrication.

(12 Hrs)

Unit II
Monolithic Architecture : Process on silicon crystal, line growth, refining substrate slicing, Polishing, chemical vapour deposition, thermal oxidation, photolithography, diffusion, dopant impurities, diffusion system, ion implantation, metallization, isolation.

(12 Hrs)

Unit III
Monolithic Components: Bipolar IC process, MOS IC process, BJT construction, diode instruction, FET and MOS construction and resistor, capacitor, and inductor, op –amp and voltage regulator, design and fabrication.
LSI Circuits: Brief introduction to LSI circuits, realizations of inter connection and realization of integrated elements.

(12 Hrs)

Unit IV
Basic VISI Design: Basic MOS transistor and working, n MOS and c MOS fabrication, thermal aspects MOS and VLSI, some electric properties of MOS, design process, circuit component, system design and layout and scaling of MOS circuit, some application of VLSI circuit like PLA.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Integrated Circuits Interfacing Technique in Digital design	KR Botkar	Khanna Publis.
VLSI Design	Sze	Tata McGraw

Reference Books

Title	Author	Publisher
Analog MOS IC circuit design	Paul R Gray	IEEE Press

EC-7106   FIBER OPTIC COMMUNICATIONS

L T P   **Credits:4**
3 1 0

Unit I

Introduction: Need of optical communication, optical communication links, Fiber transmission, Types of fibers Single mode and Multimode, step index and graded index, Numerical aperture, modes.

Transmission Properties: Attenuation, causes and measurement of attenuation, Absorption, scattering, Bending losses etc., Information capacity, Dispersion; intermodal and intramodel, material and wave guide dispersion, dispersion shifted fibers, PMD.

(12 Hrs)

Unit II

Optical Sources: Energy bands, intrinsic and extrinsic material, P-n junction, direct and indirect band gaps, LED, structure, material, quantum efficiency, power and modulation, LASER diodes, principle of operation, Laser diode rate equations, quantum efficiency, structure and modulation.

Photodetectors: Principle of PIN photo detector and Avalanche photodiode, Photo detector noise, detector response time, RAPD, Avalanche multiplication noise, circuit of In GaAs APDs, Temperature effects, Comparison of photo detectors.

(12 Hrs)

Unit III

Optical Receiver Operation: Fundamental receiver operation, digital signal transmission, error sources, receiver configuration, Fourier transform representation, digital receiver performance bit error rate, quantum limit preamplifiers, high impedance FET amplifiers, high impedance bipolar transistor Amplifiers, Tran impedance Amplifiers, Power Budgeting.

Analog Systems: Carrier to noise ratio, carrier power, photo detector and pre amplifier noises, relative intensity noise, Multichannel transmission techniques multichannel AM, multichannel FM, Sub carrier multiplexing.

(12 Hrs)

Unit IV

Advanced Concepts: ADM DWDM, EDFA amplifiers, limitations PDFA semiconductor amplifiers Wavelength converters, Nonlinear effects, optical solitons, Dispersion management.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Optical Fiber Communciation	Gerd Keiser 2nd editon	McGraw Hill
Optical Fiber Communication	Senior	PHI

Reference Books

Title	Author	Publisher
Fiber Optics	G.P.Aggarwal	Whiley

EC-7201   COMPUTER & COMMUNICATION NETWORKS

L T P   **Credits:4**
3 1 0

Unit I
Introduction To Computer Networks: Basic & Computer Networks, Need & Evolution of Computer Networks, Description of LAN, MAN, WAN and wireless Networks, OSI and TCPIIP models with description of Data Encapsulation & peer to peer communication, Comparison of OSI and TCP/IP. Basic terminology of computer networks - bandwidth, physical and logical topologies, Media 10baseZ, 10baseS, 10baseT, 100baseTX, 100baseFX, 1000baseLX and wireless. LAN & WAN devices- Router, bridge, Ethernet switch HUB, Modem CSU/DSU etc.

(12 Hrs)

Unit II
Physical Layer: Physical Layer Representation, one bit on physical modem i.e. in wired network, optical Network and wireless *N/W,* Encoding/Modulation - TTL Encoding, Manchester Encoding, AM, FM and PM. Dispersion, Jitter, Latency and collision, Different types of Media - Shielded twisted pair, Unshielded twisted pair, Coaxial cable, Optical Fiber cable and wireless.

(12 Hrs)

Unit III
Data Link Layer: Data Link Layer - LLC and MAC sub layer, MAC addressing Layer 2 devices, Framing Error control and flow control. Error detection & correction CRC code block parity & checksum. Elementary data link protocol sliding window protocol, Channel allocation problem -static and dynamic, Multiple Access protocol - ALOHA, CSMA/CD Token bus.

(12 Hrs)

Unit IV
Network Layer: Network Layer - Segmentation and autonomous system path determination, Network layer addressing, Network-layer data gram, IP addressed classes, Subne1ing - Sub network, Subnet mark, Routing algorithm - optionality Principle, Shortest path routing, Hierarchical routing, Broadcast routing, Multicast routing, Routing for mobile host-Concatenated Visual circuits, tunneling Fragmentation and DHCP, Routing Protocol-RIP, IGRP, USPF and EIGRP, Network layer in A TM Networks.
Transport Layer: Transport Layer - layer 4 Protocol TCP & UDP. Three way hand shakes I open connection, ATM AAL Layer protocol, Session Layer design issue, Presentation layer design issue, and Application layer design issue. Application layer Protocol, TELNET, FTP, HTTP, and SNMP, Application layers.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Computer Networks,	Tanebaum	PHI
Reference Books		
Computer Networks and Their Protocols	Darix	PHI

EC- 7202   RADAR AND NAVIGATIONAL AIDS

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Principle of Radar, block diagram and operation, Radar frequencies, Applications, Radar Equation, prediction of Range, minimum detectable signal, false alarms and CFARs, pulse repetitive frequency and range ambiguity, Radar cross section of targets.

(12 Hrs)

Unit II
Radar Systems: Doppler effect and it's application to CW RADAR, FM-CW radar, delay lines and cancellers, range gates and filters moving target indicator, pulse Doppler radar, multiple frequency CW radar.

(12 Hrs)

Unit III
Tracking And Scanning: Tracking radar, conical scanning, simultaneous lobbing, amplitude and phase comparisons, tracking in range and in Doppler radar.
Radar Receivers: Noise figure, Block diagram of radar receiver, mixers, duplexers, displays, modulators and pulse forming networks.

(12 Hrs)

Unit IV
Navigation: Doppler navigation, phased array radar, direction finding, instrument landing systems and ground control approach, introduction to hyperbolic navigation systems, LORAN, Radar beacons, synthetic aperture radars.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Introduction to Radar Systems	M.I. Skolnik	Mc Graw Hill
Introduction to Radar Engineering	Sen & Bhattachrya	PHI

Reference Books

Title	Author	Publisher
Radar Systems	Peyton Z. Peebles, Jr.	Willey

EC-7205   CONTROL SYSTEM ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I

Introduction To Control System And Modeling: Open loop and closed system concept of feedback, block diagram, modeling of physical system, Electrical analog of Electromechanical, mechanical, hydraulic and thermal systems, their descriptions and linearised equations, servo motors DC& AC concept of transfer functions, characteristics equations, characteristics roots systems, representations by block diagram, block diagram simplification for linear systems, signal flow graphs, mason gain rules.

(12 Hrs)

Unit II

System Response: Time and frequency domains response for first and second order systems and their Correlations between time frequency responses.

(12 Hrs)

Unit III

Stability: Absolute and relative-Routh criterion, nyquist plots, bode plots and phase and frequency margin root locus plots, Nichols chart and its application, evolution of closed loop frequency response interpretation of system response from these plots steady system response, error constants, impulses, step ramp and parabolic input.

(12 Hrs)

Unit IV

Performance Specification for Systems: Proportionate, derivative and integral control rate feed back control, Cascade compensation lag, lead and lead lag compensation.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Control System Engg	Nagrath Gopal	Wiley Eastern

Reference Books

Title	Author	Publisher
Control System Analysis	Leon Hardl	McGraw Hill
Analysis of Linear System	Cheng	Mc-Graw Hill
Automatic Control Engg	Kuo	PHI

EE-5101   BASIC ELECTRICAL & ELECTRONICS ENGINEERING

L T P   **Credits-4**
3 1 0

UNIT I
Introduction: Concept of current, potential difference, Active and passive components, power and energy resistivity, effect of temp. on resistance, Heating effect of electric current, Ohm's Law, Kirchoff's Law. Application of Ohm's Law and Kirchoff 's Law to solve simple DC circuits, Star-Delta transformation of resistors, superposition theorem, Thevenin's Theorem, Norton theorem, Max. power transfer theorem, Reciprocity Theorem.

(12 Hrs)

UNIT II
AC Fundamentals: Single phase AC, RMS and average values of different waveforms their mathematical relations, form factor, peak factor, Various types of power, Power factor, 3 phase AC system; Star-Delta connections; Inter-Relation between phase voltage, current & line voltage, current; 3 phase power and power factor measurement methods and numerical problems.

(12 Hrs)

UNIT III
Electromagnetism: Concept of MMF, Flux, reluctance, permeability, Analogy with electric circuits, Faraday's Law of Electromagnetic Induction, Lenz's idea of Hysteresis , eddy currents and its significance. Basic Principle and construction of AC/DC motors, classification of AC/DC motors, EMF equation, starting of motors, advantages of AC/DC Motors; Transformer-basic Principle and construction, classification, EMF equation, Transformation ratio, losses and efficiency.

(12 Hrs)

UNIT IV
Basic Electronics: Basic details of elements e.g. Diode, Zener Diode, transistor, thyristor, diac, triac and their applications, Transistors in CE, CB, CC configurations. Oscillators and amplifiers, advantages and disadvantages of +ve and –ve feedbacks, Introduction to OP-amp. Basic logic gates Number system, binary octal and hexadecimal numbers; Basic Introduction to the concept of modulation, need and modulation, modulation index, noise, AM,FM and their comparison. Introduction to transmitter and receiver.

(12 Hrs)

RECOMMENDED BOOKS

Title	Author	Publisher
Text Books		
Basic Electrical Engineering	D P Kothari & I J Nagrath	TMH
Principles of Electrical & Electronics	J.S. Dhillon, Jarnail Singh Dhillon & Diljinder Singh	Kalyani
Reference Books		
Electrical Machines	I. J. Nagrath & Gopal	TMH
Electronic Devices & Circuits	Millman & Halkias	McGraw Hill
Electrical Technology	B.L.Theraja	S.Chand

EE-5102   ELECTRICAL MACHINES

Unit I
Introduction: Basic Principle, Types and constructional features of electrical machines, torque, torque angle, basic electromagnetic laws, Induced EMF.

(04 Hrs)

Transformers: Basic principle, turns ratio, types and parts of a transformer, ideal transformer, transformer on no load & on load, phasor diagram, transformer reactance and equivalent circuit, losses, efficiency, all day efficiency, regulation, basic concept of 3 ph transformer &auto transformer(excluding analysis).

(08 Hrs)

Unit II
DC Machines: Principle, Constructional features, Types of DC machines, EMF and torque equations, circuit model, armature reaction, commutation, Types of armature winding(no detailed diagram), characteristics of dc motors, characteristics of dc generators, starting (3 pt. &4 pt. starters), speed control methods, efficiency and applications.

(12 Hrs)

Unit III
Induction Machines: Concept of rotating magnetic field in three phase, Construction & principle of operation. slip frequency, rotor currents, rotor MMF and torque production, equivalent circuit; torque slip characteristics, max. torque, starting torque, max. power output, starting; Principle of single phase induction motors, double field revolving theory, types of single phase induction motors.

(12 Hrs)

Unit IV
Synchronous Machines: Construction and types, EMF equation, synchronous reactance, V-curve, OCC. SCC, SCR, Short circuit loss, conditions for parallel operation, synchronous motor.

(08 Hrs)

Special Motors: AC series motor, universal motor, reluctance motor, hysteresis motor, stepper motor, Brushless Motors, Switched reluctance motor and their applications.

(04 Hrs)

RECOMMENDED BOOKS:

Author	Title	Publisher
Text Books		
Nagrath, Gopal	Theory of Electric Machines	TMH
B L Thareja	Electrical Machines, VOL II	S.Chand
Reference Books		
Fitzgerald Kingsley	Electrical Machines	McGraw Hill
I J Nagrath & D P Kothari	Electrical Machines	TMH

EE-6101   NETWORK ANALYSIS AND SYNTHESIS

Unit-I

Circuits Concepts: Circuits Elements, Independent and dependent sources, signals and wave forms; periodic and singularity voltages, step, ramp, impulse, Doublet. Loop currents and loop equations, node voltage and node equations, Network Theorems, Superposition, Thevenin's, Norton's, Maximum Power Transfer, Reciprocity.

(12 Hrs)

Unit-II

Time and Frequency Domain Analysis: Representation of basic circuits in terms of generalised freq. & their response, Laplace transform of shifted functions, transient & steady response, Time domain behaviors from poles and zeros, Convolution Theorem.

(12 Hrs)

Unit-III

Filters Synthesis: Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T section, IT section, terminating half section. Pass bands and stop bands. Design of constant-K, m-derived filters.

(12 Hrs)

Unit-IV

Network Synthesis: Composite filters, Network functions, Impedance & Admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros. Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Network Analysis	Van Valkenberg	PHI
Network Analysis and Synthesis	C L Wadhwa	New Age
Reference Books		
Network Analysis and Synthesis	Kuo, Franklin F.	John Wiley & Sons
Electric Circuits	J A Edminister	TMH

EE-7101   INDUSTRIAL ELECTRONICS & APPLICATIONS

L T P   **Credits:4**
3 1 0

Unit-I
Controlled Switches: Thyristor family, SCR-steady state and transient characteristics, gate protector circuits, comparison for Thyristor and power transistors as power devices, operation of thyristor in series and parallel, commuation process.

(12 Hrs)

Unit-II
Chopper and Voltage circuits: Design of simple DC/ DC Conversion circuits, introduction to power MOSFETS, single phase and 3-phase controlled rectifiers, design of linger circuits, AC voltage regulators.

(12 Hrs)

Unit-III
Invertors: Various types of invertors and their principle of operation, voltage and frequency controlling methods, effect of load inductance, cyclo convertor.

(12 Hrs)

Unit-IV
Converter: Line commutated circuits, input and output characteristics of bridge circuits, effect of source impedance, load impedance interphase reactor control, commutation with capacitor source impedance. Comparison of invertors and cyclo converter, principle of operation of chopper, voltage and current commutated choppers, AC&DC motor drives, closed loop speed and current control systems.

(12 Hrs)

RECOMMENDED BOOKS:
Title	Author	Publisher
Text Books		
Power Electronics	P.C Sen	McGraw Hill
Power Electronics	P.S. Bimbra	Khanna
Reference Books		
Power Electronics & Controls	Datta	Prentice hall
Thyristor and its application	Ramamoorthy	EW Press

EV-6101   ENVIRONMENT SCIENCE & ENGINEERING

L T P   **Credits:3**
3 0 0

Unit –I
Introduction: Definition, scope and importance: Concept of a neat clean environment, Ecology and Environment, Concept of an ecosystem, Its components and their interrelationships, autotrophs and heterotrophs, food chains, food webs and ecological pyramids, energy flow in the ecosystem, biogeochemical cycles, Brief study of, forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystems, The concept of biosphere, ecosystem diversity and biodiversity, Global and national concerns, threats to biodiversity and conservation efforts.

(12 Hrs)

Unit –II
Sustainable development: The apparent conflict between economic development and sanctity of the environment, Judicious use of resources for their long term viability; forest resources, water resources, mineral resources; food resources, energy resources and land resources, Renewable sources, the practice of 3Rs, Human population growth and its impact on natural resources.

(08 Hrs)

Unit –III
Environmental pollution: Air pollution, attributes of air environment; major pollutants, their natural and anthropogenic sources, effects and mitigation measures
Water pollution: attributes of water environment, major categories of pollutants; effects and mitigation measures.
Land pollution: Urban and industrial solid wastes and their management.
Noise pollution: Measurement, effects and control of noise pollution.

(12 Hrs)

Unit –IV
Sociopolitical issues: Global concerns, international endeavors and intergovernmental efforts: climate change, global warming, acid rain, ozone layer depletion, international bodies and protocols, Environmental laws and regulations in India, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

(08 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books		
Odum, E.P.	Fundamentals of Ecology	W.B. Saunders
Peary, Rowe, Tchobanoglous	Environmental Engineering	McGraw Hill
Reference Books		
Heywood and Waston	Global Biodiversity Assessment	Cambridge
	Pollution Control Acts, Rules and Notifications	CPCB

FT-5101   TECHNOLOGY OF FRUITS AND VEGETABLE PROCESSING

L T P   **Credits:5**
3 2 0

Unit I
Introduction: Production of Fruits and vegetables in India. Cause for heavy losses, Composition of each of the major fruits and vegetables produced in the country-Mangoes, Pineapple, Guava, Papaya, Grapes etc. among fruits, Beans, Carrot, Tomatoes, Potato, Onion Brinjal etc. among Vegetables. Spoilage factors, Post harvest field operations, preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. General methods of preservation of whole fruits/Vegetables and processed fruits and vegetables.
Processing of fruit juices: Preparation of specialty products like, Fruit juice concentrates, Fruit Bars and Fruit powders, Different kinds of evaporators used for concentration of fruit juices and pulp, Clarification of juices, Viscosity problems, Tomato products – Hot and Cold Break processes, Tomato Deseeding and clarification, Mango Pulp extraction and concentrations, Tubular, Plate and scraped surface evaporators, Clarification centrifuges – Decanters and desludgers, Fruit juice aroma Recovery and its importance, Brief on Aroma Recovery equipment, Definition and preparation of squashes from orange, mango, lemon, pineapple, preparation of lime juice cordials.

(14 Hrs)

Unit II
Jam, jelly and marmalades: Definition, constituents, pectin and related compounds, preparation of apple, plum, pineapple and mix fruit jam; preparation of guava jelly, marmalade, theory of jell formation, failure and remedies in jam and jelly making.
Preserves and candied fruits: Definition, preparation of peaches, pears, apple and amla preserves, Definition of candied fruits, general principles and manufacturing processes.
Chutney and pickles: Definition, manufacturing process, preparation of tomato chutney, mango chutney, tomato chutney, raw materials for the preparation of pickles and pickling process; spoilage in pickles, cabbage pickle, onion pickle, cauliflower pickles, lime pickles, turnip pickle.

(12 Hrs)

Unit III
Canning of fruits and vegetables: General comparison of fruits and vegetables canning, Containers used in canning of fruits and vegetables, types of cans, Base Box, lacquering Precautions in Canning operations. methods and equipment for processing, calculating TDT, Importance of blanching operations, Batch and continuous blanching, Hot water and Steam blanching, Different steps involved in canning of fruits, preparation of syrups and brines, testing of brines, processing methods and equipment, canning of peaches, apple, strawberries, cherries, pears, plum and pineapple, peas, tomatoes, corn, spinach, green beans, spoilage of canned foods, discolorations, corrosion.
Tomato products: Manufacturing process of tomato based products like tomato juice, soup, puree, sauce, ketchup and paste; spoilage of tomato products and their preventive measure.

(14 Hrs)

Unit IV

Drying and dehydration of fruits and vegetables: Dehydrated products, Dried Vegetable Slices and Dices, Preparation of product for dehydration, Dehydration principles and equipment used for drying, Cross Flow Shelf Dryers, Vacuum Shelf Dryers, Freeze Dryers, Simple estimation of drying costs, Freeze drying Principles, Merits and demerits of Freeze Drying, Preparation of Fruit Powders, Working of Spray Dryer and Drum Dryer, principles of dehydration, dehydration of apples, grapes, peaches, packaging of dried fruits, Preparation of Fruit material for powder production. Manufacturing process of dehydrated vegetable products like potato, onion, carrot, peas, cauliflower; effect of dehydration on nutritive value, packaging of dried vegetables, Packaging of Dried slices, Dices and powder.

Freezing: Preparation of vegetables for freezing, different methods of freezing peas, potato cubes, cauliflower, sprouts, freezing point of different vegetables.

(14 Hrs)

Recommended Books:

Title	Author	Publisher
Preservation of Fruits and Vegetables	Girdharilal, Siddappaa & Tandon	ICAR
Commercial Fruit and Vegetable Products	Cruess	AVI, NY
Commercial Vegetable Processing	Luh and Woodroof	AVI, NY
Commercial Fruit Processing	Woodroof and Luh	AVI, NY
Analysis of Fruits and Vegetales	Ranganna	TMH

FT-5102   FOOD MICROBIOLOGY

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Importance and historical developments in food microbiology, prokaryotic and eukaryotic cell, morphology, structure, microbiology and reproduction of Bacteria, Yeast and Mold.   (08 hrs)
Techniques of pure culture: Serial Dilution, pour plate, streak plate, spread plate, slant, broth and enrichment culture, lyophilization.
(04 hrs)

Unit II
Microbial growth and death kinetics: Definition, Growth curves (different phases), synchronous growth, doubling/generation time, intrinsic and extrinsic factors, relationship between number of generations and total number of microbes.
(08 hrs)

Unit III
Microbiology and microbial spoilage of Food Products: Microbiology of raw milk and fermented milk products viz yoghurt, cheese; cereals products, fruits and vegetable, meat and meat product, egg and fish.
(12 hrs)

Unit IV
Food spoilage: Bacterial and fungal food spoilage, food poisoning, food borne infection, food borne intoxication, Toxins produced by staphylococcus, clostridium, aspergillus; bacterial pathogens-salmonella, bacillus, listeria, E. coli, shigella, campylobacter.
Microbial Control: Source of microorganism, Physical and chemical agents used in microbial control, disinfected agents and its dynamics.
(16 hrs)

Recommended Books:

Author	Title
W.C. Frazier	Food Microbiology
H.J. Pleczar	Microbiology
J. Heritage	Introductory Microbiology
K.S. Bilgrami	Essentials of Microbiology
Casida	Industrial Microbiology

FT-5103   STATISTICAL QUALITY CONTROL

L T P   **Credits:4**
3 1 0

Unit I
Introduction: The meaning of quality and quality improvement, Statistical methods for quality control and improvement.   (02 Hrs)
Food Quality System: The link between quality and productivity, Quality costs, Legal aspects of quality, implementing quality improvement.   (03 Hrs)
Control Charts for Variables: Statistical basis of the charts, Development and use of x and R, Charts based on standard values, Interpretation of x and R charts, The effect of non-normality on x and R charts, Construction and operation of x and S charts, The x and S control charts with variable sample size, The S^2 control chart, The Shewhart control chart for individual measurements, Application of variables control charts.   (08 Hrs)

Unit II
Control Charts for Attributes: The control chart for fraction non-confirming, Control charts for non-conformities (defects), Procedures with constant sample size, Procedures with variable sample size, The operating-characteristic function.   (04 Hrs)
Sampling: Population and sampling distributions, Sampling and non-sampling errors, Mean and standard deviation of x, Shape of the sampling distribution of x, Applications of the sampling distribution of x, Population and sample proportions, Mean, standard deviation, and shape of the sampling distribution of p, Applications of the sampling distribution of Sampling techniques.
                                                                                                          (05 Hrs)
Test Methods: Hypothesis tests, Estimation and hypothesis testing: two populations, Chi-square tests, Analysis of Variance, Simple linear regression, Non-parametric methods.   (03 Hrs)

Unit III
Statistical Process Control (SPC) Techniques: SPC for short production runs, Modified and acceptance control charts, SPC with auto correlated process data, Economic design of control charts.
                                                                                                          (06 Hrs)
Multivariate Process Monitoring and Control: Description of multivariate data, The Hotelling T^2 control chart, The multivariate EWMA (Exponentially Weighted Moving Average) control chart, Latent structure methods.   (05 Hrs)

Unit IV
Process Capability Analysis (PCA): PCA using probability plot, Process capability ratios, PCA using a control chart, PCA using designed experiments.   (03 Hrs)
Design of Experiments and Process Optimization: Guidelines for designing experiments, Factorial experiments, the 2^k factorial design, Fractional replication of the 2^k design, Response surface methods and designs, Process robustness studies, Evolutionary operation.   (06 Hrs)
Six Sigma: Introduction, Six-sigma control chart, Six-sigma quality performance.   (03 Hrs)

Recommended Books:

Author	Title
D.C. Montgomery	Introduction to Statistical Quality Control
P.S. Mann	Introductory Statistics
Jerome D. Braverman	Fundamentals of Statistical Quality Control

FT-5201   FOOD CHEMISTRY

L T P   **Credits:3**
3 0 0

Unit I
Introduction: Development of food chemistry and its role in food processing.

(02 Hrs)

Water: Importance of water in foods, Structure of water & ice, Concept of bound & free water and their implications, Sorption Phenomena and Sorption isotherms, examples– Dispersed systems–some basic considerations.

(04 Hrs)

Proteins: Nomenclature, classification, structure, chemistry and properties of amino acids, peptides, proteins. essential and non- essential amino acids, Isolation, identification and purity of amino acids, peptides, proteins, Qualitative and quantitative analysis of amino acids and proteins, Changes during processing, protein determination methods. Physical and chemical characteristics of Proteins.

(12 Hrs)

Unit II
Carbohydrates: Nomenclature and classification, structure, physical and chemical properties of polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances) and their functions; dietary fiber, changes in carbohydrates during processing.

(10 Hrs)

Lipids: Structure, classification, physical and chemical properties, utilization of fats and oils, margarine, shortenings, salad and cooking oils, importance of fats and oils in diet, introduction to hydrogenation and its importance.

(08 Hrs)

Unit III
Browning reactions: Enzymatic and non-enzymatic browning, advantages and disadvantages, factors affecting their reaction and control.

(04 Hrs)

Vitamins: Types of vitamins, chemistry and functions, source and deficiency diseases.

(04 Hrs)

Unit IV
Plant pigment: Structure and properties of chlorophyll, anthocyanins, tannin, myoglobin and carotenoids, chemical changes during processing.

(04 Hrs)

Flavour and aroma of foods: Importance and method of retention of flavour and aroma in foods, terpenes, esters, ketones and quinines.

(04 Hrs)

Recommended Books:

Author	Title
Meyer	Food Chemistry
Fennema	Food Chemistry
Belitz	Food Chemistry
Lee	Basic Food Chemistry
Lehninger	Principles of Biochemistry

FT-5202   DAIRY ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Status of dairy industries in India, Introduction of basic unit operations involved in the processing of milk and milk products.

(04 Hrs)

Composition of milk: Composition and physico-thermal properties of milk, their interaction with processing.

(04 Hrs)

Unit II
Homogenization of milk: Principle of homogenization, single and two stage homogenizers, care and maintenance of homogenizers, application of homogenization in dairy industry.

(06 Hrs)

Thermal processing of milk: Pasteurization of milk- batch, flash and continuous pasteurizers, care and maintenance, UHT processing of milk.

(06 Hrs)

Unit III
Concentration of milk: Concentration of milk and machineries, heat and mass balance in single and multiple effect evaporator, types of evaporators and their performances characteristics and selection criteria.

(08 Hrs)

Drying and dehydration of milk: Drying theories, estimation of drying rates and drying time, drying equipment (spray drier, drum drier).

(08 Hrs)

Unit IV
Food freezing: Kinetics of food freezing, freezing methods and equipment, recent advances in food freezing, Technology of ice-cream manufacturing.

(08 Hrs)

Cleaning and sanitation: Selection and use of dairy cleaners and sanitizers, washing equipment, working and maintenance of can washers, steam sterilization of canes, clean in place system, factors affecting, washing operation.

(06 Hrs)

Recommended Books:

Author	Title
Sukumar De	Outlines of Dairy Technology
Walstra	Dairy Technology
Spreer	Milk and Dairy Product technology
Eckles, Comb and Macy	Milk and Milk Products
Kessler	Food Engineering and Dairy Technology
Farral	Engineering of Dairy and food Products

FT-6101   COMPUTER APPLICATION IN FOOD ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Introduction to computer hardware and operations, CPU, input and output devises, memory, secondary storage, operating system, spreadsheet fundamentals and based application, word processing, data base management, graphics application.

(08 Hrs)

Unit II
Data analysis: Classical and recently developed statistical procedures, basic principles of statistical inference and the rationale underlying the choice of these procedures, Problems of estimation, hypothesis testing, large sample theory, probability, regression-linear and nonlinear.

(08 Hrs)

Instrumentation and process control: Computer based instrumentation for data acquisition and their control, concept of process control.

(04 Hrs)

Unit III
Modelling and simulation: Concept, advantages and limitations of dimensional analysis, Models - Types of models and modelling approaches, features of models, Curve fitting method of least squares, estimation of coefficients of simple determination and simple correlation, properties of least square residuals. Simulation and simulation language.

(14 Hrs)

Unit IV
New techniques of computation: Response surface methodology, artificial neural network, fuzzy logic, genetic algorithm, finite element, computational fluid dynamics: concepts and their application in food processing with examples.

(14 Hrs)

Recommended Books:

Title	Author
Elements of Practical Statistics	Kapur, K.
Basic Statistics	Simpson, O.J.
Introduction to Probability and Statistics: Principles and Applications for Engineering and Computing Sciences	Milton, JS and Arnold, JC
Programming in BASIC	Balagurusamy, E
FORTRAN for Beginners	Balagurusamy, E.
C Programming for Engineers and Computer Science	Tan A.
Introduction to Computers	Norton, C.
Programming Languages: Paradigm and Practice.	Appleby, A.
PC Hardware: A Beginner's Guide	Gilster, H. K.
Database Management: Objectives, System Functions & Administration.	Everest, T.
Operating Systems: Concepts and Design	Milenkovic, S.
Introduction to Computer Graphics.	Krishnamurty, H.
Introduction to Languages and Theory of Computation	Martin, T.
Introduction to Computers: Fundamentals of Systems Analysis and Basic Programming	Subramanian, E.
PC Hardware: The Complete Reference	Zacker, A.
Computer Application in Food Technology	Singh, R. P.

FT-6102   BIOTECHNOLOGY

L T P   **Credits:4**
3 1 0

Unit I

Introduction: History, scope and present status of biotechnology in India in relation to food technology and its general applications.

(05 Hrs)

Microbial production of products: Single cell proteins, organic acids (lactic and citric acid), antibiotics and vitamins with special reference to substrates and optimum conditions for growth of microorganism.

(06 Hrs)

Unit-II

Enzyme Technology: Sources of enzymes, advantages of microbial enzymes, extraction and purification of enzymes, applications of enzymes in food industry.

(06 Hrs)

Tissue Culture Technology: Definition, cellular totipotency, somatic hybridization, protoplast fusion, application in mushroom production.

(05 Hrs)

Unit-III

Mutation and Repair Mechanisms: Mutation, mutagens, types of mutations, repair mechanisms, photoreactivation repair and excision repair, applications of mutations in strain improvement.

(06 Hrs)

Techniques of Genetic Engineering: Gene cloning procedures-general outline, recombinant DNA technology, different vectors involved plasmis, cosmids & phagemids, transfer of recombinant molecules into host organisms, genetically modified foods.

(08 Hrs)

Unit-IV

Environmental Biotechnology: Biochemical oxygen demand, chemical oxygen demand, aerobic and anaerobic methods of treatment of food industry wastes with special reference to methanogenesis. BIS standards for safer disposal of industrial waste water.

(06 Hrs)

Recommended Books:

Title	Author	Publishers
Biotechnology	M.D. Trevan	Tata McGraw Hills
Biotechnology	P.K. Gupta	Rastogi
Enzymes in Food Processing	Nagodwithana	CRC Press
Food Processing : Biotechnological Applications	S.S. Marwaha	Asiatech
Biotechnology	Crueger and Crueger	Panima

FT-6103   FOOD BIOCHEMISTRY AND NUTRITION

L T P   **Credits:4**
3 1 0

Unit – I
Enzymes: Enzymes classification, specificity of enzymes, Co-enzymes, co-factors, enzyme inhibitors and activators, Factors effecting enzyme activity, Michaelis Menten equation and Line weaver Burk plot.

(10 Hrs)

Unit – II
Metabolism of carbohydrates: Digestion and absorption, pathways, Glycolysis, glucogenesis, glycogenesis, glycogenolysis, muscular contraction, Kreb's cycle, electron transport chain and oxidative phosphorylation.

(11 Hrs)

Unit – III
Metabolism of lipids: Digestion, absorption and function of lipid, oxidation of fatty acids, Biosynthesis of fatty acids and fats.

(05 Hrs)

Metabolism of proteins: Importance of protein, digestion and absorption of proteins, nitrogen balance, Metabolism of protein and essential amino acids. End products of protein metabolism.

(07 Hrs)

Unit – IV
Nutrition: Functions and energy values of foods, basal energy metabolism: BV, NPU, BMR, PER calculations, dietary allowances and standards for different age groups, nutritive value of Indian food, techniques for assessment of human nutritional status, Causes and preventions of malnutrition.

(11 Hrs)

Recommended Books:

Title	Author	Publishers
A textbook of Biochemistry	**Ramarao**	CBS
Biochemistry	Deb	
Principles of Biochemistry	Lehninger	AVI

FT-6104   HEAT, MASS AND MOMENTUM TRANSFER

L T P   **Credits:4**
3 1 0

UNIT- I
Introduction: Basic concepts of heat and mass transfer, importance of heat and mass transfer in food processing.   (01 Hrs)
Conduction Heat Transfer: Steady state heat transfer through slabs, composite walls, cylinders, spheres; insulation and its purposes, critical thickness of insulation for cylinders and spheres, Unsteady state heat transfer in simple geometry; Use of Heisler charts, error and Bassel functions to solve transient heat transfer problems.   (07 Hrs)
Convection Heat Transfer: Natural and forced convection, dimensional analysis for free and forced convection, dimensionless numbers used in convective heat transfer, important correlations for free and forced convection.

(04 Hrs)

UNIT-II
Boiling and condensation: Boiling phenomenon, hysteresis in boiling curve, nucleate and forced convection boiling; condensation phenomenon, condensation on vertical surface, outside a tube and inside horizontal tube.   (04 Hrs)
Radiation Heat Transfer: Characteristics of black, grey and real bodies in relation to thermal radiation, Stefan Boltzman law; Kirchoff's law; Wein displacement law, intensity of radiation, radiation between two bodies.   (04 Hrs)
Heat Exchangers: Classification, overall heat transfer coefficient, fouling factors, log-mean temperature difference for parallel and counter flow heat exchangers, effectiveness of parallel and counter flow heat exchanger by NTU method, Design of shell and tube heat exchanger.

(06 Hrs)

UNIT-III
Mass Transfer: Introduction to mass transfer, different modes of mass transfer, Mass flux and molar flux for a binary system, Fick's law of diffusion of mass transfer, Derivation of general diffusion mass transfer equation, Molecular diffusion in gases, liquids and solids having steady state equi-molar counter diffusion and through non diffusing body; Steady state equimolar counter diffusion, convective mass transfer coefficient, natural and forced convective mass transfer, dimensional analysis for free and forced convective mass transfer, important correlations of convective mass transfer; permeability of films and laminates.

(12 Hrs)

UNIT-IV
Momentum Transfer: Analogy between momentum, heat and mass transfer, Physical properties of fluid, classification of fluid flow, characteristic of non Newtonian fluids- generalized viscosity coefficient and Reynolds number; Continuity equation, Bernaulli equation, Flow of compressible fluids; flow through porous media; Flow measurement devices like venturimeter, rotameter, pitot tube. Navier Stokes equation, Flow rate and pressure drop relationships for Newtonian fluids flowing through pipes, Friction losses in pipes, pumping power, pumps, compressors and viscometers.

(12 Hrs)

BOOKS RECOMMENDED

Author	Title	Publisher
Arora & D'kundwar	A course in Heat and Mass Transfer	Dhanpat Rai &Sons
R.C. Sachdeva	Fundamentals of Engg. Heat & Mass Transfer	New Age
G.K. Roy	Fundamental of Heat and Mass Transfer	Khanna Pub
D.S. Kumar	Heat and Mass Transfer	Kataria & Sons
Bird et al	Transport Phenomena	John Wiley
Geankoplis	Transport Process & Unit operations	PHI

FT-6201   BIOCHEMICAL ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Introduction to biochemical engineering, its scope and area covered, Microbiological and biochemical aspects related to biological processes
Media sterilization: Medium formulation, Thermal sterilization, Sterilization by filtration, Design criteria and design equations for sterilization process, Temperature-time profile and design calculations, Methods of air sterilization, Interception, diffusion and combined mechanism.

(08 Hrs)

Unit II
Microbial Growth and Death Kinetics: Microbial growth kinetics under batch and continuous process, Thermal death kinetics of microorganism, measuring and monitoring growth processes, influence of temperature on specific growth and death rates, relationship between growth and substrate utilization.

(08 Hrs)

Unit III
Enzyme kinetics: Concepts of biochemical reaction kinetics, thermodynamic considerations, concepts of free energy and activation energy, simple enzyme reaction kinetics, complex enzyme kinetics, Michaelis-Menten equation, Briggs–Halden approach, evaluation of parameters, enzyme inhibition (competitive and non-competitive), enzyme immobilization techniques and kinetics of immobilized enzymes.

(08 Hrs)

Unit IV
Biorector and Fermenter: Bioreactor design and analysis in view of microbial reaction process, operation of batch and continuous fermentation, aseptic inoculation of pilot and industrial fermenter, oxygen supply and demand in microbial processes, mass transfer resistances, critical value of oxygen concentration and oxygen uptake rate, aeration in fermenter, types and design of sparger.

(08 Hrs)

Recommended Books:

Title of book	Name of author	Name of publisher
Biochemical Engineering	Aiba, S,, Humphrey,A.E. and Millis, N.	Academic press
Biochemical Engineering Fundamentals	Bailey, J.E and and Ollis, D.F.	McGraw Hill, NY
Biochemical Engineering	James M. Lee	Prentice Hall, NJ
Principles of Fermentation Technology	Stanbury,P.F Whitaker,W and and Hall, S.J	Reed Elsevier Pvte Ltd,New Delhi

FT-6202   FOOD ANALYSIS AND QUALITY CONTROL

L T P   **Credits:4**
3 1 0

Unit I

Introduction: Quality Control and its importance, functions of quality control departments and quality control laboratories.   (01 Hrs)

Colour: Importance and need of colour determination, methods of colour determination with Spectrophotometer, Colorimeter, Hunter Colour lab, CIE system, Lovibond Tintometer, Munsell colour and colour difference meter, Disc colorometry and their applications.
                                                                                                                        (05 Hrs)

Flavour: Importance of flavour, food flavours, factors affecting food product flavours, measurement of food flavours, theory of taste and smell

                                                                                                                        (04 Hrs)

Unit II

Food Rheology and viscosity: Shear stress, shear rate, torque, Newtonian and Non-Newtonian flow and their further classification, measurement of rheology and its importance, Factors affecting consistency and viscosity, measurement of viscosity and consistency with Brookfield synchrolectric viscometer, Stormer viscometer, Ostwald viscometer, Bostwick consistometer, Adams consistometer.   (06 Hrs)

Kinesthetics and Texture: Food texture, Physical characteristics of food, working of texture measuring instruments such as Texture Analyser, Instron Universal Testing machine, Fruit pressure tester, puncture tester, succulometer, tenderometer, texturometer, maturometer, fibrometer, Texture Profile Analysis (TPA).

                                                                                                                        (06 Hrs)

Unit III

Non Destructive Methods: Near Infrared Spectroscopy (NIR), Nuclear Magnetic Resonance (NMR) and its application,Ultrasonic equipments, conductivity and resistivity meters.   (06 Hrs)

Chromatography: Principle and working of Gas chromatography (GC), High pressure liquid chromatography (HPLC), types of detectors used in GC and HPLC, Thin layer chromatography (TLC), Column Chromatography, chromatographic methods applied as quality control.   (06 Hrs)

Unit IV

Sensory evaluation: Objectives, panel selection, Different test methods and their groups such as difference tests, rating tests, sensitivity tests, Sensory scores, statistical analysis of the data, application of statistical tests such as t-Test, Chi-Square test, F-test, Linear Regression and Correlation Coefficient.   (05 Hrs)

Food Safety and Regulations: Food Safety and Standards Act (2006), Codex Alimentarius, ISO series, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Agricultural Practices (GAP), Genetically Modified Foods (GMF).

                                                                                                                        (06 Hrs)

Recommended Books:

Author	Title	Publisher
Ronald S	Pearson's Composition and Analysis of foods	Addison & Wesley
Ranganna	Handbook of Analysis of Fruit and Vegetable	Tata Mc Graw-Hill

FT-6203   FOOD ENGINEERING

L T P   **Credits:5**
3 2 0

Unit I
Material and energy balance: Numerical problems on material and energy balance related to food processing.   (03 Hrs)
Thermal Processing: Microbial inactivation; Derivation and application of equation for determination of thermal process time for cans, evaluation of thermal process time for batch sterilization by graphical method; calculation of process time for continuous sterilization of liquid foods; factors affecting rate of heat penetration; effect of can size on sterility requirement; related numerical problems

(09 Hrs)

Unit II
Steam Properties: Properties of wet, saturated and superheated steam, use of steam tables and Mollier diagram.   (04 Hrs)
Evaporation: Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy; related numerical problems.

(10 Hrs)

Unit III
Psychrometry: Properties of air-water vapour mixture, psychometric chart, Humidification and dehumidification operations, Application of psychometry to drying; related numerical problems.   (04 Hrs)
Drying and dehydration: Principles of drying and dehydration, water activity, sorption and desorption isotherms, rates of drying: constant and falling rate periods during convective drying, drying rate constant; capillary flow and diffusion in falling rate period; determination of moisture diffusivity for various geometries of food materials; freeze drying and spray drying; calculations of freeze drying and spray drying times; related numerical problems.

(08 Hrs)

Unit IV
Freezing and Crystallization: Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, freezing time calculations for a product having uniform temperature (negligible internal resistance), different types of freezers and crystallizers.   (06 Hrs)
Fluidization: Mechanism of fluidization, characteristics of gas –solid fluidized systems, minimum porosity, bed weight, pressure drop in fluidized bed, application of fluidization in drying.   (04 Hrs)
Extrusion Technology: Theory, Engineering aspects of single and twin screw extruders, applications of extruders in food processing.   (03 Hrs)

Recommended Books:

Author	Title	Publisher
R.T. Toledo	Fundamentals of food process Engg	CBS
Brennan and Cowell	Food Engineering Operations	Applied Science
Heldman and Singh	Food Process Engineering	Academic Press
Smith, P G	Intro to Food Process Engg	Springer
Geankoplis	Transport Process & Unit operations	PHI

FT-7101   PACKAGING TECHNOLOGY

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Definitions, Objectives and functions of packaging and packaging materials.
(02 Hrs)
Properties of Packaging Materials: Packaging requirements and selection of packaging materials, properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation.
(05 Hrs)

Unit II
Packaging Materials: (a) Paper: pulping, fibrillation and beating, types of papers and their testing methods, cellulosics, paper board. (b) Glass: composition, properties, types of closures, methods of bottle making. (c) Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminium containers, lacquers (d) Plastics: types of plastic films, laminated   plastic materials, coextrusion, edible films, biodegradable plastics.
(12 Hrs)

Unit III
Barrier Properties of Packaging Materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection and design of packaging material for different foods.   (06 Hrs)
Packaging equipment and machinery: Vacuum packaging machine, gas packaging machine, seal and shrink packaging machine, form and fill sealing machine, bottling machines, carton making machines.
(06 Hrs)

Unit IV
Food Packaging Systems: Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.(06 Hrs)
Specialized techniques in food packaging: Active packaging system, retortable pouches, aseptic packaging, controlled and modified atmospheric packaging, irradiation in food packaging.
(06 Hrs)

Recommended Books

Title	Author	Publisher
A Handbook of Food Packaging	Frank A. Paine	Blackie Academic
Food Packaging	Stanley Sacharow and Roger C. Griffin	AVI Publications
Food Packaging Materials	N.T.Crosby	Applied Science
Plastic Films for Packaging; Technology, Applications and Process Economics	Calvin J. Bening	Technomic
Plastics in Packaging	A.S.Athalye	Tata Mc-Graw Hill
Food Packaging: Principles and Practice	Gordon L. Robertson	Marcell Dekker

FT-7102   FOOD STORAGE ENGINEERING

L T P   **Credits:5**
3 2 0

Unit I

Introduction: Purpose and justification of storage of perishable and non-perishable foods, factors influencing shelf life of food materials, Brief account of engineering properties of biological materials important in design of handling and storage equipments.

(04 Hrs)

Storage requirements: Storage environment and its interaction with stored product; temperature and moisture migration;, storage practices (including fumigation and aeration of stored product); design of aeration systems.

(08 Hrs)

Unit II

Mechanical Handling equipments: Design of handling equipments like bucket elevators, belt, screw and pneumatic conveyors, and fans

(11 Hrs)

Unit III

Storage structures for non perishables: Grain pressure theories- Rankine and Airy theory: Design of bulk storage structures like bins and silos; Design of bag storage structures such as cover and plinth (CAP) and warehouses

(12 Hrs)

Unit IV

Storage structures for perishables: Design aspects of ventilated, cold, modified and controlled atmosphere storage systems.   (08 Hrs)

Management practices: Labeling, record keeping and management of godowns, silos and cold storages; maintenance of buildings and equipments; sanitary conditions in storages.

(04 Hrs)

Recommended Books:

Author	Title	Publisher
Hall, C.W.	Handling and storage of food grains in tropical and suntropical areas.	Oxford and IBH
Bala, B. K.	Drying and storage of cereal Grains	Oxford and IBH
Sinha and Muir	Grain storage- Part of a System	AVI
Volkind and Roslov	Modern Potato and Vegetable storage	Amerind
Multon, J.L.	Preservation and storage of grains, seeds and their by-products.	CBS
Vijayaraghavan, S.	Grain storage Engineering and Technology	Batra Book Store
Singh and Sahay	Unit operations in Agril processing	Vikas Pub

FT-7103   TECHNOLOGY OF FATS AND OILS

L T P   **Credits:3**
3 0 0

Unit- I
Introduction: Importance and functions of fats and oils in foods and health, composition of fats/oils from different animal sources and oilseeds. (04 hrs)

Oil extraction: Different methods of oil extraction, oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oils, Calculations based on the extraction processes.

(10 Hrs)

Unit- II
Oil/fat purification: Refining techniques, bleaching, refining losses and deodorization, Batch and continuous refining losses. (06 Hrs)

Hydrogenation: Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.

(06 Hrs)

Unit- III
Chemistry of fats and oils: Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, effects of ionizing radiation in fats, inter-esterification, reversion. (06 Hrs)

Technology of individual fat products: Butter, Margarine, Shortening, Lard, Salad, cooking and frying oil.

(04 Hrs)

Unit- IV
Different quality parameters: Peroxide value, Saponification value, Iodine value, acid value, TBA, RM value, P-value, Kries value, Adulteration in oils and fats. (04 Hrs)

Soap processing: Chemistry, physical properties of soap, processing and finishing, different types of soaps, soaps in cosmetics and toiletries.

(06 Hrs)

Recommended Books:

Authors	Title
Chrysam, Erickson and others	Bailey's Industrial Oil and Fat Products Volume-3
Fennema	Food Chemistry
Meyer	Food Chemistry
Lawson	Food oils and fats
Maran	Fats in food products
Oilseeds and Oil Milling in India	A cultural and History Survey

FT-7104　　　TECHNOLOGY OF CEREAL AND PULSE PROCESSING

L T P　　　　　　　　　　　　　　　　　　　　　　　**Credits:3**
3 0 0

Unit I

INTRODUCTION: General introduction to cereals and pulses; Production and utilization trends of various cereals and pulses; Grain classification, structure and composition; Drying, grading and storage of cereala and pulses.　　　　　　　　　　(07 Hrs)

PULSES: Anti-nutritional factors and methods of inactivation; pre-treatments; Traditional and modern milling methods and equipment involved; Byproducts of pulse milling and their utilization.

(08 Hrs)

Unit II

WHEAT: Milling of wheat; Factors affecting yield and quality of flour; Flour treatments; Air-classification; Quality assessment of grain and flour; Concept of composite flour; dough rheology; Wheat starch processing; Technology of Pasta products.

(14 Hrs)

Unit III

RICE: Rice milling; milling machines; effect of different factors on milling yield and rice quality; Parboiling of paddy- different methods of parboiling; Curing and aging of rice; Rice starch processing; Milled rice products and by-products (rice gluten and rice bran oil and de-oiled rice bran).

(14 Hrs)

Unit IV

CORN: Wet and dry milling of corn; Comparison of conventional and modern process for wet milling processes; Milling machines; Corn flakes, syrups, extraction of starch, starch derivatives, starch modification.　　　　　　　　　(10 Hrs)

BARLEY AND MILLETS: Milling of barley and millets, malting of barley, utilization of barley and millet products.

(05 Hrs)

RECOMMENDED BOOKS:

Authors	Title	Publishers
Dendy & Dobraszczyk	Cereal and Cereal Products	Aspen.
Hoseney RS.	Principles of Cereal Science and Tech.	AACC.
Kent NL.	Technology of Cereals.	Pergamon
Kulp K & Ponte GJ.	Handbook of Cereal Science and Technology	Marcel Dekker
A. Chakraverty et. al.	Handbook of Post Harvest Technology	Marcel Dekker

FT-7105　　　　BEVERAGE TECHNOLOGY

L T P　　　　　　　　　　　　　　　　　　　　　　**Credits:3**
3 0 0

Unit I
Introduction: Beverage and its importance in modern life, Current status of beverage industry in India.　　　　　　　　　　　　　　　　　　　　(01 Hrs)
Bottled Water: Water treatment before its utilization in beverages, Mineral water, bottled water, Quality standards of water.

(05 Hrs)

Unit II
Soft drinks: Technology of carbonated soft drinks, Role of various ingredients of soft drinks, Carbonationm of soft drinks.　　　　　　　　　　　　　　(06 Hrs)
Tea: Nature of tea plant, relationship between plucking and quality of the tea. Processing of black tea, green and semi fermented tea, Grading of tea, Chemical and Biochemical changes during processing of tea**.**

(09 Hrs)

Unit III
Coffee: The nature of coffee tree, structure of coffee bean, processing of green coffee (Dry and Wet Processes), conversion of green coffee into beverage, Manufacturing of instant and decaffeinated coffee, Chemical changes during coffee processing**.**　　(07 Hrs)
Cocoa and Drinking chocolate: The nature of cocoa plant, processing of raw bean and the key role of fermentation, The roasting procedure, Processing of roast bean, Chemical changes occurring during various stages of processing**.**

(08 Hrs)

Unit IV
Alcoholic beverages: The role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, Wine and related beverages, Distilled spirits**.**　　　　　　　　　　　　　　　　　　　　　(08 Hrs)
Fruit Juices: Technology of production of various juices, chemistry of major fruit juices.

(05 Hrs)

RECOMMENDED BOOK

Authors	Title	Publisher
Varnam and Sutherland	Beverages- Technology, Chemistry and Microbiology	ASPEN

FT-7106   HEALTH FOODS

L T P   **Credits:4**
3 1 0

Unit I

Definition, status and scope of health and functional foods in India, Definition of
nutraceuticals and their importance.   (05 Hrs)
Types of health and functional foods and their properties.

(05 Hrs)

Unit II

Various food constituents responsible for functional effects: - Anti-carcinogenic,
hypocholesterolemic and hypoglycemic foods, - Dietatic foods, anti-ageing foods, - Fortified
foods, diabetic foods, - Biofedic, prebiotics and probiotic foods.

(10 Hrs)

Unit III

Processing of health and functional foods, criteria for selection of raw materials, and their
processing.   (06 Hrs)
Storage, packaging and labeling of health and functional food.

(04 Hrs)

Unit IV

Marketing aspects of health and functional foods .   (04 Hrs)
Safety / Legal aspects of health and functional foods.   (04 Hrs)
Organic foods and Genetically Modified (GM) foods in relation to health.   (04 Hrs)

Recommended Books:

Title	Author	Publishers
Functional Foods	R. Chadwick,S. Henson,B. Moseley,G.	CRC Press
Methods of Analysis for Functional Foods and Nutraceuticals	W. Jeffrey Hurst	
Functional Foods	Mazza	Technomic Press
Handbook of Nutraceuticals and Functional Foods	Robert E.C. Wildman	CRC Press

FT-7201   ANIMAL PRODUCTS TECHNOLOGY

L T P   **Credits:3**
3 0 0

Unit I

Introduction: Scope of meat, poultry and fish industry in India.   (02 Hrs)
Structure and Composition of Muscle and associated tissue: Muscle tissue, skeletal muscle, skeletal muscle fiber, myofibrils, myofilaments, smooth muscle, cardiac muscle, epithelial tissue, nervous tissue, Connective tissues, Connective tissue proper, adipose tissue, Muscle bundles and associated connective tissues, Muscle and fiber types, Chemical composition of skeletal muscle.

                                                    (08 Hrs)

Unit II

Conversion of Muscle to Meat: Homeostasis, Exsanguination, circulatory failure to muscle, postmortem pH decline, rigor mortis, Enzymatic degradation.   (05 Hrs)
Properties of Fresh Meat: Water holding capacity, chemical basis of water holding capacity, color, pigments, Chemical state of pigments.

                                                    (04 Hrs)

Unit III:

Principles of meat processing: Curing, meat curing ingradients, methods for incorporation of cure ingradients, chemistry of cured color, comminution, blending and emulsification, Technologyofsausages**.**

                                                    (05 Hrs)

Unit IV

Beef, mutton and pork: Slaughtering of cattle, sheep and pig, By products of meat industry**.**   (04 Hrs)
Poultry dressing and egg processing: Stunning, bleeding, scalding, evisceration, packaging and storage, Structure, compositive nutritive value of an egg, Functional properties of egg constituents, .Interior quality of eggs and its preservation .Egg products.
                                        (06 Hrs)
Fish processing: Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates, By products of fish processingindustry.

                                                  (08 Hrs)

Recommended Books:

Title	Author	Publishers
Principles of meat science	J.C.Forest,E.D.Aberle,H.B.Hedrick	W.H.Freeman and company
Poultry Production	B.Panda	ICAR
Meat,Poultry and Seafood Technology	Robert L.Henrickson	Prentice Hall New Jersey

FT-7202   BAKING & CONFECTIONARY TECHNOLOGY

L T P   **Credits:3**
3 0 0

Unit I

INTRODUCTION: Global status of Bakery and Confectionary industry.   (04 Hrs)
RAW MATERIAL FOR BAKERY PRODUCTS: Essential and optional raw materials for bakery products, Dough development, Methods of dough mixing, Dough chemistry, Rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data.

(06 Hrs)

Unit II

MANUFACTURING OF BAKERY PRODUCTS: Detailed description of unit operations for the manufacturing of bakery products-Bread, Biscuits, Cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking.

(12 Hrs)

Unit III

MANUFACTURING OF CONFECTIONARY PRODUCTS: Characteristics and processing of raw material; Technology of manufacturing of toffee, chocolate, fruit drops, hard boiled candies, bars, chewing gums, bubble gums and special confectionary products; colour, flavour and texture of confectionary; standard and regulations.

(12 Hrs)

Unit IV

EQUIPMENT USED IN BAKERY AND CONFECTIONARY INDUSTRY: Construction and working of various equipments like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging machines, Rolling and cutting machines project profile of bakery and confectionary unit.

(10 Hrs)

RECOMMENDED BOOKS:

Authors	Title	Publishers
SB Arora	Hand Book of Bakery Products	SIRI
Matz	Bakery Technology and Engineering	AVI
Dendy & Dobraszczyk	Cereal and Cereal Products.	Aspen.
Hoseney RS.	Principles of Cereal Science and Tech.	AACC.
Kent NL.	Technology of Cereals.	Pergamon Kulp K
& Ponte GJ.	Handbook of Cereal Science and Tech.	Marcel Dekker
Lorenz KL.	Handbook of Cereal Science and Tech.	Marcel Dekker
Beckette	Industrial chocolate manufacturing	CBS

FT-7203   FOOD PROCESSING PLANT LAYOUT AND DESIGN

L T P   **Credits:4**
3 1 0

Unit -I

Introduction: Introduction to plant design and its importance in food processing industries.
(03 Hrs)

Plant location: Influence of location on plant layout, location factors, location theory and models.

(08 Hrs)

Unit -II

Plant Layout: Types of manufacturing process, Plant layout problem, objectives and principles of layout; classical types of layout Viz. product layout, process layout and stationary layout; plant layout tools and techniques like process charts, process flow diagram, machine data cards, material movement patterns, visualization of layout by templates, machine models and sketches, space requirement for machines, work stations and storage, plant layout procedures. (08 Hrs)

Evaluation of layouts: Measurement of effectiveness of layout; Layout evaluation by systematic, optimization and mathematical models.

(03 Hrs)

Unit -III

Network analysis of processes: Basic terms, objectives and advantages of Network analysis, various Network techniques like PERT and CPM. (08 Hrs)

Plant Buildings: Consideration in building design, types of factory buildings, types of building construction; Building materials, drainage, ventilation and illumination in food processing industries.

(04 Hrs)

Unit -IV

Layout of different industries: Layout of different types of food industries like bread, biscuits, soft drinks, canning, dairy, rice mill and wheat mill.

(12 Hrs)

Recommended Books:

Author	Title
O.P.Khanna	Production Engg. and Industrial Manageament
Moore	Plant Layout and Design
Peterse andTimmerhaus	Plant Design for Chemical Engg.
Rase and Barrow	Project Engg. of Process Plant
Farrall	Engg. for Dairy and Food Products

FT-7204   SPICES & FLAVOUR TECHNOLOGY

L T P   **Credits:3**
3 0 0

Unit-I
Introduction: Status and scope of spice and flavour processing industries in India; Spices, Herbs and seasonings: sources, production, selection criteria; flavours: commercially available materials, classification on the basis of origin, physical characteristic.

(10 Hrs)

Unit-II
Processing technology of Spices: Chemical composition of spices; processing methods: equipments used in the processing of spices; spice encapsulation; recent developments in production, retention and recovery of spices; effect of processing on spice quality: contamination of spices with micro-organisms and insects.   (11 Hrs)
Spice Essential Oils: Defintion, methods of extraction, isolation, separation equipments.

(10 Hrs)

Unit-III
Flavour Technology: Essence(flavour) recovery techniques from fruits,spices and herbs along with the equipment used: liquid and Solid flavour production; Flavouring remixing:flavour intensifiers:synthetic flavours;effect of processing on flavour quality.

(06 Hrs)

Unit-IV
Spice Oleoresins: Definition, method of extraction, isolation, separation equipment.
Spices and flavour quality evaluation: Criteria for assessment of flavour quality; identification of naturalfood flavours; methods of flavour evaluation (chemical, instrumental, sensory); PFA standards for flavouring materials and flavours.

(11 Hrs)

Recommended Books:

Title	Author	Publishers
Source book of flavour	Reineccius,G	CBS
Food Flavours	Morton,I.D., Macleod ,A.J	AVI

FT-7205   INNOVATIVE TECHNIQUES IN FOOD PROCESSING

L T P   **Credits:3**
3 0 0

Unit – I

Membrane technology: Introduction to pressure activated membrane processes: microfiltration, UF, NF and RO and their industrial application.   (06 Hrs)
Supercritical fluid extraction: Concept, property of near critical fluids NCF, extraction methods.

(04 Hrs)

Unit – II

Microwave and radio frequency processing : Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying.   (06 Hrs)

Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

(04 Hrs)

Unit – III

High Pressure processing: Concept, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing.   (04 Hrs)
Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques.

(04 Hrs)

Unit – IV

Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.   (12 Hrs)
Nanotechnology: Principles and applications in foods.   (04 Hrs)

Recommended Books:

Author	Title	Publisher
G. W. Gould	New Methods of Food Preservation	CRC
R.P.Singh	Introduction to Food Engineering	
Barbosa-Canovas	Novel Food Processing Technologies	CRC

HU-5101/5201   COMMUNICATION SKILLS

L T P   **Credits:3**
3 0 0

Unit -I
SPEECH MECHANISM: Organs of speech, Consonants & Vowels (basics) Cardinal Vowel Scale, Production of Speech Sounds, Description & Classification of Speech Sounds.

(12 Hrs)

Unit-II
WRITING AND SPEAKING SKILLS: Written and Oral Communication, Technical Paper Reading, Note Taking, Précis Writing, Paragraph Writing.

(10 Hrs)

Unit-III
BUSINESS COMMUNICATION: Business Letters, Interpersonal Communication, Drafting Notices, Memos, Agenda and Minutes of Meetings, Applications for Jobs, Facing Interviews

(12 Hrs)

Unit-IV
BASICS OF GRAMMER: Narration, Voice, Words Often Confused, Use of Prepositions.

(10 Hrs)

RECOMMENDED BOOKS

Title	Author	Publisher
An Introduction to Pronunciation of English	Gimson	ELBS
English Pronouncing Dictionary	Daniel Jones	ELBS
New International Business English	Leo Jones	Cambridge
Collins Cobuild English Grammar	John Sinclair ed.	Collins

HU-6101/6201   ENTREPRENEURSHIP & BUSINESS MANAGEMENT

L T P   **Credits-3**
3 0 0

UNIT-I

Entrepreneurship: Definition, Concept, Qualities of an entrepreneur, Need and importance of small scale industry, Problems of small scale industries, Role of banks and financial Institutions, forms of organizations- sole proprietorship, partnership, private limited & public limited companies.

(11 Hrs)

UNIT-II

Generation and screening of project ideas, Project report-Market and demand analysis, Technical Analysis, Financial analysis.

(09 Hrs)

UNIT-III

A brief introduction of marketing management, product life cycle, marketing mix, Functions of personnel management, concept of industrial relations, need and scope of financial management, materials management ,tools and techniques of inventory control. Stores and purchase procedure.

(12 Hrs)

UNIT-IV

Managerial communication, channels of communication, barriers and making communication effective. Motivation, XY theory, Maslow's theory and Herzburg's theory, Mc Clelland Theory, leadership styles. Managerial grid, Tasks & responsibilities of professional manager. Management process.

(10 Hrs)

AUTHOR	TITLE	PUBLICATIONS
Vasant Desai	Entrepreneurship Development	PHI
Philip Kotler	Marketing Management	PHI
Fred Luthans	Organizational Behavior	TMH
S.S. Khanka	Entrepreneurial Development	S. Chand & Company
C.B.Memoria	Personnel Management	Himalayas Pub.
KURATKO/HODGETTS	Entrepreneurship theory, Process, Practice	THOMSON-SOUTH WESTERN SINGAPORE

Recommended Books:

IE-5101 FUNDAMENTALS OF MEASUREMENT & INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit-I

Measurements and measurement Systems: Measurements, significance of measurements, methods of measurements, direct methods, indirect methods, instrument and measurement systems, mechanical, electrical and electronic instruments, classification of instruments, deflection and null type instruments- deflection type, null type, comparison of deflection and null type instruments, analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, types of instruments systems, information and signal processing, elements of a generalized measurement system- primary sensing element, variable conversion element, data presentation element, input-output configurations of measuring instruments and measurement systems- desired inputs, inferring inputs, modifying inputs, methods of correction for interfering and modifying inputs.

(12 Hrs)

Unit-II

Characteristics of instruments and measurement systems: Measurement system performance, static calibration , static characteristics, errors in measurements, true value, static error, static correction, scale range and scale span, error calibration curve, reproducibility and drift repeatability, noise –signal to noise ration, source of noise, Johnson noise, power spectrum density, noise factor and noise figure, accuracy and precision, indications of precision, significant figures, range of doubt, possible errors and doubtful figures, static sensitivity, linearity, hysteresis, threshold, dead time, dead zone, resolution of discrimination, loading effects, input and output impedances- input impedances, input admittance, output impedance, output admittance, loading effect due to shunt connected instruments, loading effects due to series connected instruments, generalized impedance and stiffness concepts, static stiffness and static compliance, impedance matching and maximum power transfer.

Dynamic response, dynamic analysis of measurement systems, mathematical models of measurement systems, linear and non-linear systems, analysis of linear systems, linear approximation of non-linear systems, electrical network, mechanical systems, force-voltage and force-current analogies, thermal systems, liquid level systems, pneumatic systems, transfer function, block diagram representation, impulse response of a linear systems, sinusoidal transfer function, time domain response, zero order systems, first order electrical systems, first order non-electrical systems, differential equation for a general first order system, response of a first order system to a unit step input, modeling of thermometer, ramp response of a first order system, impulse response of a first order system, response of a second order system, step response of a second order system, impulse response of a second order system, ramp response of second order system, impulse response of second order system, frequency domain analysis, frequency response of first order systems, frequency response of a second order system, dead time elements, correlationship between time and frequency response of second order system.

(12 Hrs)

Unit-III

Errors in measurements and their statistical analysis: Limiting errors (Guarantee errors), relative (fractional) limiting errors, combination of quantities with limiting errors, known

errors, types of errors, gross errors, systematic errors- instrumental errors, environmental errors, observational errors, random (residual) errors, central value, statistical treatment of data, histogram, arithmetic mean, measure of dispersion from mean, range, deviation, average deviation, standard deviation (SD), variance, normal or Gaussian curve of errors, precision index, probable error, average deviation for the normal curve, standard deviation for the normal curve, probable error of a finite number of readings, standard deviation of mean, standard deviation of standard deviation, probability tables, specifying ODDS, specifying measurement data, confidence interval and confidence level, rejection of data-Vhauvenet's criterion, rejection of data based upon confidence intervals, method of least squares, variance and standard deviations of combination of components- probable error of combination of components, uncertainty analysis and treatment of single sample data-propagation of uncertainties.

(12 Hrs)

Unit-IV

Display & Recording Methods: Indicating methods, analogue & digital comparison, LED, LCD as display units, 7 segment, 14 segment & dot matrix display, Nixie tube display, difference between integrating & recording methods, recording requirements, various methods of strip chart recording, potentiometer & null balance type of recorders.

(06 Hrs)

Cathode Ray Oscilloscope: CRT, its main parts, electrostatic focusing & deflection, deflection sensitivity, post deflection acceleration, types of screens for CRT, aquadag color, CRTs, various time base & amplifiers oscilloscope circuits, method of synchronization, various controls on CRO.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Electrical & Electronic Measurement and Instt.	A K Sawhney	Dhanpat Rai
Measurement Systems Applications & Design	EO Doebelin	TMH
Reference Books		
Mechanical Measurements	T G Beckwith	PHI
Transducers and instrumentation	DVS Murthy	Dhanpat Rai

IE- 5201   DIGITAL ELECTRONICS

L T P   **Credits:4**
3 1 0

Unit-I
Number System & Codes: Review of number systems, binary number systems, octal number system, hexadecimal number system, signed & unsigned numbers, different types of codes & their conversions, binary operations- addition, subtraction, multiplication, division, 1's & 2's complement of a number.

(12 Hrs)

Unit-II
Combinational Circuits: Concept of positive & negative logic, introduction to Boolean variables, Logical functions using Karnaugh map & Quine-Macluskey methods, multiplexers, demultiplexers, encoders, decoders, address, subtractors, parity generators, parity checkers, code converters.

(06 Hrs)

Sequential Logic Circuits: Flip-flops, JK flip-flops, D flip-flops, T flip- flops, SR flip- flops, edge triggered & clocked flip- flops. Registers & counters, introduction, series & parallel registers, synchronous & asynchronous counters, up & down counters, ring counters & mod, Counters.

(06 Hrs)

Unit-III
Digital Logic Families: Introduction, characteristics of digital ICs, resistor transistor logic, integrated injection logic, direct coupled transistor 109lc, diode transistor logic & transistor-transistor logic, emitter coupled logic, MOS logic, and high threshold logic families.

(12 Hrs)

Unit-IV
D/A & A/D Converters: Introduction, weighted register *D/A* converter, binary ladder, *D/A* converter, specifications for *D/A* converters, parallel *A/D* converter, successive approximation *A/D* converter single & dual slope *A/D* converter, *AID* converter using voltage to frequency conversion, *AID* converter using voltage to time conversion, countertype *AID* converters.

(06 Hrs)

Semiconductor Memories: Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write memories, content addressable memories, and programmable logic arrays, charged coupled device memory.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Digital Electronics	R. P. Jain	TMH
Digital Circuits and Logic Design	Katre	Techmax
Reference Books		
Digital Electronics & Computer Fundamentals	Albert Paul Malvino	TMH
Digital Computer Design	Radhakrishanan & Rajaraman	PHI
Digital Computer Fundamentals	Thomas Bartee	TMH
Digital Computer Design	Moris Mano	PHI

IE- 5202   ELECTRICAL AND ELECTRONICS MEASUREMENTS

L T P   **Credits:4**
3 1 0

Unit-I
Analog Measuring Instruments: Classification of analog instruments, operating forces in indicating instruments, T/W ratio, pointers and scales. Working principle, theory, construction and salient features of electromechanical indicating / registering instrument viz. PMMC, Electrodynamometer, Moving iron, Rectifier type, Induction type for the measurement of dc and ac voltage, current, power, energy (1-phase induction type wattmeter), power factor (single phase Electrodynamometer), Volt ohmmeter or multimeter.

(12 Hrs)

Unit-II
Measurement of Resistances: Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter -Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method. (06 Hrs)

AC Bridges: General theory of ac bridge, Measurement of self inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.

(06 Hrs)

Unit-III
Potentiometer: Introduction to basic principle, Laboratory type Crompton's potentiometer, Dual range potentiometer, Volt ratio box, application of dc potentiometer, self balancing potentiometer. (06 Hrs)

Magnetic Measurement: Working principle and theory of Ballistic galvanometer, Measurement of flux density, Determination of B-H curve, hystereris loop, Ewing Double bar permeameter, Hopkinson permeameter, separation of iron losses by wattmeter and Bridge methods.

(06 Hrs)

Unit-IV
Instrument Transformers: Theory and construction of current and potential transformers, transformation ratio and phase angle errors and their minimization, effects of pf, secondary burden and frequency. (06 Hrs)

Electronic Instruments: DVM, DMM, Function Generator, Electronic Energy meters, Universal Counters.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Electronic Instrumentation and Measurement Techniques	W D Cooper	PHI
Electrical and Electronics Measurements and Instrumentation	A K Sawhney	Dhanpat Rai
Reference Books		
Electronic Instrumentation and Measurements	Bell David A	PHI
Electrical Measurements Fundamentals, Concepts, Applications	Reissland Martin V	Wiley Eastern

IE- 5203   ELECTRONIC DEVICES AND CIRCUITS

L T P   **Credits:3**
3 0 0

Unit-I
Basic Semiconductor Concepts And Devices: Intrinsic and extrinsic semiconductors, diffusion and drift currents, p-n junction under open-circuit, reverse bias and forward-bias conditions, p-n junction in the breakdown region, Ideal diode, terminal characteristics of junction diode, Load-line analysis of diode circuits, Bipolar junction transistor- physical structure and modes of operation, Transistor as a switch, CB, CE and CC Configurations, Transistor Biasing.

                                                               (12 Hrs)

Unit-II
Amplifiers: BJT as an amplifier, Frequency response of an amplifier, amplifier bandwidth and Concept of Cascaded Amplifiers.   (06 Hrs)

Feedback And Oscillators: Concept of feedback, positive and negative feedback, General feedback structure, Effect of positive and negative feedback on amplifier gain and bandwidth, advantages of negative feedback, Basic principles of sinusoidal oscillators, Oscillation criteria, Brief idea about LC and RC oscillators, Crystal Oscillators (No mathematical treatment).

                                                               (06 Hrs)

Unit-III
Operational Amplifiers: Op-amp terminals, ideal Op-amp, equivalent model, Inverting and non-inverting configurations, Application of op-amps as summing amplifier, differentiator and integrator, Practical op-amps (non-ideal performance of op-amps).

                                                               (12 Hrs)

Unit-IV
Power Supplies: Block diagram of power supply, Half-wave, Full-wave and Bridge rectifiers, passive filers, Regulators, Line regulation and load regulation, Zener diode as voltage regulator, Working of Switched Mode Power Supply (SMPS).

                                                               (12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Basic Electronics and Linear Circuits	Bhargava and Kulshreshtha	TMH
Electronics Devices and Circuits	Katre and Goyal	Techmax
Reference Books		
Electronic Devices and Circuit Theory	Boylestad and Nashelsky	Pearson Education
Operational Amplifiers	Gaikwad	TMH
Microelectronic Circuits	A S Sedra and K C Smith	Oxford Univ. Press
Digital Systems – Principles and Applications	R J Tocci and N S Widmer	Pearson Education
Modern Electronic Instrumentation and Measuring Techniques	Cooper and Helfrick	PHI

IE-6101   LINEAR CONTROL SYSTEM

L T P   **Credits:5**
3 2 0

Unit-I
Introductory Concepts: Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Block diagrams, some illustrative examples.   (06 Hrs)

Modeling: Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical, mechanical analogies. Use of Laplace transforms, Transfer function, concepts of state variable modeling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

(06 Hrs)

Unit-II
Time Domain Analysis: Typical test – input signals, Transient response of the first and second order systems, Time domain specifications, Dominant closed loop poles of higher order systems, Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion.   (06 Hrs)

Frequency Domain Analysis: Frequency response specifications, Closed loop frequency response, Relation between time and frequency response for second order systems, Log, Magnitude versus Phase angle plot.

(06 Hrs)

Unit-III
Stability Analysis: Absolute and relative stability, Polar plots and Nyquist stability criterion, Bode plots-gain margin & phase margin, M and N loci.   (06 Hrs)

Root Locus Technique: The extreme points of the root loci for positive gain, Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot, criterion for stability.

(06 Hrs)

Unit-IV
Compensation: Necessity of compensation, series and parallel compensation, compensating networks, applications of lag and lead-compensation.   (06 Hrs)

Control Components: Error detectors – potentiometers and synchros, servo motors, a.c. and d.c. techno generators, Magnetic amplifiers.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Modern Control Engineering	K. Ogata	Pearson
Control System Engineering	Nagrath & Gopal	New Age
Reference Books		
Control Systems- Principles & Design	M Gopal	TMH
Modern Control Engineering	Choudhury, Roy	PHI

IE-6102   MICROPROCESSOR APPLICATIONS

L T P   **Credits:4**
3 1 0

Unit-I

Introduction: Overview of architecture & instruction set of 8085, Addressing techniques, Assembly language programming, Simple Review of timing &control, interrupts of 8085 programming.

(12 Hrs)

Unit-II

Interfacing Devices: Introduction to Interfacing and I/O techniques, .Block diagram and modes of operation of interfacing devices like 8255 (PPI), 8251 (USART), 8253 (PIT), 8259(PIC) , 8257 (DMA).

(12 Hrs)

Unit-III

Microprocessor Applications : Traffic light control, interfacing of 8085 with keyboard & display, ADC & DAC using 8255, stepper motor, temperature controller, flow and level control, data acquisition system.

(12 Hrs)

Unit-IV

Buses: Bus standards, types of buses, IEEE 488, multi-bus, centronics standard, serial bus standard, RS 232.

(08 Hrs)

Advanced Microprocessor: Intel 80286, 386, 486 and Pentium features only.

(04 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
TEXT BOOKS		
Microprocessor Programming and Applications with 8085/8080	Gaonkar	Wiley Eastern
Microprocessor Programming	B. Ram	Dhanpat Rai
REFERENCE BOOKS		
Microprocessor, interfacing	Douglas Hall	PHI
Programming and Hardware	Linc & Gibson	PHI
Microprocessor of 8086		

IE-6103   INDUSTRIAL INSTRUMENTATION & SAFETY

L T P   **Credits:5**
3 2 0

Unit I
Temperature Measurement: Transducers used for temperature measurement, Temperature scale and conversion, principle of operation, construction, characteristics of vapor, gas, liquid filled thermo meters, thermocouple and its configuration, extension wires, bimetallic thermo meter, resistance temperature detector & compensation techniques, Thermistor, pressure spring thermometer, radiation and optical pyrometer.

(06 Hrs)

Pressure Measurement: Transducers used for pressure measurement, Introduction to static and dynamic pressure, unit of pressure and conversions, pressure standards, principle of working, material of Construction, advantages and limitations of various instruments based upon elastic transducers like ordinary and diaphragm, bourdan tube, bellows, capsules etc. sealed pressure gauges, pressure transmitters, pressure switches and strain gauge pressure pick ups, methods for measurement of vacuum and high pressure. Piratti Gauge, calibration of pressure measurement, Mclead Gauge, K Gauge.

(06 Hrs)

Unit II
Flow Measurement: Transducers used for flow measurement, Basic properties of fluids, principle of operation. construction, classification, characteristics of various measurement methods, variable headmeters, orifice plate & its types, venturi tube, flow nozzle, pitot tube, rotameter and its types, magnetic meter, turbine meter, vortex meter, mass flow meter. ultrasonic meter, thermal flow meter. Positive displacement meters.

(12 Hrs)

Unit III
Level Measurement: Transducers used for level measurement, Importance of level measurement, principle of working, material of construction, advantage and limitation of various instruments such as visual level indicators, ordinary float type using string and pulley, purge method of measuring level Buoyancy method, resistance probes for level measurement, capacitive level meter, ultrasonic level measurement, Gamma rays level measurement, level limit switches, level measurement of closed vessel.

(12 Hrs)

Unit IV
Industrial Safety: Fire Prevention and Control, Handling of Fire Accidents, Electrical Safety, Environmental Safety, Various safety equipments and their constructional features, Maintenance and repair of safety equipments, Safety in High Pressure Operations, Safety Management.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Process Control Instrument	Jhonson	PHI
Instrumentation Handbook	Kallan	Mc Graw Hill
Reference Books		
Instrument Measurement & Analysis	Nakara	PHI
Measurement Systems Applications	E O Deoblin	Mc Graw Hill

IE-6201   SENSOR & SIGNAL PROCESSING

L T P   **Credits:5**
3 2 0

Unit I
Introduction: General Concept of Measurement: Basic block diagram stages of generalized measurement system state characteristics; accuracy, precision, resolution, reproducability, sensitivity, zero drift, linearity, Dynamic characteristics, zero order instrument first order instrument, time delay.

(12 Hrs)

Unit II
Sensors: Sensors and Principles: Resistive sensors, Potentiometer and strain gauges, Inductive sensors: Self inductance type, mutual inductance type, LVDT, Capacitive sensors, piezoelectric sensors thermocouples, thermistors, radiation pyrometry, Fibre optic sensors, Bio – Sensors, temperature sensor, photo electric sensors, pressure and flow sensors.

(12 Hrs)

Unit III
Signal Conditioning : Signal conditioning: Amplification, Filtering, Level conversion, Linearisation, Buffering, sample and hold circuit, quantization, multiplexer/ demultiplexer, analog to digital converters, digital to analog converters.

(12 Hrs)

Unit IV
Data Acquisition: Data acquisition and conversion: General configuration, single channel and multichannel data acquisition system, Digital Filtering, data logging data conversion, introduction to digital transmission systems, PC based data acquisition system.

(06 Hrs)

Interfacing: Interface systems and standards: Block diagram of a typical interface IEE 488 standard bus British Standard interface (BS 4421) CAMAC Interface MEDIA interface RS232C standard.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Instrumentation -Devices and Systems	Rangam, Sarma & Mani	TMH
A Course in Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney	Dhanpat Rai
Reference Books		
Measurement Systems	E.O. Doeblin	McGraw Hill
Instrument Measurement & Analysis	Nakra	PHI

IE-6202 PROCESS DYNAMICS & CONTROL

L T P   **Credits:4**
3 1 0

Unit-I
Basic Considerations: Introduction, Basic components, diagrammatic representation, symbol and Terminology, changes at arbitrary points in the loop, offset and its analysis.

(04 Hrs)

Process Characteristics: Process variables, mathematical modeling of liquid, gas, and thermal, mechanical and chemical systems, Linearzing techniques, Liquid level control in a tank, Dynamics of manometer, response of non-interacting and interacting first-order elements in series, Mixing process, Heat transfer process, Distillation column.

(08 Hrs)

Unit-II
Controller Characteristics: Control modes, characteristics and comparison of on-off, proportional, integral, derivative modes and their combinations (PI, PD and PID), Introduction to Digital controllers.

(06 Hrs)

Introduction to Computerized Process Controls: Control algorithm, PID Control action with Dead time.

(06 Hrs)

Unit-III
Automatic Control: Single and combined modes in closed loop, static error, velocity error. Dynamic behaviour of feedback control processes for different modes, IAE, ISE, IATE criteria, Tuning of controllers, process reaction curve.

(06 Hrs)

Controller Hardware: Electronic pneumatic and hydraulic controller's implementation, single and composite modes of controllers.

(06 Hrs)

Unit-IV
Final Control Elements: Control valves, types, functions, Electrical, Pneumatic hydraulic-actuators, Solenoid, E-P converters, stepper motors.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Process Control Instrumentation Technology	Johnson Curtin	PHI
Principles of Process Control	D. Patranabis	TMH
Reference Books		
Chemical Process Control: An Introduction to Theory and Practice	G. Stephanopoulos	PHI
Process Systems Analysis & Control	R Coughanowr Donald	TMH

IE-6203   NON LINEAR & DISCRETE CONTROL SYSTEM

L T P   **Credits:5**
3 2 0

Unit-I

State space analysis & design: Invariance of eigen values, Digonalisation of system matrices having distinct & repeated eigen values, Vander monde & modified Vander monde matrix. Definition of controllability & observability, derivation of controllability & observability matrix, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback, state feedback with integral control, luenberger observer.

(12 Hrs)

Unit-II

Non-linear control systems: Different types of non-linearities. Peculiarities of non-linear systems. Definition of describing function.(D.F.) derivation on D.F.'s for various non-linearities, D.F. analysis of non-linear control systems, Limit cycles, Merit and limitations of D.F. analysis. Phase-plane method. Singular points, Construction of phase-plane plots for non -linear systems by isocline method, Obtaining time- domain response from the phase-plane plots, Stable, semistable and unstable limit cycles.

(12 Hrs)

Unit-III

Discrete time control systems (Part-I) : Basic elements of a discrete data control system & its advantages over the continuous time systems A/D and D/A conversions, Sample and hold device, Pulse transfer function, starred Laplace transforms, Pulse transfer functions of cascaded elements, Pulse transfer function of close loop system Modified Z-transform, Stability analysis of close loop systems in Z-domain, Stability criterion by Jury's test, Stability analysis by bilinear transformation and Routh's stability criterion.

(12 Hrs)

Unit-IV

Discrete time control systems (Part-II) : Discrete time equivalent of continuous time filters, State space representations of discrete time systems, State Space models from pulse transfer functions, Solution of discrete time state space equations, Design of digital control system, PID controller and frequency domain compensation design, State variable method.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Modern Control Engineering	Katsuhiko Ogata	Prentice Hall of India Pvt Ltd
Digital Control Systems	Benjamin C. Kuo	Pearson Education
Reference Books		
Digital Control Engineering	M. Gopal	Wiley Eastern
Automatic Control system	Benjamin C. Kuo	Prentice Hall of India Pvt Ltd

IE-7101   MICROCONTROLLERS & EMBEDDED SYSTEMS

L T P   **Credits:4**
3 1 0

Unit I
Architecture of Microcontrollers MCS – 51 family: Architectural Block Diagram, Status Signal, control Signals, Address and Data Buses, Interrupt Signals, Pointers and Index Registers, Timers and Counters.

(12 Hrs)

Unit II
Programming: Software model of microcontroller, Assembly level programming, addressing modes, instruction set.

(12 Hrs)

Unit III
Interfacing & microcontroller applications: Memory interfacing, peripheral interfacing, serial interfacing, RS – 232, RS – 485, study of assemblers and cross compilers, development of applications using microcontrollers, parallel processing of two microcontrollers.

(12 Hrs)

Unit IV
Real Time Operating Systems: Embedded System Software: Round Robin with Interrupts, Function-Queue-Scheduling Architecture, Introduction to Real-Time Operating Systems, Real-Time Operating System Architecture, Selecting Architecture, Tasks and Task States, Tasks and Data, Real Time and Embedded Linux: Features.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
8051 Programming & Architecture	K. J. Ayala	Penram Publications
Real-Time Programming: A Guide to 32-bit Embedded Development	R. Grehan, R. Moote, and I. Cyliax	Pearson Education
Reference Books		
The 8051 Micro controller and Embedded Systems	M. A. Mazidi & J. G. Mazidi	Pearson Education
An Embedded Software Primer	D. E. Simon	Pearson Education

IE-7102   DATA ACQUISITION & TELEMETRY

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Generalized data transmission systems, analog & digital data Transmission and their comparison, block diagram of data acquisition System & its applications, introduction to electrical telemetry, its needs & block diagram.

(12 Hrs)

Unit II
Data Acquisition Systems: Analog& digital acquisition systems, signal conditioning of the inputs ratio metric conversion & logarithm compression, single channel data acquisition, multi-channel DAS, computer based DAS, digital to analog converters, analog to digital converters, electromechanical ADC, uses of data acquisition systems, use of recorders in digital systems & block diagram of digital data recording system, data logging system, compact data logger , modem digital data acquisition, sensors based computer data system, digital transducer.

(12 Hrs)

Unit III
Data Conversion & Transmission: Methods of data transmission, transmission channels & media, Modulation & demodulation, amplitude, frequency &phase modulation, Comparison between frequency & amplitude, pulse modulation (PAM, PDM, PFM, POM), delta modulation, adaptive data modulation & Companding, digital data codes, error correcting & error detecting codes, Asynchronous & synchronous data transmission, pulse code formats used in data transmission, radio link, frequency division &time division multiplexing, time division multiplexing using mechanical commutator, electronic time division multiplexing system, block diagram of AM frequency division multiplexing system.

(12 Hrs)

Unit IV
Telemetry & Remote Control: Various classes of telemetry systems, land-line & radio telemetry, dc Telemetry , voltage current & position telemetry, land-line telemetry feedback systems, ac telemetry, frequency modulation telemetry systems, complete telemetry package including telemetry transmitting & receiving systems, case studies of remote control &telemetry applied to communication based processing control systems (pipeline control & power system control) & biomedical engineering.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Telemetry Principles	D Patranabis	TMH
A Course in Electrical & Electronics Measurement & Instrumentation	A K Sawhney	Dhanpat Rai
Reference Books		
Data Acquisition and Measurement Techniques	Munez-Ruiz, Angel; Vromans, Herman	CRC
Handbook of Telemetry & Remote Control	Elliot L Gruenberg	McGraw Hill
Electronic Instrumentation	H S Kalsi	TMH

IE-7103   DIGITAL SIGNAL PROCESSING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Signals**,** Systems and signal processing. Classification of signals, Concept of frequency in continuous and discrete time signals.

(06 Hrs)

Discrete Time Signals And System: LSI system, causality, frequency domain representation, sampling, aliasing, two dimensional sequences, systems.

(06 Hrs)

Unit II
The Z-Transform & Discrete Fourier Transform : Z-transform, system function Z-transform. Discrete Fourier series representation, sampling the Z-transform, properties of OFT, Fourier representation of finite duration sequences, linear convolution. using DFT, Two D-DFT.

(12 Hrs)

Unit III
Digital Filters: Introduction, signal flow graph representation of digital networks, Basic network structure of IIR system, tellyam theorem for digital filter and its applications.

(05 Hrs)

Digital Filter Design Techniques: Design of IIR digital filter from analog filters, design examples, computer aided design, properties of FIR digital filters, design using windows, CAD of FIR digital filters. Comparison of IIR and FIR filters, implementation and realization, block diagram, cascade and parallel realization, effect of finite word length, transfer function of Degree one and two.

(07 Hrs)

Unit IV
Computation of DFT: Goevtzal algorithm, decimation in time FFT algorithm, decimation in frequency, general computational considerations, chirps Z-transform.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Digital Signal Processing	Oppenheim & Schafer	PHI
Digital Signal Processing: Principles, algorithms and Applications	Proakis & Manolakis	PHI
Reference Books		
Theory and Application of DSP	Rabiner & Gold	PHI
Understanding Digital Signal Processing	R. G. Lyons	Pearson Education

IE-7104   VIRTUAL INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit-I

Introduction to Virtual Instrumentation: Historical perspective, Classification of different instruments / instrumentation system, Definition and architecture of virtual instrumentation system, salient features and application area of virtual instrumentation.

(12 Hrs)

Unit-II

Data Flow Programming Techniques: Graphical programming in data flow, comparison with conventional programming, popular data flow and VI software packages. Building a VI front panel and block diagram, sub VI, for and while loops, case and sequence structure, formula nodes, local and global , string and file I/O, array and clusters, charts and graphs, attributes nodes.

(12 Hrs)

Unit-III

Data Acquisition Basics: ADC, DAC, D/O, counters and timer, PC hardware structure, timing, interrupts, DMA, software and hardware installation, Configuring data acquisition hardware using the drives in application software, use of DAQ library functions for different analog and digital input/output operations.

(06 Hrs)

Common Instrument Interfaces: Current loop, RS 232, RS485, GBIP. Use of library functions to communicate with different instruments.

(06 Hrs)

Unit-IV

Use of Measurement Analysis Tools: Measurement of Max, Min, Peak-Peak voltage, Mathematical tools, time period of a signal, power spectrum and logging Fourier transform, Correlation methods, windowing and filtering.

(06 Hrs)

Building a web based virtual instrument: Networking basics for office and industry application.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Virtual Instrumentation Using Labview	Gupta	TMH
PC Inerfacing for data acquisition	S Gupta & J Gupta	ISA
Reference Books		
LabVIEW for everyone	Wells Lisa K,Travis Jeffry	PHI
Lab view Graphical Programming	Johnson Gary W	McGraw Hill

IE-7201   ANALYTICAL INSTRUMENTATION

L T P   **Credits:3**
3 0 0

Unit I

Introduction: Difference between analytical and other instruments, sampling, sampling system for liquids and gases, sampling components, automatic and faithful sampling.

(04 Hrs)

Humidity and Moisture Measurements: Humidity measurement: definitions – absolute, specific, relative humidity and dew point, Dry and wet bulb psychrometer, Hair hygrometer, dew point meter. Moisture Measurement: definitions, electrical methods, NMR method, IR method.

(08 Hrs)

Unit II

Gas Analysis: Gas Chromatography – principles & components, Thermal conductivity gas analyzers, Heat of reaction method, Estimation of Oxygen, Hydrogen, Methane, CO_2, Carbon monoxide etc. in binary or complex gas mixtures, paramagnetic oxygen analyzer, Electro chemical reaction method, Polarography, Density measurement.

(12 Hrs)

Unit III

Chemical Composition Measurements: Newtonian and Non Newtonian flow, Measurement of viscosity and consistency, Laboratory and on line methods, Measurement of pH:- definition and methods, redox potential, electrical conductivity, conductivity cell and applications, density measurement: solids, liquids, gages.

(12 Hrs)

Unit IV

Spectro-chemical Analysis: Classification of techniques, Principles and components, emission spectrometery:- flame emission, atomic absorption type, Dispersive techniques, scheme for UV, IR and near IR analysis, comparison of methods, X-ray analyzers NMR spectrometry, ESR spectroscopy, Mass spectrometery.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Handbook of Analytical Instruments	R S Khandpur	TMH
Analytical Instrumentation: an Introduction	R P Khare	C.B.S. Publication
Reference Books		
Principles of Industrial Instrumentation	Patranbis	TMH
Instrument Technology Vol II	E B Jones	Butterworths Scientific Publication

IE-7202   BIO-MEDICAL INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit-I

Physiological Transducers: Introduction to physiological systems, Pressure transducers, Transducer for body temperature measurement. Pulse sensors, Respiration sensors.

(06 Hrs)

Bio-Electric Signals and Electrodes: Origin of bio-electric signals, Recording electrodes, Polarization Skin contact impendence, Electrodes for ECG, EEG, Electrical conductivity of electrode jellies and creams, Microelectrodes.

(06 Hrs)

Unit-II

Measurement And Analysis Techniques: Blood flow meters, Cardiac Output measurement, Pulmonary function analyzers, Spiro-meter, Respiratory gas analyzers, Blood gas analyzers Blood pH, PCO2, PO2 measurement, Blood cell counters, Audio meter, Pure tone audio meters, Speech audiometers Evoked response audio-metric systems, Oxy-meters.

(06 Hrs)

X-Ray And Ultrasonic Diagnosis: Soft & Hard X-Rays. X-Ray generators for diagnosis. Radiography, Angiography, Fluoroscopy, X-Ray computed tomography, Ultrasonic principles, Application of ultrasonic for diagnosis.

(06 Hrs)

Unit-III

Physical Medicine And Assist Devices: Diathermy-Short wave, ultrasonic and Microwave, Range and area of irritation of each type, Nerve and muscle simulators, Pace makers external and implantable pacemakers, DC defibrillators, Defibrillator with synchronizer, Implantable defibrillators.

(12 Hrs)

Unit-IV

Radiotherapy: X-Raytherapy, Radio nuclide therapy, Units for radiation and radiation dose.

(04 Hrs)

Bio-Telemetry: Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Application of telemetry in patient care.

(08 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Biomedical Instrumentation	Cromwell Pratt	Prentice Hall
Handbook of Biomedical Instrumentation	R S Khandpur	TMH
Reference Books		
Medical Instrumentation, Applications &Design	John G Webster	John Wiley
Baker Principles of Applied Biomedical Instrumentation	Geddes	John Wiley

IE-7203 ADVANCED PROCESS CONTROL

L T P   **Credits:3**
3 0 0

Unit-I

Introduction: Review and limitations of single-loop control, need for multi-loop systems.

(04 Hrs)

Advanced Process Control Techniques: Concept of multiloop process controls, analysis and applications of cascade, ratio, Feed forward, override, split-range, selective and Auctioneering Control Systems with multiple loops, Dead time compensation, Adaptive control, inferential control.

(08 Hrs)

Unit-II

Design of control systems for multivariable process: Multivariable control system, interaction in multiple loops, RGA method for minimizing interactions e.g. distillation column, absorbers, Heat Exchangers, Furances and Reactors, P-I diagrams, standard instrumentation symbols for devices, signal types, representation and reading of instrumentation scheme using PI diagrams.

(12 Hrs)

Unit-III

Introduction to Computer Control systems in Process Control: DCS Configuration, control console equipment, communication between components, local control units, DCS flow sheet symbols, DCS I/O hardware and setpoint stations, Supervisory control and data acquisition system (SCADA).

(12 Hrs)

Unit-IV

Programmable Logic Control: Introduction, relative merits over DCS and relays, programming languages, Hardware and system sizing, PLC installation, Maintenance and trouble shooting.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Process Control Instrumentation Technology	Johnson Curtis D	PHI
Chemical Process Control – An introduction to Theory & Practice	George Stephanopoulos	PHI
Reference Books		
Process System Analysis and Control	Coughanowr R Donald	McGraw Hill
Handbook of Process Control	B G Liptak	Chilton Press

IE-7204   ELECTROMAGNETIC FIELD THEORY

L T P   **Credits:3**
3 0 0

Unit-I

Review of Vector Analysis: Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, stoke's theorem, green's theorem and Helmholtz theorem.

(06 Hrs)

Electrostatics: Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equi-potential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.

(06 Hrs)

Unit-II

The Steady Magnetic Field: Magnetic induction and Faraday's laws; magnetic Flux Density; magnetic field strength and magnetomotive force; Ampere's work Law in the differential vector form; permeability; energy stored in a magnetic field ; ampere's force law; magnetic vector potential, Analogies between electric and magnetic fields.

(12 Hrs)

Unit-III

Maxwell's equations and Poynting vector: Equation of continuity for time varying fields, Inconsistency of ampere's law, Maxwell's equations, conditions at a Boundary surface, Poynting Theorem, Interpretation of ExH.

(12 Hrs)

Unit-IV

Electromagnetic Waves: Solutions for free-space conditions; Uniform plane Wave Propagation; Wave equations for a conducting medium; Sinusoidal time variations; Polarization; Conductors and Dielectrics; Direction Cosines; Reflection by Perfect Conductor -normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator – Oblique incidence; Reflection at a surface of Conductive medium.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Electromagnetic	John D. Kraus	TMH
Engineering Electromagnetic	W. Hayt	TMH
Reference Books		
Schaum's theory and problems of Electromagnetics	Joseph A. Edminister	Schaum's Series
Foundation of Electromagnetic Theory	J. R. Reiz	Narosa

IT-5101   FUNDAMENTALS OF IT AND APPLICATIONS

L T P   **Credits-4**
3 1 0

Unit I
Fundamentals : Information Technology, Introduction to Computers, Number systems& Logic Gates.
Computer Architecture: Various units, Instruction Format, Instruction Set, Speed.
Computer Software: Categories, system s/w, Application s/w, Working of Input & Output Devices, Computer Program & Computer Languages, Data communication & Computer Networks, Classification of Data Networks, LAN, MAN, WAN, Communication Protocols.
(11 Hrs)

Unit II
Primary storage: Types of RAM, ROM, Cache Memory, Flash & Auxiliary memory.
Secondary storage: Classifications of secondary storage Devices, Magnetic disk, Magnetic tape Optical Disk, Magneto-optical Disk)
Operating systems: Evolution Types, Functions
Database Fundamentals: Logical & physical concept, Architecture, Data Models Database Languages
Introduction to Windows: Working with Windows operations, Microsoft office.
(12 Hrs)

Unit III
Internet: Internet Connectivity, Working with Internet Protocols, WWW, Internet and WWW, Internet Addressing (IP address, domain name, domain address), URL^s, Web pages, Web Browsers, Searching the Web – web Index, search engines, meta search engines, Electronic Mail–mailing basics, mailing list, news groups, bulletin boards.
(12 Hrs)

Unit IV
Applications of IT: Business through Computer, Computer for Education, Scientific use, Medicine &Health care, Engineering, Manufacturing & Computer for Home, Theater, Film & Television, Legal practice & Law Enforcement.
Social impacts of Information Technology: Introduction, Privacy, Security and Integrity of Information, Disaster Recovery, Intellectual property rights, career opportunities in the field of IT.
Security Issues: Firewalls and proxy application gateways public and private key encryption, digital signatures.
(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Fundamental of Computers	V. Raja Raman	PHI
Fundamentals of Computer	Yadav	BPB
Reference		
Programming and Information Technology		
Internet Complete Reference	Harley Hahy	McGrawHill
Fundamental of IT	AxexB Leoh	LeonTech World

IT-5102   DIGITAL ELECTRONICS AND LOGIC DESIGN

L T P   **Credits-4**
3 1 0

UNIT I
Number Systems And Codes: Number systems, binary number system, octal number system, hexadecimal number system, signed and unsigned numbers, different type of codes, binary operations- addition, subtraction, multiplication, division, 1s and 2s complement of a number. Introduction to gates and various logic families: An example of TTL for NAND/NOR gates, CMOS circuits for NAND/NOR gates, Introduction to IC technology (SSI, MIS, VLSI).

(10 Hrs)

UNIT II
Logic Circuits: Introduction to Boolean algebra and Boolean variables, AND, or, NAND, NOR gates and inverter, MIN-TERM and MAX-TERM realization, MAX_TERM representation, logical functions using Karnaugh map and Quine-macluskey methods, Plotting, Labeling and Reading the K-map, Don't care Map entries, Map reduction resulting in Product -of-sum expressions, minimization and combinational design, Multiplexers, de-multiplexers, encoders, decoders, adders, subtractors, parity generators, parity checkers, code converter.

(14 Hrs)

UNIT III
Sequential Circuits: Introduction to programmable logic arrays, PLDs, FPGA.
Registers and counters: Introduction, designing of series and parallel registers, Designing of synchronous and asynchronous counters, designing of up and down counters, ring counters.

(12 Hrs)

UNIT IV
Semiconductor Memories: Introduction, memory organization, classification and characteristics of memories, sequential memories, read only memories, read and write memories, content addressable memories, programmable logic arrays, charged coupled device memory.

(12 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
An engineering approach to Digital design	William I. Fletcher	Prentice-Hall
Digital design: principles and practice package	J. F. Wakerly	Pearson Edu
Reference		
Digital Design	M. Morris Mano	PHI
Digital Principles & Applications	Malvino & Leech	TMH

IT-5201   DATA STRUCTURES

L T P   **Credits-4**
3 1 0

UNIT I
Introduction: Basic concepts and notations; Data structures and Data Structure operations; Mathematical Notation and Functions; Algorithmic complexity and time-space trade off.
Recursion: Recursion; types of recursion; Examples of recursion – the exponential power of a number, Fibonacci numbers, the greatest common divisor, Towers of Hanoi.
Arrays: Introduction; One dimensional array – storage, Traversing, Insertion, Deletion, Searching; Multidimensional arrays – Two dimensional arrays, General multidimensional arrays, String Manipulation: Storage structure – Fixed length, Variable length, Linked list storage; String operations – Indexing, Concatenation, length etc.

(12 Hrs)

UNIT II
Linked List: Introduction; Basic concepts of linked list – Memory representation, Building a linked list, Traversing, Insertion, Deletion, Searching; Double linked list; Merging two lists; Header linked list; Circular linked list.
Stacks & Queues: Stack: Representation of stack, Implementation of stack; Polish Notation; Queues; Implementing queues; Circular queues; Double ended queue; Priority Queues.

(13 Hrs)

UNIT III
Binary Trees: Introduction; types of Binary trees; Complete Binary trees; Extended binary tree; Search tree, Representation of Binary trees in memory; Searching a Binary Tree; Operations of Binary Trees; Traversing, insertion and deletion of nodes in a binary Tree; Minimum weighted path length algorithm; Application of Binary trees: Polish notations and expression trees; Heap tree;; Balanced Binary tree, Multiway trees: B-trees; Threaded Binary Trees.

(12 Hrs)

UNIT IV
Graphs: Basic concepts & definitions; Representation of Graphs: Path Matrix, Adjacency list; Shortest Path Algorithms; Graph Traversal; Topological sorting, Spanning Trees
Sorting & Searching: Linear search; Binary search; Bubble sort; Insertion sort; Quick sort; Selection sort; Shell sort; Merge sort; Heap sort; Radix sort.

(11 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Data Structures using C and C++	A.M. Tanenbaum	PHI
Data Structures	Lipschutz	TMH
Reference		
Data Structures and algorithms in C++	Frozen	Thomson
Data Structures and algorithms in C++	Drozdek Adam	Thomson
Introduction to Data Structures with Applications	Trembley Sorenson	TMH

IT-5202 MICROPROCESSORS AND INTERFACING

L T P   **Credits-4**
3 1 0

UNIT I

Introduction: Architecture of 8085 Microprocessor, 8085 Instruction Set, Instruction classification, Addressing modes of 8085, Timing diagram, Fetch Cycle, Execution Cycle, Instruction cycle and Machine cycle.

(10 Hrs)

UNIT II

Programming the 8085: Programming examples like Looping, Counting, Data transfer, Logic operations, Sorting, Time Delay programs. Use of stack and subroutines, Code conversion, BCD to Binary, Binary to BCD, BCD arithmetic, ASCII to Hex and Hex to ASCII Conversion.

(11 Hrs)

UNIT III

Interfacing Peripherals and Applications: Interrupts, Software and Hardware, Enabling, Disabling and masking of interrupts. 8085 based Microcomputer system, Memory organization, Memory mapped I/O, I/O mapped I/O, I/O operations, Programmed I/O, Interrupt driven I/O, DMA. Support chips like 8255, Programming examples with 8255 I/O ports, Industrial examples.

(13 Hrs)

UNIT IV

Interfacing and Advanced Microprocessor: Analog to Digital Converters and Digital to Analog Converters, ADC 0801 and ADC 0808 interfacing with microprocessor. 8253 Timer, Use of timer and wave form generation, 8279 Programmable key board/ Display interface, Sample programs, Industrial application examples, Introduction to the architecture of 8086, 8088, Advancements made in 80186, 80286 and 80386, Introduction to Micro controller Evolution of 8031/8051 family micro controller.

(14 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Microprocessor Architecture Programming and Applications with the 8085/8080A	R. S. Goankar	Wiley Eastern Ltd
Microprocessor, interfacing, programming & Hardware.	D.V. Hall	PHI
Reference		
Introduction to Microprocessors	A.P. Mathur	Tata McGraw Hill.
Microprocessor systems 8086 & 8080 family	Liu & Gibsion	PHI.
Introduction to 8086 programming and interfacing.	UffenBeck	PHI
The 8051 Microcontroller and Embedded systems	Mazidi, & Mazidi	Pearson Edu.

IT-5203   INTERNET PROGRAMMING

L T P   **Credits-3**
3 0 0

UNIT I
Introduction: Brief history, How Java Works, JVM, JIT, Java features, using Java with other Tools, Native code, Java script, Active JDBC, Java Beans Java Applets Vs Java Applications, Building Application with Jdk, Building Applets with JDK, HTML for Java Applets, Working with Java Objects, Data types, Arrays, Classes, inheritance, encapsulation and Polymorphism, constructors and Finalizers, Garbage collection, Built-in Data types, Scope Rules, Using Arrays creating and copying array.

(11 Hrs)

UNIT II
Interfaces and Packages: Wrapper class, string class, Casting, using this and Super, using Java interface, using Java Packages Overview of exception handling, Method to use exception handling, Method available to exceptions (The throw statement, The throws clause, Finally clause), Creating your own exception classes, Input stream, Output stream.
Thread Basics – Creating and running a thread, the thread control methods, The threads life cycle, The thread groups
Advance multi-threading – Thread synchronization, inter thread communication, Priorities and scheduling, Thread local variable, Daemon thread.

(13 Hrs)

UNIT III
Animation and images: Java Basic Drawing tools, Drawing lines and rectangles, Drawing Polygons, ovals, Arcs, Rendering text, Animation Basics, Java images, Image processing – Color Models, Algorithmic image generation, Image filtering Event driven programming, Java event types, item events, Key events, Mouse events, Pop-up menu events, Text events, Window events.

(11 Hrs)

UNIT IV
Introduction to Swing, awt,util,lang API: Java Networking Protocols – TCP/IP, Internet Addressing, Communication in the remote system – UDP, TCP/IP, SMTP, HTTP, Client – server model. Implementing sockets , semaphores. Java Beans, creating the component. Creating a sample been & attaching it with the main program, RMI accessing remote methods, creating a sample application based on RMI. JDBC, accessing a database and implementing the queries in the program.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Mastering Java	John Zukowski	BPB
The Complete Reference	Patrick Naughton	TMH
Reference		
Java Programming	Balagurusamy	
Java 2 Programming Bible	Aaron Walsh & Daniel Steinberg	IDG Books

IT-6101   OPERATING SYSTEM CONCEPTS

L T P   **Credits-4**
3 1 0

UNIT I
Introduction: What is an Operating System, Simple Monitor, Performance, Multiprogramming, time-sharing, Real time systems, Protection.
Operating System Services: Types of services, The User view, The Operating system View.

(10 Hrs)

UNIT II
File Systems: File Concept and support, Access and allocation methods, directory systems, File protection.
CPU Scheduling: Scheduling concepts and algorithms, Algorithms evaluation and multiple processor scheduling.

(12 Hrs)

UNIT III
Memory Management: Preliminaries, Bare Machine, Resident Monitor, Swapping, Multiple partitions, Paging, Segmentation, Combined systems.
Virtual Memory: Overlays, Demand paging, Performance of demand paging, Page replacement, Virtual memory concepts, Page replacement algorithms, Allocation algorithms, and Thrashing.

(13 Hrs)

UNIT IV
Disk Scheduling: Physical characterization, FCFS scheduling, and Shortest-Seek-Time-First.
Deadlocks: The deadlock problem, Deadlock characterization, Deadlock prevention, Deadlock avoidance; Deadlock detection, Recovery from deadlock, and Combined approach to deadlock handling.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Operating System Concepts	Silber Schatz & Galvin	Jonh Wiley
An Introduction to Operating System	Deitel H.M.	Addison Wesley
Reference		
Operating System	Mandinck S.E.	McGraw Hill
Operating Systems	Dhamdhere	TMH

IT-6102   DATA COMMUNICATION SYSTEMS

L T P   **Credits-5**
3 2 0

UNIT I
Concepts & Terminology: Data communication : data representation, Analog versus digital signals; Direction of Data flow Analog and digital data transmission, data rate limits, Transmission impairments random & nonrandom, Transmission Media- Guided and unguided media, Line configuration, Topology, Categories of networks, Network Architecture – layered protocol TCP/IP and OSI model.

(12 Hrs)

UNIT II
Data Encoding and Modulation: Encoding of digital Data: Line coding schemes, Block coding, Encoding Analog data into digital signal: Pulse code modulation, sampling rate, Modulation of Digital data: ASK, FSK, PSK, QAM, Bit/baud comparison Modulation of Analog data: AM, FM and PM

(12 Hrs)

UNIT III
Transmission of digital data: Asynchronous and Synchronous transmission, DTE-DCE interface, Multiplexing Techniques – FDM: Multiplexing and de-multiplexing process, Applications of FDM, Analog hierarchy, TDM: Time slots and frames, Synchronizing and Bit padding, Statistical TDM, Digital signal service, T lines.

(11 Hrs)

UNIT IV
Data link Control: Factor Contributing Errors, , Error Control: Stop & wait ARQ, Go back N & Selective ARQ., Error Detection Methods – parity checking, checksum error detection & CRC, Forward Error Correction Method – block parity, Hamming code, Burst Error Correction Method, Flow control : Stop and wait flow control, Sliding window flow control, Data Link protocols – HDLC, CSMA/CD, token bus, token ring & FDDI.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Data Communications Networking	Behrouz A Forouzan	PHI
Data and Computer Communication	William Stalling	Pearson Education
Reference		
Data Communication	Prakash C-Gupta	PHI
Computer Networks	A. S. Tanenbaum	PHI

IT-6103   INTERACTIVE COMPUTER GRAPHICS

L T P   **Credits-5**
3 2 0

UNIT I
Overview of graphics systems: Display devices, physical input and output devices: storage tube graphic displays, Raster Refresh, Plasma Panel Displays, Liquid Crystals.
Output Primitives: Point plotting, Line Drawing algorithms – DDA algorithms, Bresenham's Line algorithm, Areafilling – Scan Line algorithm, flood-fill algorithm, Circle-Generating algorithms. .

(11 Hrs)

UNIT II
Two-dimensional Transformations: Basic transformations-translation, scaling, rotation, Matrix representation and homogenous coordinates, composite transformations-scaling relative to a fixed pivot, rotation about a pivot point, general transformation equations, other transformation-reflection, shear.
Windowing and Clipping Techniques: Windowing concepts, Clipping algorithms-Line clipping – Cohen-Sutherland algorithm, Area clipping, Text clipping, Blanking, Windows-to-View port transformation.

(13 Hrs)

UNIT III
Three Dimensional Graphics and Transformations: Coordinate systems and Display techniques, Representations-Polygon surfaces, Curved surfaces-Bezier and B-spline curves, Transformation – translation, scaling rotation, rotation about an arbitrary axis, other transformations-reflections, shear and 3-D viewing projections.

(11 Hrs)

UNIT IV
Hidden-Surface and Hidden-Line Removal: Back-face removal, Depth-buffer method, Scan-line method, Depth-Sorting method i.e. Painter's algorithm, Hidden-Line elimination.

Shading (Overview): Modeling Light intestines diffuse reflections; diffuse reflectors, Specular reflectors, refracted light & reture surface patterns.
Half toning, Surface Shading methods (overview): Constant Intensity method, Gouraud Shading, Phong – Shading.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Computer Graphics	Hearn. D & MP Baker	Prentice Hall
Principle of Interactive Computer Graphics	Newman W.M	McGraw Hill
Reference		
Computer Graphics - A Programming Approach	Harrington. S.	McGraw Hill
Fundamentals of Computer	Foley J.D et al.	Addison Wesley Graphics

IT-6104   COMPUTER ARCHITECTURE AND ORGANIZATION

L T P   **Credits-4**
3 1 0

UNIT I
Design Methodology: System design, Design levels- Gate level, Register level, Processor level.
Register Transfer and Micro-operations: Register transfer language, bus and memory transfers, arithmetic, logic and shift micro-operations. Case study of 8085 instruction set, Design of arithmetic logic shift unit.

(10 Hrs)

UNIT II
Basic Computer Organization & Design: Instruction codes, common bus system, timing and control, instruction cycle, memory reference instructions, I/O instructions, Design of basic computer, Design of accumulator logic.
Control Design: Basic concepts, Hardwired control, Micro programmed control: Control memory, address sequencing. Design of control unit: Microprogram sequencer.

(13 Hrs)

UNIT III
Central Processing Unit: Introduction, General register organization, stack organization, Instruction formats Addressing modes, Data transfer & manipulation, Program Control, RISC & CISC Characteristics.
Computer Arithmetic: Unsigned notation, signed notation, BCD, addition, subtraction, multiplication and division, Floating point numbers.

(13 Hrs)

UNIT IV
Memory Organization: Memory hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory, Input-Output Organization, I/O interface, Modes of transfer, Priority interrupts, DMA, I/O processor.

(12 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Computer System organization and J.D. Architecture	Carpinelli	Pearson Edu.
Computer System Architecture	Morris Mano	PHI
Reference		
Advanced Computer Architecture	Kai Hwang	TMH
Computer Architecture & Organization	J.P Hayes	TMH
Computer Organization and Architecture	William Stallings	PHI

IT-6201   RELATIONAL DATABASE MANAGEMENT SYSTEM

L T P   **Credits-5**
3 2 0

UNIT-I
Introduction to Database Concepts: Difference between database and non database System, data independence, 3 level architecture, components of a database system, example of database transaction, processing, advantages and disadvantages of Database system.
Data Modeling: Data associations and Data relationships, ER Model; Design, issues, Mapping constraints, keys, ER diagram, weak entity sets, extended ER features, Design of an ER Database schema, Reduction of an ER Schema to tables.

(11 Hrs)

UNIT-II
Database Design: Integrity Constraints: Domain constraints, Referential integrity, entity integrity, functional dependencies, pitfully in Relational database design, Decomposition, Normalization using FD's MVD's and JD's Domain key normal form, Denormalization, Approaches to database design.

(12 Hrs)

UNIT-III
Relation Algebra, SQL, Relational Calculus & Query Optimization: Relational Algebra, Relational Calculus, Query by Example, SQL, Introduction, overview of optimization process, expression transformation, Database statistics, A divide and conquer strategy, Implementing the relational operators.

(12 Hrs)

UNIT-IV
Transaction processing: Transaction Concept, Transaction state, Implementation of Atomicity, and durability, concurrent execution, serializability, Recoverability, implementation of isolation, transaction definition in SQL.
Advanced Topics in DBMS: Object Oriented Databases, Deductive Databases, Internet and DBMS, Multimedia Databases, Digital libraries, Mobile Databases.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Database system concepts	Korth & Silberchatz,	McGraw Hill
Introduction to Database system	Date, C.J.	Addison Wesley
Reference		
Fourth Generation Languages	Martin, James	Prentice Hall
Introduction to Database Management Systems	Atul Kahate	Pearson Education

IT-6202   COMPUTER NETWORKS AND SECURITY

L T P   **Credits-5**
3 2 0

UNIT-I
Basics of Computer Networks: Need & Evolution of Computer Networks, Description of LAN, MAN, WAN and Wireless Networks, OSI and TCP/IP Models with Description of Data Encapsulation & Peer to Peer Communication, Comparison of OSI and TCP/IP. Basic Terminology of Computer Networks - bandwidth, physical and logical topologies, media – 10base 2, 10base 5, 10base T, 100baseTX, 100base FX, 1000baseLX and wireless, LAN & WAN Devices – Router, Bridge, Ethernet Switch, HUB, Modem CSU/DSU, Representation of one Bit on Physical Media i.e. in wired network, optical network and wireless N/W

(11 Hrs)

UNIT-II
Data Link Layer: LLC and MAC Sub Layer, MAC Addressing Layer 2 Devices, Framing, Error Control and Flow Control, Error Detection & Correction - CRC code block parity & checksum, Elementary Data Link Protocol, Sliding Window Protocol, Channel Allocation Problem – static and dynamic, Multiple Access Protocol – ALOHA, CSMA/CD, token bus, token ring, FDDI.

(12 Hrs)

UNIT-III
Network Layer: Segmentation and Autonomous system, Path Determination, Network Layer Addressing, Network Layer Data Gram, IP Address Classes, Subneting – sub network, subnet mask, Routing Algorithm – optimality principle, shortest path routing, hierarchical routing, broadcast routing, multicast routing, routing for mobile host, Concatenated Visual Circuits, Tunneling, Fragmentation, Firewall, Internet Control Protocol – ICMP, ARP, RARP, Internet Multicasting, Mobile IP, IPv6, Routing Protocol – RIP, IGRP, USPF and EGRP, Network layer in ATM Networks.

(13 Hrs)

UNIT-IV
User Support Layers: Design Issues, Layer 4 Protocol - TCP & UDP, Three-way Handshake Open Connection, ATM AAL Layer Protocol, Application layer Protocol - TELNET, FTP, HTTP, SNMP. Introduction to security issues – cryptography, message security, digital signature, firewalls, VPN, and security protocols : IPSEC

(12 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Computer Networks	Tanenbaum	PHI
Data communication and networking	B. A. Forouzan	Tata Mcgraw-Hill.
Reference		
Computer Networks and Their Protocols	Darix	DLA Labs
Computer Communication & Networks	Freer	East-West-Press

IT-6203   MULTIMEDIA TECHNOLOGY

L T P   **Credits-5**
3 2 0

UNIT-I
Introduction: Motivation Overview, Evolution of Multimedia, Structure and components of Multimedia. Application Domains, Internet and Multimedia, Multimedia and Interactivity, multimedia devices CD- Audio, CD-ROM, CD-I, LANs and multimedia; internet, Primary User-Interface Hardware: Mouse. Keyboard, Joystick. Primary Visual Interface Items: Window, Buttons, Textbox, Icons. Hypertext, Hypermedia, Multimedia

(10 Hrs)

UNIT-II
Image & Graphics: Principles of raster graphics, Computer Visual Display concepts, Resolution, Computer color models, Digital image Representation and formats, overview of other image file formats as GIF, TIFF, BMP, PNG etc
Data Compression & Standards: Text compression, image compression, various methods of compressions, Run Length coding, Huffman Coding, LZW Encoding, JPEG-objectives and architecture; JPEG-DCT encoding and quantization, JPEG statistical coding, JPEG predictive lossless coding; JPEG performance.

(13 Hrs)

UNIT-III
Audio & Video: Digital representation of sound; method of encoding the analog signals; transmission of digital sound; Principles Broadcast standards , IDTV and HDTV principles, MPEG Audio; audio compression & decompression; brief survey of speech recognition and generation; musical instrument digital interface(MIDI); MPEG motion video compression standard;
Animation: Animation principles, Survey of animation tools, Various animation effects.

(12 Hrs)

UNIT-IV
Synchronization: Temporal Dependence in Multimedia presentation, Inter-object and Intra-object Synchronization, Time Abstraction for authoring and visualization, Reference Model and Specification.
Application Development: Product development overview, Life cycle Models, Human Roles and Teamwork, Product Planning, Basic Authoring Paradigms: Story Scripts, Authoring Metaphors and authoring languages, Content Analysis: Message, platform, Metaphor and Navigation, cost-quality tradeoffs, Intellectual Property Right and Copyright issues.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Multimedia Systems Design	P.K. Andleigh and K. Thakrar	Prentice Hall PTR
Multimedia Computing, Communications and Applications,	Ralf Steinmetz	Prentice Hall
Reference		
Multimedia Systems	John .F. Koegel	Buford
An introduction to Multimedia	Villamil & Molina	Mc Milan
Multimedia: Sound & Video	Lozano	PHI
Multimedia on the PC	Sinclair	BPB

Multimedia: Making it work	Tay Vaughan	TMH.
Multimedia in Practice	Jeff Coate Judith	PHI.
Multimedia Systems	Koegel	AWL
Multimedia Communications	Halsall & Fred	AWL.

IT-7101   SOFTWARE PROJECT MANAGEMENT

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction to Software Project Management (SPM): Definition of a Software Project (SP), SP Vs. other types of projects activities covered by SPM, categorizing SPs, project as a system, management control, requirement specification, information and control in organization.
Stepwise Project Planning: Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analyzing project characteristics, identifying project products and activities, estimate efforts each activity, identifying activity risk, allocate resources, review/ publicize plan.

(10 Hrs)

UNIT-II
Project Evaluation & Estimation: Cost benefit analysis, cash flow forecasting, cost benefit evaluation techniques, risk evaluation. Selection of an appropriate project report; Choosing technologies, choice of process model, structured methods, rapid application development, water fall-, V-process-, spiral- models, Prototyping, delivery, Albrecht function point analysis.
Activity Planning & Risk Management: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, network planning model, representation of lagged activities, adding the time dimension, backward and forward pass, identifying critical path, activity throat, shortening project, precedence networks.

(13 Hrs)

UNIT-III
Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to the schedule, calculating the z values.
Resource allocation &Monitoring the control: Introduction, the nature of resources, identifying resource requirements, scheduling resources creating critical paths, counting the cost, being specific, publishing the resource schedule, cost schedules, the scheduling sequence.
Monitoring the control: Introduction, creating the frame work, collecting the data, visualizing progress, cost monitoring, earned value, prioritizing monitoring, getting the project back to target, change control.

(13 Hrs)

UNIT-IV
Managing contracts and people: Introduction, types of contract, stages in contract, placement, typical terms of a contract, contract management, acceptance, Managing people and organizing terms: Introduction, understanding behavior, organizational behavior: a back ground, selecting the right person for the job, instruction in the best methods, motivation, working in groups, becoming a team, decision making, leadership, organizational structures, conclusion, further exercises..
Software quality: Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, ISO 9126, Practical software quality measures, product versus process quality management, external standards, techniques to help enhance software quality.

(12 Hrs)

Study of Any Software Project Management software viz Project 2000 or equivalent

Recommended books:

Title	Author(s)	Publisher
Text		
Software Project Management	Bob Hughes and Mike Cotterell	TMH
Software Project Management	Pankaj Jalote	Pearson Edu.
Reference		
Software Project Management	Walker Royce	Addison Wesley.

IT-7102   WEB APPLICATION ENGINEERING

L T P   **Credits-4**
3 1 0

UNIT-I
The Internet: Basics of Internet, Addresses and names for the Internet, Web Objects, and Sites, E-mail, World Wide Web, File Transfer, Telnet and Use net, Gophar, Wais, Archie and Veronica, Internet Chat.
Web Servers Browsers, and Security: Web and Proxy Servers The fast ready connections on the Web, Web browsers Netscape Communication Suite, Microsoft Internet explorer, the Virus menace in the Internet , Firewalls, Data Security.

(10 Hrs)

UNIT-II
Creating a Website and the Markup languages: The Art of creating a Website, Hypertext and HTML , HTML document features, Document Structuring Tags in HTML, Special Tags in HTML, Dynamic HTML, XML and Microsoft front page.

(13 Hrs)

UNIT-III
Searching and Web – Casting Technologies: Introduction, Search Engine, Search Tools, Getting found or hidden data, Channels and Channels Push Technology .
Network and Security programming: Network Programming, URL classes, Socket classes, Programming for security.

(12 Hrs)

UNIT-IV
The Dynamic Functionality in Web Pages: CGI, CGI Script Communication CGI script languages, A Scripting, Language , Java Script, Dynamic Page Functionality Using servlets and JSPs, ASP_S, COMs , DCOMSs.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Internet and Web Technology	S. Raj Kamal	TMH
Web Technology	A.S. Godbole & Kahate	TMH
Reference		
The Complete Reference	Patrick Naughton	TMH
Java Programming	Balagurusamy	BPB.
Java 2 Swing, Servlets, JDBC and		
Java Beans Programming	Steven Holzner	Black Book, IDG Books

IT-7103   ENTERPRISE RESOURCE PLANNING

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction to ERP: Evolution of ERP, What is ERP, Reasons for the growth of the ERP market, Advantages of ERP, Reasons of Failure.
Enterprise- An overview: Integrated Management information, Business Modeling, Integrated Data Model.

(11 Hrs)

UNIT-II
ERP and Related Technologies: BRP (Business Process Reengineering), MIS (Management Information System), DSS (Decision Support System), EIS (Executive Information system), OLAP, Supply Chain Management.

(12 Hrs)

UNIT-III
A Manufacturing Perspective: ERP, CAD/CAM, MRP (Material Requirement Planning), Bill of Material, Closed loop MRP, MRP-II, DRP (Distributed Requirement Planning), Product Data Management, Data Management.

(12 Hrs)

UNIT-IV
Benefits of PDM: ERP Modules, Finance, Plant Maintenance, Quality Management, Material Management.
ERP Market: Benefits of ERP, SAP, BAAN, Oracle Corporation, People Soft, ERP Implementation Life Cycle
Vendors, Consultants & Users: In-house Implementation – pros & cons, Vendors, Consultants, End-users.
Future Directions in ERP and ERP Case Studies

(13 Hrs)

Recommended books

Title	Author(s)	Publisher
Text		
Enterprise Resource Planning	Alexis Leon	TMH.

IT-7201   INTELLIGENT INFORMATION SYSTEMS

L T P   **Credits-4**
3 1 0

UNIT-I

Information Systems for decision making: Introduction –Transaction Processing System –Management Information Systems- Intelligent Support System-Office Automation Systems.
Management Information System: An Overview, Introduction – Management Information System-Definition of MIS –Framework of MIS organization and management triangle-Information needs and its economics –System Approach –Meaning and objectives of MIS – Disadvantages of Information Systems –Approaches of MIS Development –Constraints in Developing an MIS-MIS and use of computer –Limitations of MIS.

(10 Hrs)

UNIT-II

Computer Hardware for Information System: Introduction – basics of data Representation –Types of computers – Basic Components of computer System –Factors to buy a Personal Computer.
Computer Software for Information System: Introduction– Programming Languages– Classification of software –Role of software in problem solving– Criteria for Investment in Hardware and Software.

(11 Hrs)

UNIT-III

Decision Support System: Introduction-Definitions- Evolution of DSS- Objectives of DSS-Classification of DSS – Characteristics of DSS – Components of FSS- Functions of DSS – Development of DSS- Group Decision Support System – Executive Information System – Relationship between MIS and DSS – DSS measures of success in organizations – Applications of a DSS-TPS, MIS, DSS and EIS. Future developments in DSS.
Artificial Intelligence: Introduction –Definition –History of AI-Expert System –Components of Expert System –Advantages and Disadvantages of Expert System –Business Applications of Expert System – Criteria for adopting Expert System-Neural Networks – Applications of Neural Networks.

(14 Hrs)

UNIT-IV

Office Information System: Introduction – Office Automation – Offices and Office systems-Types of Office Automation Systems – Integrated Office.
Information System in Business: Introduction- Functional Areas of Business-Manufacturing Information Systems – Marketing Information Systems-Quality Information Systems-Financial and accounting Information systems – Research and Development Information Systems – Human Resource Information System – Geographical Information Systems – Cross Functional Systems.
Strategic Management Information System: Introduction – Characteristics of SMIS-Strategic Planning for MIS – Development of SMIS- MIS Strategy Implementation – Barriers to development of SMIS.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
Artificial Intelligence	Elaine Rich and Kevin Knight 2nd Ed.	TMH IVth Ed.
Artificial Intelligence	Patrick Winston	
Reference		
Artificial Intelligence	Luger	
MIS	A.K. Gupta	S. Chand

IT-7202   CYBER LAWS AND IPR

L T P   **Credits-4**
3 1 0

UNIT-I
Basics of Computer & Internet Technology: Internet, ISP & domain name; Network Security; Encryption Techniques and Algorithms; Digital Signatures.
Introduction to Cyber World: Introduction to Cyberspace and Cyber Law; Different Components of cyber Laws; Cyber Law and Netizens.

(11 Hrs)

UNIT-II
E-Commerce: Introduction to E-Commerce; Different E-Commerce Models; E-Commerce Trends and Prospects; E-Commerce and Taxation; Legal Aspects of E-Commerce.

(11 Hrs)

UNIT-III
Intellectual Property Rights (IPR): IPR Regime in the Digital Society; Copyright and Patents; International Treaties and Conventions; Business Software Patents; Domain Name Disputes and Resolution.

(13 Hrs)

UNIT-IV
IT Act, 2000: Aims and Objectives; Overview of the Act; Jurisdiction; Role of Certifying Authority; Regulators under IT Act; Cyber Crimes-Offences and Contraventions; Grey Areas of IT Act.
Project Work: Candidates will be required to work on a project. At the end of the course students will make a presentation and submit the project report.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
A Guide to Cyber Laws & IT Act 2000 with Rules & Notification	Nandan Kamath.	
Cyber Cops, Cyber Criminals & Internet	Keith Merill & Deepti Chopra	
References		
Information Technology Law	Diane Row Land	
Handbook of Cyber Laws	Vakul Sharma	Mc Millian

ME-5101 MECHANICS OF SOLIDS

L T P   **Credits:4**
3 1 0

UNIT-I
Review of Stress and Strain: Simple stresses and strain, Composite system and temperature stresses. Plane stress and strain, Principal stress, Principal strain, Compound stresses, Mohr's circle representation.

(12 Hrs)

UNIT-II
Bending of Beams: Plane Bending, Theory of bending, Composite or flitched beams, distribution of horizontal shear stress in a beam
Curved Beams: Castigliano's theorem, Deflection of beam using Castigliano's theorem, Introduction, Winkler-Bach Theory, Stresses in crane hook, Ring, chain link, Deflection of curved beams by Castigliano's Theorem.

(12 Hrs)

UNIT-III
Unsymmetrical Bending: Unsymmetrical Bending and shear centre, Principal axes, unsymmetrical bending, shear centre of simple unsymmetrical sections.
Thick Pressure Vessels: Thick cylinders: Lami's theory, Compound cylinder, Comparison with thin cylinder theory, Thick spherical shell.

(12 Hrs)

UNIT-IV
Centrifugal Stresses: Introduction, Rotating rings, Rotating discs, Discs of uniform strength, Rotating cylinder.
Theories of Elastic Failure: Maximum principal stress theory, Maximum principal strain theory, Maximum strain energy theory, Maximum shear stress theory, Maximum distortion energy theory, Graphical representation and comparison of different theories of failure.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Mechanics of Solids	Popov	PHI
Strength of Materials	D. S. Bedi	S. Chand
Advanced Strength of Materials	Ryder G.H	MacMillan
Strength of Materials	Sadhu Singh	Khanna
Strength of Materials	R. S. Lehri	Kataria

ME-5102   APPLIED THERMODYNAMICS

L T P   **Credits:4**
3 1 0

UNIT-I
I.C. Engines: Introduction to I.C. Engines and their classification, Engine components, Nomenclature, Comparison of S.I. & C.I. engine, Working principles of 2-stroke and 4-stroke engine, Comparison of 2-stroke and 4-stroke engine, Gas power cycle, Introduction of different cycles, Carnot cycle, Otto, Diesel cycle, Dual cycle. Analysis of Otto cycle, Diesel cycle & Dual cycles.
Combustion in S.I. Engine: Introduction, Combustion in S.I. engine, Flame front propagation, Factor influencing flame speed, pre-ignition, abnormal combustion, Phenomena of knock in S.I. engine, Effect of engine variables on knocking.
Combustion in C.I. Engine: Stages of Combustion in C.I. engine, Factors affecting delay period, Phenomena of knocking in C.I. engine, Comparison of knocking in S.I. & C.I. engine.

(12 Hrs)

UNIT-II
Steam Nozzles: Introduction to nozzles & types, Equation of continuity, Steady flow energy equation, Momentum equation, Nozzle efficiency, Calculation of nozzle area in adiabatic and frictionless flow, Mass flow rate through nozzle.
Steam Engines: Parts of steam engine and their function, Working of steam engine, Indicator diagram (Theoretical & actual), Diagram factor, IHP, BHP, Mechanical efficiency, Compounding of steam engines.

(12 Hrs)

UNIT-III
Steam Turbines: Rankine's cycle, Principle of operation of steam turbine, Types of steam turbines, Simple impulse turbine, Compounding of impulse turbine, impulse reaction turbine, Reaction turbine, Velocity diagram of impulse turbine, effect of blade friction on velocity diagram, Blade or diagram efficiency, gross stage efficiency.
Gas Turbines: Simple open cycle gas turbine, Actual Brayton's cycle, Rate & work ratio, Open cycle gas turbine with regeneration, Open gas turbine cycle with reheat, Open gas turbine with inter cooler, Comparison between closed cycle gas turbine & open cycle gas turbine, advantages & disadvantages of gas turbine over steam turbine, application of gas turbine.

(12 Hrs)

UNIT-IV
Jet Propulsion: Introduction to turbojet engine, Thrust power propulsive efficiency, Thermal efficiency relations, Advantages & disadvantages of jet propulsion over other system, Operation of rocket engine using solid, Liquid propellant.
Compressors: Types of compressors, Reciprocating, centrifugal, screw comp. etc., Work done in single & multi cylinder compressor, Inter-cooling, Principle of minimum work for multi compressor, Efficiency.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
I.C. Engine	Mathur & Sharma	Dhanpat Rai & Sons
Thermodynamics	P.K.Nag	TMH
Thermodynamics (Vol. I-III)	R.Yadav	CPH
Heat Engineering	V.P.Vasandhani	Khanna Pubilsher
Thermal Engineering	P.L.Ballaney	Khanna Pubilsher
Engineering Thermodynamics	O.P.Single	TMH

ME-5103   METAL CASTING

L T P   **Credits:3**
3 0 0

UNIT-I
Mould & Mould Materials: Preparation of mould cavity, Moulding and core sands-mould materials, Refractory sands, Moulding sands, Types-Natural sands, Synthetic sands, Loam sands, Moulding sand binders, Additives, Properties of moulding sands, Mould making machines.
Moulding and Casting Processes: Investment, full mould process, pressure die-casting, centrifugal casting, shell mould, vacuum moulding.

(10 Hrs)

UNIT-II
Solidification of Castings: Solidification of pure metals, Nucleation-Homogenous nucleation & Hetrogeneous nucleation, Solidification of alloys, Mechanism of dendrite formation and dendrite growth, Solidification rate, solidification time and Chrovinov's rule, Progressive and directional solidification.

(10 Hrs)

UNIT-III
Principles of Castings: Gating Systems- requirements and functions, Design of gating system, defects occurring due to improper design of gating system, Design criteria for pouring basin, design of sprue, pouring time, filling time and aspiration of gases and their prevention, Pressurized and unpressurized gating systems.

(10 Hrs)

UNIT-IV
Principles of Risering: Functions of risers, Riser and directional solidification, Riser design-Riser shape, riser size, riser placement.
Casting Defects: Casting Defects and their remedies, Stresses in castings and stress relieving, Metal mould reactions.

(10 Hrs)

Recommended Books

Title	Author(s)	Publisher
Manufacturing Science	Malik & Ghosh	EWP
Foundry Engineering	Taylor	John Wiley & Sons
Principles of Metal Casting	Rosenthaul	Mc Graw Hill
Foundry Technology	O.P. Khanna	S. Chand
Foundry Technology	Beeley	Butterworth Scientific

ME-5201   FLUID MECHANICS AND MACHINERY

L T P   **Credits:4**
3 1 0

UNIT-I
Properties and Flow of Fluid: Fluid properties & pressure measurements, Types of flow, Rate of discharge, Conservation of mass, Momentum and energy of fluid, Potential energy, Pressure and kinetic energy, Bernoulli's theorem.
Kinematics and Dynamics of Fluid: Description of fluid flow, classification of fluid flows, Stream lines, Path lines, Streak lines. Acceleration of fluid particle, Motion of fluid particle along a curved path, Differential equation of continuity, Continuity equation in polar co-ordinates, Rotational flow, rotation and vorticity, Stream function Circulation and flow net, Fluid dynamics, Control volume and Control surface, energy and its form, Euler's equation along a streamline, Euler's equation in Cartesian co-ordinates, Application of Bernoulli's theorem, Momentum of fluids in motion, Kinetic energy correlation factor and momentum.

(12 Hrs)

UNIT-II
Dimensional Analysis and Model Similitude: Systems of dimensions, Dimensional homogeneity and its applications. Dimensional analysis in Rayleigh's method, Buckingham's π-theorem, model studies, Similitude, Dimensionless numbers and their significance, distorted model.
Boundary Layer Theory: Description of boundary layer, Boundary layer parameters, Prandtl's boundary layer equations, Blasius solution for laminar boundary layer flows, von-Karman momentum integral equation, Laminar boundary layer, Turbulent boundary layer flows, Boundary layer separation.

(12 Hrs)

UNIT-III
Hydraulic Turbines: Impact of jet, Impulse momentum theorem, Elements of hydroelectric power plant, heads and efficiencies of hydraulic turbines; Classification of turbines, Pelton wheel-work done and efficiency of Pelton wheel, Design of Pelton turbine runner, Radial flow impulse turbine, Reaction turbine: - Francis turbine: - work done and efficiency of Francis turbine, Design of Francis turbine runner, Kaplan turbine:-work done & efficiency of Kaplan turbine, Cavitation and its effect.

(12 Hrs)

UNIT-IV
Hydraulic Machines: Working principles, Description and application of hydraulic accumulator, intensifiers, hydraulic jigger, hydraulic jack, Hydraulic ram.
Pumps: Classification of pumps, Analysis of reciprocating and centrifugal pump.

(14 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Fluid Mechanics	White	McGraw-Hill
Fundamentals of Fluid Mechanics	Munson	John Wiley & Sons
Fluid Mechanics	Cenegal	McGraw-Hill
Fluid Mechanics & Fluid Machines	Modi & Seth	Standard Publishers
Fluid Mechanics & Fluid Machinery	D. S. Kumar	Kataria & Sons

| Fluid Mechanics | A.K Jain | Khanna Publishers |
| Fluid Mechanics & Fluid Machinery | Om & Biswas | Tata McGraw-Hill |

ME-5202   METALLURGY & HEAT TREATMENT

L T P   **Credits:3**
3 0 0

UNIT-I
Transformations of Metals: Introduction, Phase changes in steel, Phase changes in cast iron, ferrite, pearlite, cementite and austenite
Solidification of Metals: Introducing the C- curves, Concept of solidification, nucleation and growth.

(12 Hrs)

UNIT-II
Non-equilibrium Transformations: Concept of under cooling, Ingot structure and coring, Pearlite, Bainite and martensite reactions, Mechanism of precipitation hardening, its process and application.

(12 Hrs)

UNIT-III
Heat Treatment of Steels: Austenitic grain growth grain size and effect on heat treatment, Annealing, normalizing, hardening, tempering, spherodising, austenitizing, stress relieving, TTT and CCT diagrams
Case Hardening: Introduction to case hardening, Advantages of case hardening & its methods, carburizing, nitriding, cyaniding, carbonitriding, and induction hardening.

(12 Hrs)

UNIT-IV
Alloy Steels: Industrial importance of alloys, types of cast iron and steels, the properties and applications of various types of cast iron and steels, coding of steel and other alloys, SG iron.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Engg. Phy. Metallurgy &Heat Treatment	Yuri Lakhtin	Mir Publishers
Physical Metallurgy	Donalk S Clark	East West Press
Material Science and Engineering	Raghvan	PHI
Material Science and Engineering	Srifastba	Wiley Eastern

ME-6101   METROLOGY & MECHANICAL MEASUREMENTS

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Measurement, definition, aim, method of measurement, measurements in design, factor in selection of measuring instruments, measurements systems, time element in measurement, error in measuring instruments, temperature problem, static & dynamic characteristics of measuring instruments, calibration, error, classification, system error analysis, theoretical relationships.
Standard of Measurements: Introduction, legal status, present measurement system & its advantage over previous system, standard of length, mass, time, temp. etc.
(12 Hrs)

UNIT-II
Displacement & Dimensional Measurement: Problems of dimensional measurement, gage block, surface plate, temp problem etc., use of different type of comparators, optical method, optical flats, application of monochromatic light & optical flats, use of optical flats & monochromatic light for dimensional comparison, interferometer.
Surface Testing & Measurement: Surface roughness, definition, various methods to measure surface roughness, different instruments for measuring surface roughness, roughness standard.
(12 Hrs)

UNIT-III
Speed Measurement: Introduction, use of counters, stroboscope, direct application of frequency standard by comparative methods, calibration of frequency sources, tachometers, different types- mechanical, electrical, frequency tachometer.
Stress Strain Measurements & Strain Gauges: Introduction, mechanical strain gauges, optical strain gauges, electrical strain gauges, stress measurement by variable resistance strain gauge, sensing element materials, forms of strain gauge sensing elements, strain gauge adhesive, protective coating, strain gauge mounting techniques.
(12 Hrs)

UNIT-IV
Measurement of Force & Torque: Introduction, measuring methods, elastic transducers, strain gauge, load cell, piezo type load cell, hydraulic & pneumatic system, torque measurement, dynamometer, classification, type & characteristics.
Screw Thread Measurements: Errors in threads, screw thread gauges, measurement of elements of the external & internal threads using caliper gauges, various other methods to measure screw thread parameters
Spur Gear Measurement: Geometry of spur gear, measurement of spur gear parameters, run out, pitch, profile, lead, backlash, tooth thickness, composite elements, various other methods to measure spur gear parameters.
(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Instrumentation, Measurement & Analysis	Nakra & Chaudhary	TMH
Measurement Systems: Application & Design	E. O. Doebelin	TMH
Mechanical Measurement	Thomos G. Beckwith	
Mechanical Measurement	Buck and Marangoi	Addison Wesley

| Instrumentation for Engg measurement | Dally,William and Connel | John Wiley |
| Transducers: Theory and application | Alloca and Stuart | Reston Publishing |

ME-6102   WELDING PROCESSES-I

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction to Welding Processes: Definition, Terms used in welding, Advantages, Classification of welding processes and their principles in brief with applications.
Gas Welding: Introduction & principle of gas welding, Different gases used & their properties, Types of flames, Welding technique and safety Applications of the process.

(12 Hrs)

UNIT-II
Basics of Arc Welding: Electric arc, arc starting methods, Arc stability, arc efficiency etc, arc blow, power sources, comparison, VI characteristics of power source, Rating, duty cycle
SMAW: Principle, welding parameters and their effect, Equipments used, Electrodes classification, coding of electrodes AWS and BIS codes, types of electrode coatings, Applications of the process.

(12 Hrs)

UNIT-III
Submerged Arc Welding: Submerged arc welding- Principle, equipments used, welding parameters, SAW fluxes, classification, flux- wire combination, Multi wire, strip cladding and narrow gap welding Applications of the process.
GMAW: Gas metal arc welding- Principle, Equipments used and variables, Shielding gases and their effect on bead geometry, Mode of metal transfer and pulse MIG, Flux core arc welding and CO_2 Welding, Applications of the process.

(12 Hrs)

UNIT-IV
GTAW: Gas tungsten arc welding- Principle, Equipments used and welding parameters, Shielding gases and their effect, Advantages, Disadvantages and Applications of the process.
Plasma Arc Welding: Plasma arc welding- Principle, Comparison with TIG, Transfer and non- transfer mode, Micro plasma, Advantages, Disadvantages and Applications of the process.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Welding Processes & Technology	RS Parmar	Khanna publishers
Modern Arc Welding Technology	SV Nadkarni	Oxford & IBH
Modern Welding Technology	Hobart B Cary	Prentice Hall
Welding Skills	Dave Smith	
Welding technology	R. little	Tata McGraw-Hill
Welding Handbook Vol. 3	Kearns, W.H.	AWS, Miami

ME-6103   THEORY OF MACHINES-I

L T P   **Credits:5**
3 2 0

UNIT-I
Review of Mechanism & Machine: Introduction, kinematics links, pair, chain and their classification, types of constraints motion, degree of freedom, simple mechanism & their inversion.

(12 Hrs)
UNIT-II
Kinematic Analysis: Absolute and relative motion, kinematics and dynamics and their relationship, instantaneous centre in mechanism, Velocity and acceleration polygons, Corrolies component of acceleration, force acting in mechanism, Klein's construction, Ritterhau construction & Bennet construction for velocity & acceleration analysis of single slider crank mechanism.

(12 Hrs)
UNIT-III
Friction: Introduction, law of friction, pivot and roller friction flat pivot and conical pivot, flat collar pivot, single and multiple clutches, cone clutch.
Belt, Rope & Belt Drive: Introduction, flat and V-belt drive, velocity ratio, Creep, slip in belt drive, velocity law, compression in belt, tension in belt, and angle of contact, power transmission. Belt, chain and rope drive.

(12 Hrs)
UNIT-IV
Flywheel & Governors: Introduction, an approximate analysis, Flywheel in punching, inertia force analysis of reciprocating engine, fluctuation of energy, speed, energy in flywheel, Type of governors, function of governors, sensitivity analysis, stability of governors, isochronous governors, hunting, power and efforts of governors, controlling force diagrams.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Theory of Machines	S.S. Rattan	TMH
Mechanism & M/c Theory	Rao & Dukkipati	New Age Int
Theory of Machines & Mechanism	Shigley	McGraw hill
Theory of Machines & Mechanism	Beven	TMH
Theory of Machines	P. L. Ballaney	Standard Publishers

ME-6104   DESIGN OF MECHANICAL ELEMENTS

L T P   **Credits:5**
3 2 0

UNIT-I

Shafts: Stresses in shaft, design of shafts subjected to bending moment or torsion moment and combined bending and torsion moments, shafts subjected to fluctuating load conditions, shafts subjected to axial load in addition to combined bending and torsion moments, Design of shaft on the basis of rigidity.

(12 Hrs)

UNIT-II

Power Screws: Power to screw drive, efficiency of screw like square, trapezoidal threads, stresses in screw and design procedure of screw Jack. Condition for self locking
Clutches: Design procedure for positive, friction and centrifugal clutch.

(12 Hrs)

UNIT-III

Brakes: Introduction, heat generation equation, design of shoe, band-brake and combination of shoe and band brake, design of calliper type and disc brake
Bearings: Classification of bearing, selection of rolling bearing for given application.

(12 Hrs)

UNIT-IV

Springs: Design of leaf spring.
Gears: Design of spur and helical gears.
I.C. Engine parts: Principal parts of an I.C. engine, Design of a Cylinder, Design considerations for piston, piston rings, piston barrel, piston skirt, Design of connecting rods and crankshafts.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
A Text book of Machine Design	Sharma & Aggarwal	Katson
Mechanical Engineering Design	Shigley	Mcgraw-Hill Company
Machine Design-An Integrated Approach	Norton	Pearson Education.
Design data handbook	P. S. G	P. S. G., Coimbatore
Design data handbook	Mahadev & Reddy	CBS

ME-6201   HEAT TRANSFER

L T P   **Credits:5**
3 2 0

UNIT-I
Introduction: Different modes of heat transfer: conduction, convection, radiation.
Conduction: Fourier's law of heat conduction, thermal Conductivity, effect of temperature and pressure on thermal conductivity of solid, liquid, Three dimensional general conduction equations in rectangular cylindrical and spherical coordinates, Electrical analogy for solving 1-D steady state conduction problem for slab, cylinder, sphere and influence of variable thermal Conductivity.

(12 Hrs)

UNIT-II
Application of conduction: Straight and circular fins of rectangular cross-section, optimum design of rectangular fin, efficiency of fin, fin effectiveness for rectangular and circular cross section fins, Application of fins in temperature measurement of flow In tubes, Critical radius of insulation for pipes and electrical cables, Introduction to unsteady state heat transfer.

(12 Hrs)

UNIT-III
Convection: Free and forced convection, derivation, mass, momentum and energy equations, Concept of boundary layer, boundary layer thickness, Heat transfer coefficient, Heat transfer in laminar and turbulent flow over plates, tubes using empirical relations, Dimensional analysis for forced and free convection.
Boiling and Condensation: Introduction, boiling phenomena, pool boiling regimes, condensation drop-wise and film-wise.

(12 Hrs)

UNIT-IV
Heat Exchangers: Overall coefficient of heat transfer, different design criterion of heat exchangers (LMTD & NTU methods), calculation of number, diameter & length of tubes, mean temperature difference for parallel & counter flow heat exchangers.
Radiation: Laws of radiation, definition of- emissivity, absorptivty, reflectivity and transmissivity, Concept of black and grey bodies Planck's law monochromatic radiation, Kirchoff's law and the geometric factor, Lambert's cosine law, definition of intensity of radiation, radiation exchange between simple bodies, two parallel surfaces, concentric cylinders, furnace walls, using definition of radiosity and irradiation, radiation shields, simple problems.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Heat and Mass Transfer	R. K. Rajput	S. Chand
Heat Transfer	J.P. Holman	TMH
Heat and Mass Transfer	R.C. Sachdeva	New Age International
Heat and Mass Transfer	R. Yadav	Central Publishing House
Heat Transfer	P.K.Nag	TMH
Heat Transfer	Domkundwar	Dhanpat Rai

ME-6202   THEORY OF MACHINES-II

L T P   **Credits:5**
3 2 0

UNIT-I
Gears: Introduction, Classification, terminology, Law of Gearing Spur Gear, velocity of sliding in mating teeth, Involute and Cycloidal teeth & their comparison, Length of path of contact, Contact Ratio, Interference, number of teeth on wheel, pinion & rack to avoid interference, Introduction to helical and worm gears.
Gear Trains: Introduction of simple, compound, reverted, epicyclic gear train & compound epicyclic gear train, Tooth load & torque in gear trains.

(13 Hrs)

UNIT-II
Cams: Introduction, Classification of followers and cams, Terminology, Analysis of motion of follower for SHM, uniform velocity, uniform acceleration and retardation, Cycloidal motion.
Cam Profile: Construction of CAM profile for SHM, uniform velocity, uniform acceleration and retardation, Cycloidal motion, (with drawing practice).

(12 Hrs)

UNIT-III
Gyroscope: Introduction. Principle of gyroscope, Gyroscopic couple, Direction of vector with forced precession, Analysis of precession due to forced precession of rotating disc mounted on shaft, Motion of rigid body with reference to Euler's equations, Effect of gyroscopic couple, Stability of two wheeler, four wheeler, sea vessels and aircraft with numerical problems.
Balancing of Rotating Masses: Introduction, Balancing of rotating masses, Determination of balancing masses rotating in same plane and different planes.

(12 Hrs)

UNIT-IV
Balancing of Reciprocating Masses: Partial balancing of unbalanced forces in Single cylinder reciprocating engines, Variation of tractive forces, swaying couple and hammer blow, Balancing of multi-cylinder (uncoupled) engines.
Mechanical Vibrations: Introduction, Type of vibratory motion, Type of free vibration, Natural frequency of free, longitudinal and transverse vibration, Concept of SHM, Modeling of practical system, Free vibration of Single degree spring mass system, Damped free vibration with viscous damping, Response of damped spring mass system due to Harmonic force (concept only) Introduction to vibration isolation and transmissibility.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Theory of Machines	S.S. Rattan	TMH
Mechanism & M/c Theory	Rao & Dukkipati	New Age Int
Theory of Machines & Mechanism	Shigley	McGraw hill
Theory of Machines & Mechanism	Beven	TMH
Theory of Machines	Sadhu Singh	Standard Publishers

ME-6203   CAD/CAM-I

L T P   **Credits:5**
3 2 0

UNIT-I
Fundamentals of CAD/CAM: Introduction to CAD and CAM, Definition of CAD and CAM tools, Applications of CAD/CAM, Design process and application of computers in design, Creating Manufacturing database, Benefits of CAD/CAM.
CAD Hardware: Input devices: Keyboard, Touch panel, Light pens, Graphic tablets, Joysticks, Trackball, Mouse, Voice systems, Output devices: Storage, Tube graphics display, Raster refresh graphics display, Plasma panel displays, Liquid crystal displays. Central Processing Unit (CPU).
CAD Software and Database Management: Graphic Standards: GKS, IGES, PHIGS, Data Structure and Database Management of a Graphics System, Coordinate Systems: WCS, MCS, SCS, Software modules: Operating System, Graphics, Application, Programming and Communication.

(12 Hrs)

UNIT-II
Curves and Surfaces: Explicit and Implicit equations, parametric equations, analytical curves, Bezier and B-spline curves, NURBS. Representation of surfaces: plane, cylindrical, spherical, ruled, coons patch, swept, revolved, Bezier, B-spline. Ferguson and Bilinear patch.
Solids: Introduction, Solid models, Solid entities and representation, Solid representation, r-sets, half spaces, B-rep. CSG, Sweep representation, spatial enumeration. CAD/CAM data exchange.

(12 Hrs)

UNIT-III
Fundamentals of Numerical Control: Principles of NC, Types of NC machines, Classification of NC: Motion control, control loops, power drives, positioning systems, NC, CNC, DNC, Combined CNC/DNC systems. Components of NC machines: prime movers, transducers, lead screw, control loops and interpolation.

(12 Hrs)

UNIT-IV
Numerical Control Programming: Block format and codes, tool length and radius compensation, manual and interactive part programming, tool path simulation of lathe and milling, post processor and auxiliary statements.
Adaptive Control Systems: Types, advantages, adaptive control for proper cutting speed, feed in turning operation.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
CAD/CAM – Theory and Practice	Zeid, Ibraham	Tata Mc Graw Hill
Geometric Modeling	Mortenson	John Wiley& Sons
Automation, Production Systems and CIM	Groover & Zimmer	PHI
Computer aided manufacturing	Chang, Wysk and Wang	PHI
Computer Aided Design and Manufacturing	Besant and Lui	EWP
Numerical Control and Computer Aided Manufacture	Kundra, Rao, Tiwari	Tata Mc Graw Hill

ME-7101 QUALITY ASSURANCE & RELIABILITY

L T P   **Credits:3**
3 0 0

Unit – I
Introduction to Reliability: Definition of reliability, quality vs. reliability, need for reliable machines/equipment.
Maintainability and Availability: Availability, maintainability, system downtime, RAM engineering and its importance.
Failure Data Analysis: Failure data, Mean Failure Rate, Mean Time to Failure, Mean Time between Failures, Mean Time to Failure, reliability in terms of hazard rate and failure density.

(12 Hrs)

Unit – II
Failure Data Analysis: Failure data, Mean Failure Rate, Mean Time to Failure, Mean Time between Failures, Mean Time to Failure, reliability in terms of hazard rate and failure density.
System Reliability: Introduction, series configuration, parallel configuration, mixed configurations, application to specific hazard models, an r-out-of-n structure, methods of solving complex systems, Markov models, systems projected to probability laws.

(12 Hrs)

Unit - III
Reliability Improvement: Improvement of components, redundancy, element redundancy, unit redundancy, standby redundancy, and optimization.
Fault Tree Analysis: Introduction, symbols used, Fault-Tree construction, reliability calculations from Fault-Tree.

(12 Hrs)

Unit - IV
Repairable Systems: Introduction, instantaneous repair, rate, Mean Time to Repair, reliability and Availability functions.
Reliability Allocation: Introduction, reliability allocation for a series system, and problems.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Reliability Engineering	L.S. Srinath	EWP
Reliability Analysis and Prediction	Mishra K. B.	Elsevier Science
Engineering Reliability- New Techniques and Applications	Dhillon B.S.	John Wiley & Sons

ME-7102   OPTIMIZATION TECHNIQUES

L T P   **Credits:4**
3 1 0

Unit-I

Introduction: Meaning of OR, Analytical approaches to optimization, historical development, application of OR, main feature of OR, scope of OR.

Linear Programming: Introduction, formulation of LP problem, graphical representation and solution to LP problems, simplex method, two phase method, degeneracy problem, duality in linear programming

(12 Hrs)

Unit-II

Transportation Model: Definition, mathematical formulation, optimal solution of transportation problem, optimality test, balanced and unbalanced problem, minimization and maximization problem, different methods of finding solution

(12 Hrs)

Unit-III

Assignment Model: Introduction, mathematical formulation, Hungarian method for assignment problem, minimization and maximization problem, unbalanced, sequencing and traveling salesman problems

PERT & CPM: Introduction, evolution and application of PERT & CPM technique, Drawing of network diagram, float and slack times, time estimates, critical path, crashing and updating problem

(12 Hrs)

Unit-IV

Queuing Theory: Characteristics of queues, Kendall's notations, queuing system, analysis of M/M model, Case studies.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Engineering Optimization	S. S. Rao	New Age International
Operations Research	A. H. Taha	Prentice Hall of India
Operations Research	P. K. Gupta & D. S. Hira	S. Chand & Co.
Operations Research	A. D. Belegundu	Prentice Hall of India
Operations Research	C. K. Mustafi	New Age International

ME-7103   CUTTING TOOL DESIGN

L T P   **Credits:3**
3 0 0

Unit-I

Classification of cutting tools: Various machining operations and the tools required to carry out these operations: principle elements of various cutting tools; single point cutting tool geometry in ASA, ORS & NRS systems.

Tool Materials: Properties of cutting tool materials, development of cutting tool materials, composition, production process and application of different cutting tool materials viz. High carbon steel, HSS, carbides, ceramics, CBN, UCON, diamond, etc.

(12 Hrs)

Unit-II

Design of Single point cutting tools: Cutting parameters of a lathe, different turning operations and cutting tools used for these operations. Classification of single point cutting tools: solid, carbide tipped tools, geometrical parameters of a single point cutting tool, design procedure of single point cutting tool, re-sharpening of single point cutting tools.

Form Tools: Purpose and types, design procedure and their sharpening.

(12 Hrs)

Unit-III

Drill design: Drilling operations, Cutting parameters of drilling operations, different drilling operations and cutting tools used for these operations. Types of drills, solid, carbide tipped drills, geometrical parameters of a twist drill, design procedure of a twist drill, re-sharpening of the twist drill.

Milling Cutter Design: Milling operations, milling cutting parameters, different milling operations and cutting tools for these operations, Types of milling cutters, solid, and carbide tipped cutter; geometrical parameters of a milling cutter, design procedure of a disc type milling cutter, re-sharpening of the cutters.

(12 Hrs)

Unit-IV

Broach design: Broaching operation and its advantages, broaching cutting parameters, types of broaches, solid, and carbide tipped broaches; design procedure of a broach, re-sharpening of the broach.

Hob design: Gear nomenclature, construction of involutes profile, hobbing operation and its advantages, geometrical parameters of a hob, design procedure of a hob.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Tool Design	Donaldson	McGraw Hill
Cutting tools	Prakash Joshi	Wheeler Publishing
Metal Cutting theory & practice	Arschinov & Alearoev	MIR publication

ME-7104 INDUSTRIAL AUTOMATION & MECHATRONICS

L T P   **Credits:3**
3 0 0

UNIT-I
Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics, Electrical, Control, computer and Instrumentation
Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Boolean Algebra, Logic Gates, Karnaugh maps and simple circuits

(12 Hrs)

UNIT-II
Sensors: Strain Gauge, Potentiometer, Optical encoders: incremental and absolute encoders, Linear variable differential transformer(LVDT), Piezoelectric, Proximity sensor, Resistance Temperature Detector(RTD), Thermistors, Thermocouple, Hall effect sensor
Actuators: Permanent Magnet DC motor, Stepper motor

(12 Hrs)

UNIT-III
Pneumatics and Hydraulics: Hydraulics and Pneumatic power supplies, Direction control valves, Pressure control valves: Pressure limiting, pressure relief and pressure sequence valves, Speed control valves, Check valves, Time delay valves, shuttle valve, Actuators: Single acting and double acting cylinders, Cushion assembly, Rotary actuators, vane motors, Jeroter, Pilot operation, Cylinder sequencing and process control.

(12 Hrs)

UNIT-IV
Programmable Logic Controller (PLC): Function of PLC, Architecture, Components of PLC, selection of PLC, Ladder Logic diagram, Logic functions: latching, sequencing, counters, shift registers, jumpers, manipulation of data, arithmetic operations
Application of Personal Computer in Control and Automation: Data acquisition: ADC, DAC, Digital input, digital output, control of DC motor, stepper motor.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Mechatronics	W. Bolten	Pearson Education
Pneumatic Systems	Majumdar	TMH
Hydraulics and Pneumatics	Andrew Parr	TMH
Mechatronics	Mahalik	TMH
Automation, Production Systems and Computer Integrated Manufacturing	Groover	PHI

ME-7105   WORK STUDY AND ERGONOMICS

L T P   **Credits:3**
3 0 0

UNIT-I
Productivity: Introduction, Types of productivity, Measurement of productivity, Productivity Index, Importance of productivity, Means of productivity improvement, Effect of productivity on society.

(12 Hrs)

UNIT-II
Method study: Introduction to method study history in general, Definitions, objectives, Formulation of problem, analysis of problem including use of various aids operation Process chart, flow process Chart , multiple activity chart & other different charts, Principle of motion economy, Therbligs Left hand & right Hand charts, Travel chart, Simo Chart, Micro motion study, Memo Motion Study, Cyclograph.

(12 Hrs)

UNIT-III
Work Measurement: Introduction to various work measurement techniques, Stop watch Time study, definition, equipment, stop watch time study procedure, standard data, PMTS, Types & uses, Rating- Approach to rating Problem, Various rating methods.

(12 Hrs)

UNIT-IV
Work Sampling: Application of work sampling, Work sampling procedure, Design of work sampling plan
Ergonomics : Scope & content, occupational ergonomics, RSI, MSD. Analysis of loads, Design of display & controls, Motion Economy, Environment

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
A Manual of Method Study	NPC	NPC
Work Study Manual	ILO	ILO
Work Study & Ergonomics.	Dalela & Sharma	Standard
Industrial Engineering	M. Mahajan	Dhanpat Rai
Indl. Engg. & Organization Management	S. K. Sharma	Kataria
Motion and Time study	Barnes	John Wiley

ME-7107   WELDING PROCESSES-II

L T P   **Credits:3**
3 0 0

UNIT-I

Electro Slag and Electro Gas Welding: Principle of operation, equipment-power source, wire feeder and oscillator, guide tube consumable and non consumable, retaining shoes, welding head with control, travel carriage, process variation, advantages, disadvantages and applications, comparison between EGW and ESW.

Electron Beam Welding: Principle of operation, equipment details, EBW in different degree of vacuum- high, medium and non vacuum, process characteristics (key hole penetration), process variables (acceleration voltage, beam power, spot size, travel speed, powder density), advantages, disadvantages and applications.

Laser Beam Welding: Principle of operation, different laser medium (CO_2, Ruby and Nd-YAG), advantages, limitation and applications.

(12 Hrs)

UNIT-II

Resistance Welding: Basic principle, brief introduction to spot, seam, projection and flash butt welding, welding variables, resistance welding equipments, heat balance, applications, process capabilities.

Solid State Welding Processes: Friction and friction stir welding, explosive welding, diffusion bonding, ultrasonic welding-Basic principle, process variables, weld characteristics and applications.

Thermit Welding: Principle of operation, thermit mixtures, area of application.

(12 Hrs)

UNIT-III

Brazing and Soldering: Difference between brazing and soldering, braze welding, Wetting and spreading characteristics, surface tension and contact angle concept, introduction to different brazing and soldering methods (torch, furnace, dip, induction and resistance), brazing and soldering filler materials, fluxes, application of brazing and soldering.

Thermal Cutting: Principle of oxy-acetylene cutting, different conventional (metallic, carbon, air-carbon, and oxygen arc) and plasma arc cutting, flux and powder cutting techniques, areas of application of different cutting processes, introduction to gouging.

(12 Hrs)

UNIT-IV

Surfacing and Thermal Spraying: Introduction to surfacing, type of surfacing (cladding, hard facing, built-up and buttering), different welding methods used for surfacing, different surfacing materials used and their characteristics, introduction to spraying, different spraying methods and applications.

Under Water Welding: Introduction to dry and wet under water welding

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Welding Processes and Technology	R.S Parmar	Khanna Publishers
Modern Arc Welding Technology	S.V. Nadkarni	Oxford & IBH
Modern Arc Welding Technology	Hobart B. Carry	Printice Hall
Welding	A.C Davies	Cambridge Univ. Press
AWS hand book Vol.-3	Kearns, W. H.	AWS, Miami

ME-7108   INSPECTION & TESTING OF WELDMENTS

L T P   **Credits:3**
3 0 0

UNIT-I
Weld and weld Related Discontinuities: Definition of discontinuity, imperfection and defects, classification of various welding defects, causes and remedies
Quality Assurance: Concept of quality assurance in welding, weld quality-meaning, organization, requirement, procedure and program for quality assurance

(12 Hrs)

UNIT-II
Welding Inspection: Meaning of welding inspection, responsibilities in welding inspection, role and certification of welding inspectors
Welding Procedure Specification (WPS): Description and important details of WPS, Essential, Non-essential and supplementary variables, Various steps in procedure qualification, PQR (Procedure qualification record)
Qualification of Welders and Welding Operators: Welding performance qualification-requirement, qualification and re-qualification of welders, Qualification record, Essential and non-essential variables in performance qualification

(12 Hrs)

UNIT-III
Destructive Testing of Welds: Classification and description of destructive testing techniques like Tensile test, Bend test, Impact test, Hardness test, Fatigue test; Testing of welding consumables-All weld test, Determination of diffusible hydrogen, Deposition efficiency, Coating moisture determination
Non Destructive Testing: Visual inspection, Dye-penetrant inspection, Magnetic particle inspection, Ultrasonic testing, Radiographic testing, Eddy current testing

(12 Hrs)

UNIT-IV
Statistical Quality Control Techniques applied to Weld Testing: Basic concept about application of control charts and acceptance sampling for testing and inspection of welds

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Welding Engineering & Technology	R. S. Parmar	Khanna Publications
Modern Arc Welding Technology	S. V. Nadkarni	Oxford & IBH.
AWS Welding Handbook, Volume-1	Leonard. P. Connor	AWS
Statistical Quality Control	Juran	McGraw Hill.
Quality Control	Mahajan	Dhanpat Rai & Sons
Method of Testing Fusion Welded Joints and Weld Metals in Steel	IS-3600 (Part-I & II)	BIS, New Delhi
ASME Boiler and Pressure Vessel Code Section IX.		ASME

ME-7201   METAL CUTTING AND FORMING

L T P   **Credits:4**
3 1 0

UNIT-I

Tool Geometry of Single Point Cutting Tool: Kinematics, Elements involved in metal cutting action, Classifications of cutting tools, Single point tools, multi point tools, principle angle on a single point cutting tool, tool signature, ASA system, ORS system, NRS system, Interrelation ship between ASA, ORS & NRS System. Concept of oblique cutting & difference between Orthogonal cutting & oblique cutting

Chip Formation Mechanism: Mechanics of chip formation, types of chips, adverse effect of BUE formation, Chip reduction coefficient, cutting ratio, shear plane, shear strain, chip velocity & velocity of shear, Factors involved in chip formation analysis, effect of cutting variables on chip reduction coefficient, Chip formation in Milling & drilling

(12 Hrs)

UNIT-II

Force System in Machining: Force system during turning, Merchant circle diagram for cutting force, Frictional force system at chip tool interface, Force system at interface, Effect of obliquity, nose radius & wear land on force system, Forces in drilling & milling, Fundamentals of dynamometry, lathe dynamometer, drilling & milling dynamometer.

Thermal Aspect in Machining: Heat generation in metal cutting, tool wear & temperature, coolants & their applications

Tool Wear: Types of tool wear, Machinability, Tool life analysis & tool life equation

(12 Hrs)

UNIT-III

Metal Forming: Plastic Deformation & Yield Criterion: Plasticity, True stress, True strain, Elastic & plastic strain, Yield stress, Plastic incompressibility, Poisson's ratio for plastic deformation, Von Misses yield criterion, Tresca yield criterion, generalized strain hardening curve.

Rolling: Analysis of the processes, Roll separating force, Torque on the rolls, Effect of front & back Tension, Effect of support rolls

(12 Hrs)

UNIT-IV

Wire & Strip Drawing: Analysis of the processes

Plain Strain Forging : Analysis of the processes, Deep drawing of circular blanks-analysis of process, Extrusion- analysis of process

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Manufacturing Science	Mallick & Ghosh	EWP
Production Engineering Science	Pandey & Singh	Standard Publishers
Metal cutting Theory	A.Bhattacharya	Central Book Publishers
Manufacturing Processes	Lindberg	PHI
Fundamentals of Machine Tools & Cutting Tools	Juneja & Sekhon	New Age
Mechanical Metallurgy	Dieter	Mc Graw Hill
Metal Forming	G. R. Nagpal	Khanna
Metal Cutting	M.C.Shaw	CBS

ME-7202   NON CONVENTIONAL MACHINING

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Classification, Advantages & limitations of non conventional machining, Ultrasonic machining (USM)-Principle of operation, process details, applications and advantages, limitations of USM.

(12 Hrs)

UNIT-II
Abrasive and Water Jet Machining: Basic principle, mechanism of material removal, working principle of Abrasive jet machining (AJM), water jet machining (WJM), merits & demerits, application.

(12 Hrs)

UNIT-III
Chemical Machining (CM): Working principle, process characteristics, procedures, advantages & disadvantages of chemical machining.
Electrochemical Processes: Fundamentals, details of machining setup, materials and selection of tools, applications, Concept of others processes like ECG, Electrochemical deburring etc.

(12 Hrs)

UNIT-IV
Thermal Metal Removal Processes: Working principles, Mechanism of material removal, process parameters, advantages & limitations, applications of processes like electric discharge machining(EDM), Electron Beam Machining (EBM), Ion beam machining (IBM), Plasma arc machining (PAM), Laser beam machining(LBM).

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Production Technology	HMT	TMH
Non Convectional Machining	M. Adhithan	John Wiley
Non Conventional Machining	P.K.Mishra	Narosa
Modern machining process	Pandey & Shaw	TMT

ME-7203   CAD / CAM - II

L T P   **Credits:3**
3 0 0

UNIT-I
Geometric Transformations: Formulation, translation, rotation, scaling, reflection, mapping of geometric models, projections, Concepts of hidden surface removal and shading.
Assembly Modeling: Assembly modeling, assembly tree and planning, mating conditions, bottom-up and top-down approach, assembly analysis.

(12 Hrs)

UNIT-II
Product Life Cycle Management: Product information, PLM framework, benefits, implementation, emerging technologies, example of business problems. Product Data Management (PDM): Motivation, Evolution, Scope, benefits, implementation, Software capabilities and functions.
Computer Aided Quality Control (CAQC): Role of computers in QC, Contact and Non-contact inspection methods, Computer aided testing, CMM, 3D scanners, Integration with CAD/CAM.

(12 Hrs)

UNIT-III
Material Requirement Planning: Material requirement planning (MRP)- concepts, inputs, output, Benefits, Manufacturing Resource Planning (MRP-II), Entrepreneur Resource Planning (ERP).
Computer Integrated Manufacturing System: Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, human labor in manufacturing systems, CIMS benefits. Robots: anatomy, configuration and control. Conveyor system, automated guided vehicle (AGV), automated storage and retrieval systems (AS/RS), flexible manufacturing systems (FMS).

(12 Hrs)

UNIT-IV
Group Technology and CAPP: Introduction, Part families, Coding and classification, production flow analysis, benefits of group technology, Computer aided process planning (CAPP)-variant and generative approach.
Recent Trends in CAD/CAM: Concurrent Engineering: concept, emerging technologies, Collaborative design. Deign for 'X', Design for Manufacturing, Reverse Engineering. Agile Manufacturing, Lean Manufacturing, Rapid Prototyping (RP).

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Mastering CAD/CAM	Zeid, Ibraham	Tata Mc Graw Hill
CAD/CAM	McMohan & Browne	Pearson Education
Geometric Modeling	Mortenson	John Wiley& Sons
Automation, production systems and CIM	Groover & Zimmer	PHI
Computer aided manufacturing	Chang, Wysk and Wang	PHI
Computer Aided Design and Manufacturing	Besant and Lui	EWP
Numerical Control and Computer Aided Manufacturing	Kundra, Rao, Tiwari	Tata Mc Graw Hill

ME-7204   MACHINE TOOL DESIGN

L T P   **Credits:3**
3 0 0

UNIT-I

Introduction: General requirements to machine tool, Machine tool design recommendations, Classifications of motions to shape surface; Machine tool drives for rectilinear motion, Periodic motion, reversing motion etc.

Kinematics of Machine Tools: Kinematics of gearing diagram of lathe, drilling machine, milling machine and broaching machine, Main drive and feed drive, principles, specification of machine tool.

(12 Hrs)

UNIT-II

Design of Kinematics Scheme: Methods to determine transmission ratios for drives, development of kinematics scheme; minimum of transmission, transmission groups, determination of number of teeth on gears.

Speed an Feed Boxes: General requirement; Design of gear trains, speed boxes, types, speed changing devices, feed boxes, characteristics of feed mechanism, types, rapid transverse mechanism, variable devices.

(12 Hrs)

UNIT-III

Spindle Design and Spindle Bearings: Main requirements; Materials and details of spindle design, spindle bearings, types of bearings and their selections, bearing materials.

Bed, Columns, Tables and Ways: Materials and construction of bed, columns, tables and ways, Design criterion.

(12 Hrs)

UNIT-IV

Machine Tool Control Systems: Requirements of control system, selection and construction of control systems, Mechanical control system, and prediction control, remote control, safety devices.

Machine Tool Dynamics: Dynamic performance, dynamic and elastic system of machine tools, dynamics of cutting forces, tool chatter.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Machine Tool Design	A. Bhattacharya	Central Book Agency
Machine Tool Design	N.K. Mehta	Tata-McGraw Hill
Design of Machine Tools	S.K. Basu and D. K. Pal	Oxford and IBH

ME-7205   WELDING METALLURGY

L T P   **Credits:3**
3 0 0

UNIT-I
Introduction: Introduction to Iron-Carbon equilibrium diagram, different phases, eutectic, eutectoid and peritectic reactions, lever rule, CCT and TTT diagrams.
Structure and Properties of Weldment: Temperature distribution, weld thermal cycles, cooling rate and cooling rate equations, solidification of weldmetal and solidification rate, microstructure of weld metal and HAZ, properties of weld metal and HAZ, gas metal and slag metal reactions.

(12 Hrs)

UNIT-II
Weldability: Concept, factors effecting weldability, weldability tests, Hot cracking tests (Murex test, Varestraint and Houldcroft Fishbone test), Cold cracking test (CTS test, Tekken, Lehigh restraint, Implant test).

(12 Hrs)

UNIT-III
Weldment Cracking: Introduction hot and cold cracking, factors affecting hot and cold cracking and remedies of hot and cold cracking.
Weldability of commonly used Engineering Materials: Welding of plain carbon steels, Effect of carbon and alloying elements on weldability, carbon equivalent, preheating and methods to determine preheating temperature, Difficulties in welding of stainless steel, cast iron, aluminium and copper, Selection of welding process and procedure appropriate for the same, Welding of dissimilar metals, Welding of plastic.

(12 Hrs)

UNIT-IV
Post Weld Heat-Treatments: Need for post weld heat-treatment, stress relief, annealing, normalizing and tempering of welds, purpose and procedure for above said heat-treatment processes.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Welding Engineering & Technology	R. S. Parmar	Khanna
Metallurgy of Welding	J. F. Lancaster	Allen & Unvin
The Metallurgy of Welding	D. Seferian	Chapman and Hall

ME-7206   DESIGN OF WELDMENTS

L T P   **Credits:3**
3 0 0

UNIT-I
Fracture in Metals: Ductile fracture, brittle fracture, Intergranular fracture, Conditions affecting fracture toughness.
Fatigue: Definition and meaning of fatigue of metals, Mechanism of fatigue, S-N diagram.
Fracture Mechanics: Assessment of fracture toughness, Griffith's theory of fracture mechanics, Brittle fracture test parameters, Procedure for evaluating propensity for brittle fracture, Fracture mechanics testing of ductile metals, Fatigue cracking assessment by fracture mechanics.

(12 Hrs)

UNIT-II
Mechanical Properties at Low Temperature: Strength at low temperature, Impact toughness at low temperature, Energy absorption in Impact testing, Test methods for toughness evaluation.
Analysis of Stresses: Fundamental principle of stress analysis of welded components loaded under tension, compression, bending and torsion, combined stresses, failure criteria.
Design of Welded Joints: Types of welds and welded joints, Different types of edge preparation and factors affecting its selection.

(12 Hrs)

UNIT-III
Sizing of Welds: Primary and secondary welds, Parallel and transverse welds, permissible stress, sizing of butt and fillet welds.
Welding Symbols: Primary and secondary weld symbols, location of welding symbols on drawings.
Residual Stresses in Weldments: Definition, causes and control of residual stresses in Weldments.

(12 Hrs)

UNIT-IV
Distortion in Weldments: Definition, types of distortion in weldments, causes and control of distortion.
Welding Jigs and Fixtures: Jigs and fixture for welding, their need and types used in welding

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Welding Metallurgy (Volume-1)	George E.Linnert	AWS
Welding Metallurgy	Sindo Kou,	John Wiley & Sons
Design of Welded Structures	Blodgett, Lincoln	Electric Co.
Welding Engineering & Technology	R.S. Parmar	Khanna Publications
Modern Arc Welding Technology	S.V. Nadkarni	Oxford & IBH
Standard Methods for Mechanical Testing of Welds	ANSI/AWS B4.0-92	AWS
Guidelines for Fracture-Safe and Fatigue-Reliable Design of Welded Structures	Pellini, W.S ISBN:0-85300-166-9	The Welding Institute, UK
AWS Welding Handbook Volume-1	Leonard. P. Connor	AWS.

MS-6101/6201   MATERIALS SCIENCE AND ENGINEERING

L T P   **Credits:3**
3 0 0

UNIT - I

Introduction: A brief Introduction to material science, classification of engineering materials (metals, alloys, ceramics, composites and polymers), Properties and characteristics of materials, Material structure.   (04 Hrs)

Crystal Structure: Space lattices, Unit cell, primitive cell, Bravais lattice, Atomic packing factor, Miller Indices, directions and planes in crystal lattice (cubic and hexagonal only), distribution of atoms in lattice planes (in cubic crystal only), Important structures (NaCl, CsCl, Diamond and ZnS), structure determination; X-ray diffraction, Neutron and electron diffraction.

(06 Hrs)

UNIT - II

Imperfections in Crystals: Point imperfections, Frenkel, and Schottky defects and their equilibrium concentration determination, Color centres, types of color centres, generation of color centres, Edge and screw dislocation, Burger vector, Surface defects.

(04 Hrs)

Equilibrium diagrams and phase transformations: Phase rule, Hume-Rothery rules for solid solutions, cooling curves for solidification of pure metals and alloys, unary system, binary system, Invariant reactions in binary system, iron-carbon equilibrium diagram, Nucleation and growth of crystal. (Homogeneous case only), application of phase diagrams.

(06 Hrs)

UNIT - III

Band Theory of solids: Concept of energy bands, Bloch theorem, Electron in a periodic field of crystal (The Kronig – Penny Model) and its applications in metals, Construction of Brillouin Zones, reciprocal lattice, effective mass of an electron, Free electron model, overlapping of energy bands, Hall effect.   (06 Hrs)

Dielectric materials: Introduction of dielectric materials, Polarization, Different types of polarization, Electronic, ionic, orientational and space charge polarization, polarizability, Clausius-Mossotti relation, temperature and frequency dependence of polarizability, dielectric breakdown, measurement of dielectric properties, Dielectric constant, Dielectric loss, ferroelectric and piezoelectric materials, examples of materials and their applications.

(06 Hrs)

UNIT - IV

Magnetic Materials: Terminology and classification of engineering materials, Type of magnetism (dia, para, ferro, ferri and anti ferromagnetisms), Theories of para dia and ferromagnetic materials, magnetic anisotropy and magnetrostriction, magnetic domains, hard and soft magnetic materials, ferrites and their applications, magnetic recording materials, magnetic memories, Ferrite core memories.   (06 Hrs)

Nano-materials: Fundamentals of nanomaterials and nanotechnology, nano particles, properties of nanomaterials, applications of nanomaterials

(04 Hrs)

Recommended Books:

Author	Title
Raghvan	Materials Science
Srinivasan & Srivastava	Science of Engineering Materials
Callister JR	Materials Science and Engg.: An Introduction
Askeland & Phule	The Science and Engineering of Material

AM-P6201   ADVANCED MATHEMATICS

L T P   **Credits:3**
3 0 0

UNIT-I
Review of analytic function and its properties, Line integral, Cauchy's theorem (proof using Green's Theorem) Cauchy's integral formula. Morera's theorem, Cauchy's inequality, Poisson's integral formulae. Power series. Taylor's and Laurent's series,
(10 Hrs)

UNIT-II
Singularities. Zeros. Residues. Cauchy's residue theorem. Integration around unit circle. Integration over semi-circular contours (with and without real poles). Integration over rectangular contours. Engineering applications: analysing AC circuits and using Harmonic functions.
(12 Hrs)

UNIT-III
Integral transforms. Fourier integral theorem. Fourier sine and cosine integrals. Fourier sine and cosine integrals. Fourier transforms. Properties of Fourier transforms. Convolution theorem for Fourier transforms. Applications of Fourier transforms to heat conduction, vibrations of a string, transmission lines etc.

12 Hrs)

UNIT-IV
Z transforms and its properties. Z transform of polynomial functions, trigonometric functions and hyperbolic functions. Convolution theorem. Inverse Z-transform. Formation of difference equations and solution of first and second order difference equations with constant coefficients using Z-transform.

(12 Hrs

RECOMMENDED BOOKS

Text Book
R.K. Jain & S.R.K. Iyengar, Advanced Engg. Mathematics, Narosa
Glyn James, Advanced Modern Engg. Mathematics,Pearson

Reference Books
H.S. Kasana, Complex Variables (Theory & Applications), PHI
R.V. Churchill& I.W. Brown, Complex Variables and applications, McGraw
Michael D Greenberg, Advanced Engg. Mathematics, Pearson

AM-P6202   STATISTICAL AND OPTIMIZATION TECHNIQUES

L T P   **Credits:3**
3 0 0

UNIT-I

Axiomatic definition of probability. Baye's theorem, Random variables. Probability mass function and probability density function. Mathematical Expectation. Probability distributions-Binomial, Poisson and Normal distributions and their applications.

(12 Hrs)

UNIT-II

Sampling distributions. Small and large sample tests (Z test, t test and F test). Chi-square test for independence and goodness of fit.

(11 Hrs.)

UNIT-III

Introduction to Optimization Techniques. Basic concept and notations. Formulation of Linear Programming Problem (LPP). Graphical Solution. Standard Form of an LPP. Simplex method. Big M method. Two phase method. Duality Theory.

(14 Hrs.)

UNIT-IV

Basic concept & notations. Balanced & unbalanced TP. Initial BFS of TP by using North-West corner rule, Matrix minima method & Vogel's Approximation Method. Improving an initial BFS to optimal solution. Introduction to Assignment Problem. Hungarian method to solve Assignment Problem.

(10 Hrs.)

RECOMMENDED BOOKS
Text Book
S.P. Gupta, Statistical Method, Sultan Chand & co.
H.A. Taha, Operations Research

Reference Books
Hira & Gupta , Operations Research, S. Chand & co.
S.C. Gupta, Fundamentals of Mathematical Statistics, S. Chand & Co.
Snedecor & Cocharan, Statistical Methods

AM-P6203   FOURIER AND WAVELET METHODS

UNIT-I
L^2 (R) and approximate identities. Fourier transform, Basic properties. Fourier inversion.

(10)

UNIT-II
Continuous wavelets. Examples of wavelets . Continuous wavelet transform (CWT) as a correlation. Constant Q- factor filtering interpretation and time frequency resolution. CWT as an operator. Inverse CWT. Discrete wavelet transform.

(12)

UNIT-III
Multiresolution analysis(MRA). Construction of a general orthonormal MRA. Wavelet basis for MRA. Decomposition filters and reconstructing the signal. Continuous MRA interpretation for the discrete wavelet transform and discrete MRA.

(12)

UNIT-IV
Condition number of a matrix. Wavelet-Galerkin methods for differential equations. Fourier and wavelet solutions of sideways heat equations.

(12)

RECOMMENDED BOOKS

Text Book
M.W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer.
K.P. Soman and KI Ramachandran, Insight into Wavelets from Theory to Practice, PHI.

Reference Books
R.M. Rao and A.S. Bopardikar, Wavelet Transforms: Introduction to Theory and Applications, Pearson Education
Brani Vidakovic , Statistical Modeling by Wavelets, John Wiley & Sons.
A.I. Zayed, Function and Generalized Function Transforms, CRS Press.

AM-P6204   INDUSTRIAL MATHEMATICS

UNIT-I

Background about model and modeling methodology. Some basic facts about differential equations & Industry based simple differential-equation models. Industrial problems modelled with differential equations including, desalination, casting of sheet steel, and solar heating; problems include drug adoption and delivery.

UNIT-II

Basic structure of queuing models, examples of queuing systems drawn from real life situations, role of exponential distribution.

UNIT-III

Fuzzy Sets – Basic definitions. a-level sets. Convex fuzzy sets, Basic operations on fuzzy sets. Types of fuzzy sets.   Cartesian products. Algebraic products. Bounded sum and difference. t – conorms.   The Extension Principle – The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

UNIT-IV

Introduction, modeling random variables, Generating random numbers, Simulations, using simulation models, data collection, empirical models, estimating parameters, Error and accuracy

RECOMMENDED BOOKS

Text Book
J.N.Kapoor, Mathematical Modeling
H.A. Taha, Introduction to Operation Research, PHI.

Reference Books
H.J. Zimmermann,   Fuzzy Set Theory and Its Applications, Allied Publishers Ltd.,New Delhi,
G.J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice-Hall of India, New Delhi.
Palgrave, Mathematical Modeling, Second Edition.

AP-P6201   LASER AND ITS APPLICATIONS

UNIT- I

LASER

Introduction, Einstein coefficient and light Applications, Laser rate equations, Optical resonators, The laser output, Q-switching, mode locking properties, Ruby, helium-neon, Solid state, carbon di-oxide, Dye and semiconductor lasers, free electron Lasers and cyclotron resonance masters.   (10 hrs)

UNIT- II

HOLOGRAPHY

Introduction, Recording and reconstruction of Holograms, Type of Holograms, Holographic recording materials, holographic storage of information and Data processing, Holographic Interferometry and its application.   (10hrs)

UNIT-III

OPTICAL FIBER COMMUNICATION

Introduction, Optical fibre Numerical Aperture, coherent bundle, fibre-optic communication system, Losses in optical fibres (Attenuation & Dispersion) Pulse dispersion in step index fibres, Graded index fibres, some general consideration: First and Second generation fibre optic communication system, Single mode fibres and the third Generation Optical communication system operation at 1.5 um wavelength, Fourth Generation optical fibres, applications fibre optic system, Advantage of fibre optic system.   (12hrs)

UNIT- IV

APPLICATIONS OF LASERS & OPTICAL FIBRES

Introduction, Material processing, Welding, Cutting, Drilling, Hardening, Micro machining and other application, Metrology, Non-destructive testing, Pollution Detection, Laser tracking LIDAR, Precision length measurement, Velocity measurement, Recent advances, optical interconnections for integrated circuits, optical computing, Star war.   (10hrs)

RECOMMENDED BOOKS

Lasers – Theory & applications   K Thyagarajan & A K Ghatak   MacMilllan India
                                                                                                 Ltd

AP-P6202   SEMICONDUCTOR PHYSICS AND DEVICES

L T P   **Credit:3**
3 0 0

UNIT – I

THE SEMICONDUCTOR

Introduction**,** Charge carrier in Semiconductor; Equilibrium distribution of electrons and holes, the n_0 and p_0 equations, intrinsic carrier concentration, intrinsic Fermi level; Dopant Atoms and energy Levels; qualitative description, ionization energy, Group III – IV semiconductors; The Extrinsic Semiconductor, Statistics of Donor and acceptors, Charge Neutrality, Position of Fermi Energy Level

4 Hrs

CARRIER TRANSPORT PHENOMENA

Carrier Drift; Drift current density, mobility effects, conductivity, velocity saturation; Carrier Diffusion; Diffusion current density, total current density; Graded Impurity Distribution; Induced electric field, Einstein relation; Hall Effect

6 Hrs

UNIT - II

PN JUNCTION DIODE AND BIPOLAR TRANSISTOR

Introduction of PN junction, PN Junction current, Generation – Recombination currents, Junction breakdown, Charge storage and diode Transients, Tunnel Diode, Bipolar transistor action; Basic principle of operation, The modes of operation, amplification with Bipolar Transistors.

4 Hrs

FUNDAMENTALS OF THE METAL-OXIDE- SEMICONDUCTOR FIELD EFFECT TRANSISTOR

Two Terminal MOS structure; Energy band diagrams, depletion layer thickness, work function differences, Flat band voltage, threshold voltage, charge distribution; Capacitance – voltage characteristics, Basic Operation of MOSFET, CMOS technology, radiation and Hot electron effects

6 Hrs

UNIT - III

JUNCTION FIELD – EFFECT TRANSISTOR

JFET concepts; Basic PN JFET and MESFET operations, Device Characteristics; Internal pinchoff voltage and Drain to source saturation voltage, Transconductance, MESFET, Nonideal effects, High electron mobility transistor

6 Hrs

SEMICONDUCTOR POWER DEVICES

Power Bipolar Transistors; vertical power transistor structure, Power transistor characteristics, Darlington pair configuration, Power MOSFETs; Power transistor structure, power MOSFET characteristics, Parasitic BJT; Heat Sinks and Junction Temperature, Thyristors and varistors

6 Hrs

UNIT - IV

OPTICAL DEVICES
Optical Absorption; Photon absorption coefficient, electron hole pair generation rate Solar Cells; PN junction solar cell, hetero-junction solar cell, amorphous solar cell Photo-detectors; Photoconductor, photodiode, PIN photodiode, Avalanche photodiode, phototransistor; Photoluminescence and Electroluminescence: Basic transitions, luminescent efficiency, materials; Light Emitting Diodes: Generation of light, internal and external quantum efficiencies; LED devices; Laser Diodes; Stimulation emission and population inversion, optical cavity, threshold current, Device structure and characteristics

10 Hrs

Recommended Book

Donald A. Neamen: Semiconductor Physics and Devices, Tata McGraw-Hill
S.M.Sze: Physics of semiconductor Devices (Wiley)

AP-P6203   PLASMA AND ITS APPLICATIONS

L T P   **Credit:3**
3 0 0

UNIT-I

Introduction to Plasma:
Excitation and ionization in a gas (different methods), Definition of plasma, Basic parameters of plasma, Bulk properties, Quasi-neutrality, Electrostatic Boltzman's equation, Plasma sheaths, The plasma frequency, Saha equation, Debye shielding and skin depth, Diffusive transport in plasma, Electron collision frequency, Cold and hot plasma, Magnetized plasmas, Plasma confinement, Radiation plasma, Arc Plasma, Fully ionized plasma
(12hrs)

UNIT-II

Charged particle motion:
Particle description of plasma, Motion of charged particles in electrostatic field, Motion of charged particles in uniform magnetic field, Motion of charged particles in electric and

magnetic fields, Motion of charged particles in inhomogeneous magnetic field, Motion in a torrodial magnetic field, Magnetic mirror confinement, Motion of an electron in a time varying electric field, Motion in a crossed radio frequency and magnetic field, Theory of simple oscillations, Electron oscillations in a plasma, Electronic oscillation along with motion of ions, Derivation of plasma oscillations using Maxwell's equations, Ion oscillations and waves, Landau damping, Propagation of e.m. waves in plasma containing a magnetic field, Instabilities in plasma

(12hrs)

UNIT-III
Plasma Diagnostic Techniques:
  Single probe method, Double probe method, Use of probe technique for measurement of plasma parameters, Microwave method, Spectroscopic method, Laser as a tool for plasma diagnostics, X-ray diagnostics, Acoustic method

(10hrs)

UNIT-IV
Plasma applications:
  Source of power (MHD generator and Controlled thermonuclear fusion), Generation of microwaves utilizing high density plasma, plasma propulsion, materials processing with plasma arcs, plasma processing and fabrication (ion implantation in solids, plasma deposition and etching, paint spraying), Plasma diode and plasma lighting devices/torches, insulating dielectrics and breakdown, Plasma chemistry and Pollution control (thermal, non-thermal, electrostatic precipitation, corona)

(12hrs)

Recommended Books:
1. F.F. Chen: *Introduction to Plasma Physics and Controlled Fusion*, Vol.1, Plasma Physics. 2nd Edition, Plenum Press 1984.
2. J. R. Roth : *Industrial Plasma Engineering*, Vol.1, Principles. IOP Publishing, Ltd 1995.
3. S.N.Sen: *Plasma Physics, Plasma state of matter*, Pragati Prakashan, Meerut, second edition, 1996.
4. Brian Chapman, *Glow Discharge Processes,* John Wiley & Sons, 1980.

CH-P6201   ENVIRONMENT IMPACT & ASSESSMENT

L T P   **Credits:3**
3 0 0

Unit-I
Scope and Significance: Objective od EIA, comparative study of different assessment methodology, Adhoc procedures, overlay techniques, checklist, matrices and networks, Essential elements of abn environmental impact analysis, Details content of EIA/Environmental Impact Assessment.

(13 Hrs)

Unit-II
Impact Assessment for Air Environment: Evaluation of the possible impacts of a proposed action on the air environment at meso scale and micro scale level, Methodological, adopted and step evolved.

(09 Hrs)

Unit-III
Impact Assessment for Biological and Socio-cultural Environment: Possible impact of a proposed action on specific diversity and functional balance of the ecosystem, Possible impact on the existing socio-cultural and economic patterns of the surrounding population, Assessment of noise pollution.

(07 Hrs)

Unit-IV

Environmental Regulations and Standards: Study of different Govt. regulations, Acts and specified emission standards, Constitution and working of Pollution Control Boards, International Treaties and Protocols.

(07 Hrs)

RECOMMENDED BOOKS:

Author	Title	Publishers
Harrson R.M. & Mora, S.J.	Introductory Chemistry for the Environmental Sciences	--
Rai, G.D.	Non-conventional Energy Sources	Khanna Publishers
Witte Schmidt & Brown	Industrial Energy Management & Utilization	Hemisphere Pub. Corp.
--	Energy Auditing Manuals	National Productivity Council, New Delhi.

CH-P6202   NON-CONVENTIONAL ENERGY SYSTEMS

L T P   **Credits:3**
3 0 0

Unit-I
Introduction: Introduction to Energy Science & Technology, Law of conservation of energy, Energy calculations, energy demand, various resources of non-conventional energy.
Solar Energy: Historical review and future prospects, fundamentals and applications, Solar thermal energy conversion systems: Solar Collectors, Solar thermal power plants, solar photovoltaic systems: Prospects of solar PV systems, principles of a photo voltaic cell, V-I characteristics of a solar cell, efficiency of a solar cell.

(13 Hrs)

Unit-II
Geo-Thermal Energy: History resources and applications, Hydrothermal (convertive) resources, geo-thermal electric power plants, vapor dominated (stream) geothermal electrical power plant, liquid dominated (hot-water) geo-thermal electrical power plant, Liquid dominated lashed steam geothermal electric power plant, Binary cycle liquid dominated geothermal power plants, Comparison of various liquid dominated geo-thermal systems.

(09 Hrs)

Unit-III
Liquid Energy: Introduction, History and applications, Pipes of wind turbine generator units, Horizontal axis propeller type wind turbine generator units, Three blends, Horizontal axis wind turbine (WAWT), vertical axis wind turbines, introduction to wind energy forms and energy conversion systems.

(07 Hrs)

Unit-IV
Bio-mass Energy: Introduction, various resources and applications, processes, combustion, thermo-chemical, bio-chemical, hybrid bio-gas plants, Introduction and brief idea about ocean energy, tidal energy and nuclear energy systems etc.

(07 Hrs)

RECOMMENDED BOOKS:

Author	Title	Publishers
Saha, S.N.	Food Combustion Energy Technology	Dhanpat Rai Pub.
Rao, G.D.	Non-Conventional Energy Sources	Khanna Publications

CS-P6201   Interactive Computer Graphics

L T P   **Credits:3**
3 0 0

UNIT I

Overview of graphics systems

Display devices, physical input and output devices: storage tube graphic displays, Raster Refresh, Plasma Panel Displays, Liquid Crystals

Output Primitives
Point plotting, Line Drawing algorithms – DDA algorithms, Bresenham's Line algorithm, Areafilling – Scan Line algorithm, flood-fill algorithm, Circle-Generating algorithms.   **(**11 Hrs)

UNIT II
Two-dimensional Transformations

Basic transformations-translation, scaling, rotation, Matrix representation and homogenous coordinates, composite transformations-scaling relative to a fixed pivot, rotation about a pivot point, general transformation equations, other transformation-reflection, shear.
Windowing and Clipping Techniques
Windowing concepts, Clipping algorithms-Line clipping – Cohen-Sutherland algorithm, Area clipping, Text clipping, Blanking, Windows-to-View port transformation.   **(**13 Hrs)
UNIT III
Three Dimensional Graphics and Transformations

Coordinate systems and Display techniques, Representations-Polygon surfaces, Curved surfaces-Bezier and B-spline curves, Transformation – translation, scaling rotation, rotation about an arbitrary axis, other transformations-reflections, shear and 3-D viewing projections.   (11   Hrs)

UNIT IV
Hidden-Surface and Hidden-Line Removal
Back-face removal, Depth-buffer method, Scan-line method, Depth-Sorting method i.e. Painter's algorithm, Hidden-Line elimination.

Shading (Overview)
Modeling Light intestines diffuse reflections; diffuse reflectors, Specular reflectors, refracted light & reture surface patterns.

Half toning, Surface Shading methods (overview)
Constant Intensity method, Gouraud Shading, Phong – Shading   **(13Hrs)**

Recommended books

Title	Author(s)	Publisher
	Text	
Computer Graphics	Hearn. D & MP Baker	Prentice Hall
Principle of Interactive Computer Graphics	Newman W.M	McGraw Hill
	Reference	
Computer Graphics - A Programming Approach	Harrington. S.	McGraw Hill
Fundamentals of Computer Graphics	Foley J.D et al.	Addison Wesley

CS-P6202 COMPUTER NETWORKS

L T P   **Credits:3**

UNIT-I

Basic & Computer Networks 12

Need & Evolution of Computer Networks, Description of LAN, MAN, WAN and wireless Networks, OSI and TCP/IP models with description of Data Encapsulation & peer to peer communication, Comparison of OSI and TCP/IP. Basic terminology of computer networks - bandwidth, physical and logical topologies, Media – 10 base Z, 10base S, 10base T, 100baseTX, 100base FX, 1000baseLX and wireless. LAN & WAN devices – Router, bridge, Ethernet switch HUB, Modem CSU/DSU etc.

UNIT-II

Physical Layer 12

Representation, one bit on physical modem i.e. in wired network, optical Network and wireless N/W, Encoding / Modulation – Manchester Encoding, AM, FM and PM. Dispersion, Jitter, Latency and collision. Different types of Media – Shielded twisted pair, Unshielded twisted pair, Coaxial cable, Optical Fiber cable and wireless.

UNIT-III

Data Link Layer 12

LLC and MAC sub layer, MAC addressing Layer 2 devices, Framing Error control and flow control. Error detection & correction CRC code block parity & checksum. Elementary data link protocol sliding window protocol, Channel allocation problem – static and dynamic. Multiple Access protocol – ALOHA, CSMA/CD Token bus Token ring, FDDI.

UNIT-IV

Network Layer 12

Segmentation and autonomous system path determination, Network layer addressing, Network-layer data gram, IP addressed classes. Subnetting – Sub network, Subnet mark. Routing algorithm – optimality Principle, Shortest path routing, Hierarchical routing, Broadcast routing, Multicast routing, Routing for mobile host – Concatenated Visual circuits, tunneling Fragmentation and DHCP. Routing Protocol – RIP, IGRP, OSPF and EIGRP. Network layer in ATM Networks.

Transport Layer

Layer 4 Protocol TCP & UDP. Three-way hand shakes open connection. ATM AAL Layer protocol, Session Layer design issue, Presentation layer design issue, and Application layer design issue. Application layer Protocol, TELNET, FTP, HTTP, SNMP.

Recommended Books

Title	Author(s)	Publisher

		Text
Computer Networks	Tanenbaum	PHI
Computer Networks and Their Protocols	Darix	DLA Labs
		REFERENCE
Comp. Communication & Networks	Freer	East-West-Press
Data Communication and Networking	Forouzen	Tata McGraw Hill

CS-P6203 SIMULATION & MODELLING

L T P   **Credits:3**
3 0 0

UNIT-I
System Models   12
Introduction to systems; scientific and nonscientific systems; discrete & continous systems; characteristics of systems; different views of systems; odeling of systems; physical and smbolic models; examples of models from various disciplines. Computer systems; electrical systems, economic system & inventory system.

UNIT-II
System Simulation   12
Continous system simulation; analog versus digital simulation; basic operation & notation for analog simulation; linear systems & simulatianeous equation representation; digital computer simulation; simulation of a real life time-dependent system via a programming lanuage such as Fortran/Pascal.

UNIT-III
Discrete system simulation-event, activity & process; representation of time; fixed stem vs. event-to-event model; analysis of a discrete system; generation of random number generation for microcomputers; testing of pseudo-random numbers; monte-carlo computation; simulation of a real life discrete system. 12

UNIT-IV   12
Computer language for simulation of continous & discrete systems; characteristics of a simulation language; introductory discussion of CSMP, GPSS and SIMSCRIPT

Recommended Books

Title	Author(s)	Publisher
Text		
Simulation and Modeling	Liffick	TMH
System Simulation with Digital Computer	Deo	PHI
Reference		
Computer Simulation and Modeling	Neelamkavil,John-Wiley	
System Simulation	Gorden	PHI

CS-P6204   SOFTWARE ENGINEERING
L T P   **Credits:3**

UNIT-I

Evolving role of Software 12

characteristics, components, applications of S/W. A layered technology, S/W process Linear Sequential, Prototyping, RAD, Incremental, Spiral, Component assembly & S/W process & Project metrics.

UNIT-II

S/W scope 12

resources, estimation, decomposition techniques, empirical estimation models. Project scheduling, refinement of major tasks, scheduling project plan, Software reliability, S/W equality assurance plan, software quality standards (ISO/CMM). The system engineering hierarchy information engineering, information strategy planning, requirement analysis, analysis principles, Data modeling information flow structured analysis

UNIT-III

Data Dictionary 12

Software testing Fundamentals, Test Case design, White box testing, Basis path testing, Control structure testing, Black box testing. Activity network for conversion. Combating resistance to change.

UNIT-IV

Post implementation review 12

review plan. S/W maintenance and enhancement procedure. System security, Threats & control measures, disaster/recovery planning, ethics in system development, ethics codes & standard of behavior

Recommended Books

Title	Author(s)	Publisher
Text		
Software Engineering	Ian Somer Ville	Addison Wesley
Software Engineering	ROGER S.PRESSM	TMH
Reference		
An Integrated Approach to Software Engineering	Pankaj Jalote	
System Analysis & Design Software Engineering	ELIAS M AWAD, Richard Fairley Principles	

EC-P6201   INTRODUCTION TO DIGITAL SIGNAL ROCESSING

L T P   **Credits:3**
3 0 0

Unit I

Introduction: Limitations of analog signal processing, Advantages of digital signal processing. Discrete time characteristics of Signals & Systems Some elementary discrete time sequences and systems; Concepts of stability, causality, linearity, time invariance and memory; Linear time invariant systems and their properties; Linear constant coefficient difference equations.

(12 Hrs)

Unit II

Z-Transform: The Z Transform Z-Transform, Region of convergence; Properties of the Z-transform; Convolution theorem; Parseval's relation; Unilatera; Z-transfform and its application to difference equations with non-zero initial conditions.

(12 Hrs)

Unit III

DFT: Discrete Fourier Transform DFT and its properties; Linear, Periodic and Circular convolution; Fast Fourier Transform algorithm using decimation in time and decimation in frequency techniques; Linear filtering approaches to computation of DFT. Structure for Discrete Time Systems Signal flow graph representation, Transposed forms, Lattice structures.

(12 Hrs)

Unit IV

Filter design: Design of Digital Filters Linear Phase FIR filters; Design methods for FIR filters; IIR filter design by impulse Invariance, Bilinear Transformation, Matched Z-Transformation, Frequency Transformation in the Analog and Digital Domain.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Digital Signal Processing -	J. G. Proakis & D.G. Manolakis,	Prentice Hall, 1992

Reference Books

Title	Author	Publisher
Discrete Time Signal Processing	- A. V. Oppenheim & R W. Schafer,	Prentice Hall

EC-P6202   PRINCIPLES OF DIGITAL COMMUNICATIONS

L T P   **Credits:3**
3 0 0

Unit I

Review to Random Variables and processes: Random variables: commutative distribution function, probability density function (pdf), average value and variance of random variables.Tchebycheff's inequality, Gaussian pdf, Rayleigh pdf of sum of random variables, Correlation between two random variables. Random processes: Introduction classification, correlation, auto correlation, Power spectral density (PSD) of a sequence of random pulses, PSD of digital data.

(12 Hrs)

Unit II

Formatting and source coding: Introduction, concept of amount of information, entropy and information rate. Shannon's theorem, channel capacity, capacity of a Gaussian channel, BW-S/N trade off, sampling, quantization, quantization error, quantization noise, companding, PCM, delta modulation, adaptive delta modulation.

(12 Hrs)

Unit III

Line coding schemes: Introduction, properties, general method for derivation of power spectral density of a broad class of digital signals, ON-OFF signaling, polar signaling, bipolar and split phase (or Manchester) signaling and comparison among them pulse shaping: Nyquist's first, second and third criterions for zero ISI, introduction to equalizer and eye diagram, Derivation of error probability for signaling in AWGN.

(12 Hrs)

Unit IV

Modulation schemes: Introduction, generation, reception, spectrum and geometrical representation and error probability (in AWGN) of BPSK, binary differential phase shift keying (BDPSK), QPSK, MPSK, QAM, BFSK, and MSK.

(12 Hrs)

EC-P6203   ANALOG AND DIGITAL ELECTRONICS

L T P   **Credits:3**
3 0 0
RECOMMENDED BOOKS
Text Books

Title	Author	Publisher	Uni
Modern analog and digital business and promotion communication beauro	B.P Lathi	Wiliy	t I
Reference Books			**Se**
			mic
Title	**Author**	**Publisher**	**ond**
Communication systems	Bruce Carlson	Mc Graw Hill	**uct**
Digital Communications	S .Haykins	Wiliy	**or**
			Dio

des: PN junction Diode - VI characteristics, qualitative analysis of its behavior, Rectifiers-half wave and full wave, clippers, clampers, clamping circuit theorem, Voltage multipliers, Special purpose diodes - Zener diode, Tunnel diode, Varactor diode.
Bipolar Junction Transistor: Transistors-construction, operation, characteristics, parameters, Transistor as an amplifier at low frequency Amplifier types-CE, CB, CC.

Unit II
Transistor Biasing and Stabilization: DC operating point, DC Biasing circuits-fixed bias, emitter bias, voltage divider bias, voltage feedback, Bias stability, Stabilization against variation in I_{co}, V_{BE} and β, Bias compensation.
Field-Effect Transistor: The junction FET - construction, operation, characteristics, parameters, Biasing of JFET, Small signal analysis of JFET as an amplifier.

(12 Hrs)

Unit III
Number Systems And Boolean Algebra: Review of Number systems, Radix conversion, Complements 9's &10's, Subtraction using 1's & 2's complements, Binary codes, Error detecting and Correcting codes, Theorems of Boolean algebra, Canonical forms, Logic gates.

(12 Hrs)

Unit IV
Combinational Logic: Representation of logic functions, Simplification using Karnaugh map, Tabulation method, Implementation of combinational logic using standard logic gates, Multiplexers and Demultiplexers, Encoders and Decoders, Code Converters, Adders, Sub tractors, Parity Checker and Magnitude Comparator.
Sequential Logic Concepts And Components: Flip flops: SR, JK, D and T flip flops - Level triggering and edge triggering, Excitation tables - Counters - Asynchronous and synchronous type, Shift registers.

(12 Hrs)

EC-P6204   MICROPROCESSORS PRINCIPLES

L T P   **Credits:3**
3 0 0

Unit I
Introduction: Microprocessors, its evolution, function and impact on modern society, Microcomputer systems, Microprocessor architecture and its operations, Memory, Inputs

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Electronics Circuits and devices	JB Gupta	Dhanpat Rai
Modern Digital Electronics	R P Jain	Tata McGraw-Hill,

Reference Books

Title	Author	Publisher
Electronic Devices and Circuit Theory	Boylestad Nashelsky,	8th Ed., Pearson Education,

and output devices.

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Microprocessor and micro controllers	Dr B P Singh	Galgiria Publications
Microprocessor Architecture ,programming and application with 8080/8085	Ramesh S Gaonker	Willey Eastern Ltd New Delhi

Reference Books

An introduction to microprocessors	A P Mathur	Tata McGraw hill, new Delhi
Microprocessor and microcomputer	Refiquzzaman	Universal Book

Architecture of a microprocessor (with reference to 8085 microprocessor): Concept of Bus, Bus organization of 8085, Functional block diagram of 8085, and function of each block, Pin details of 8085 and related signals, Demultiplexing of address/data bus (Ado-AD7), Generation of read write control signals.

(12 Hrs)

Unit II
Memories and I/O Interfacing: Memory organization, memory map, portioning of total memory space, address decoding, and concept of I/O mapped I/O and memory mapped I/O. Interfacing of memory and I/O devices.

(12 Hrs)

Unit III
Programming using 8085 microprocessors: The 8085 programming model, instruction classification, instruction format, how to write assemble and execute a simple program introduction to 8085 instruction data transfer (copy) operations, Arithmetic operations, Logic operations Branch operations Writing assembly language programs, programming techniques with additional instruction programming techniques: looping counting and indexing additional data transfer and 16 bit arithmetic instruction arithmetic and logical operations related to memory, Stack and Sub Routines, Stack, Subroutine, Conditional call and return instructions.

(12 Hrs)

Unit IV
Programming: Counters and time delays, Illustrative program hexa decimal counter, Illustrative program: zero to nine (Modulo 10) counter, Illustrative program: Generating pulse waveform.
Comparative study of 8 bit microprocessors i.e. 8085, Z80, 6800.

(12 Hrs)

FT-P6201   SEPARATION TECHNOLOGY

L T P   **Credits:3**
3 0 0

UNIT-I

Introduction to various separation processes: Gas-Liquid, Gas–Solid, Liquid-Liquid, Liquid-Solid separation; Concept of phase equilibrium, Stage equilibrium, Stage efficiency, Equilibrium concentration; Single stage contact equilibrium, counter-current multiple contact stages, Concept of equilibrium line and operating line, Determination of optimum number of contact stages by analytical and graphical method; Rate of extraction, Rate of gas absorption, Individual and over all mass transfer coefficient; Calculation of tower height for gas absorption for both dilute and concentrated solution. Construction and working mechanism of different extraction equipments like single stage extraction, Multiple stage static bed system, Bollmann extractor, Hildebrandt extractor, Rotocell extractor.

(12 Hrs)

UNIT-II

Solid Separation Process: Introduction, Concept of size, Shape, Cut-size, Sieving, Magnetic separation, Eddy-current separation, Wet separation, Ballistic separation, Color separation.

(03 Hrs)

Wet separation process: Liquid-solid and liquid- liquid separation by hydroclones, Surface velocity classifier, Elutriators, Impingement separator, Electrostatic precipitation.

(04 Hrs)

Distillation: Introduction, boiling point diagram, differential or simple distillation, Flash or equilibrium distillation, Continuous rectification with and without reflux, Reflux ratio, Optimum reflux ratio, Batch distillation, Application of distillation in food processing.

(05 Hrs)

UNIT-III
Membrane Separation Technology: Introduction to microfiltration, Ultrafiltration, Reverse osmosis, Electro dialyses, dialyses, physical characteristics of membrane separation, Factors affecting reverse osmosis process, Concentration polarization, Design of reverse osmosis and ultra filtration systems, Operation layout of the modules, Electrodialysis, pervaporisation, Fabrication of membranes, Application of membrane technology in food industry.

(12 Hrs)

UNIT-IV
Powder Technology: Classification off powder, Separation of powder, Sieving, Air classification, Factors affecting air classification, Cyclone application, Air separation, Particle size distribution**.**

(06 Hrs)

Super Critical Fluid Extraction: Introduction, Properties of SCF, Food application, Application of SCFE in analytical technique, Pharmaceutical application.   (06 Hrs)

Recommended Books:

	Author	Title	Publisher
1	Grandison A S & Lewis M J	Separation Process in The Food & Biotechnology Industries	Woodhead Pub Ltd
2	Narayanan CM & Bhattacharyya BC	Mechanical Operations For Chemical Engineers	Khanna Pub
3	Dutta B K	Mass Transfer & Separation Process	PHI
4	Anantharaman N & Begum KMMS	Elements of Mass Transfer	PHI

FT- P6202   BIOINSTRUMENTATION

L T P   Credits: 3
3 0 0

INTRODUCTION:

Sensors, biological materials in sensors, difficulties in ordinary chemical sensors, problems associated with sensors and different transducers used in instrumentation.

BIOSENSORS:
Basic principle of operation types of biosensors accuracy and precision, industrial application and future trends.

BIOINSTRUMENTS:

Principles, functions and application of bioinstruments i.e. Gene gun, ELISA probe, Biochips, molecular switches, PCR
Bioprocess control
Control algorithm, types working principles and their applications

Author	References Books Title
Mittal, G.S	Computerized control system in Food Engg.
Gabriele Wagner and J.G. Guilbault	Food Biosensor analysis
Mukhopadhyay, S.N.	Process Biotechnology Fundamentals

IE-P6201- Fundamentals of Measurement and Instrumentation

L	T	P	Credits
3	0	0	3

Unit-I

1. **Measurement System** **6 hrs**
   Necessity & scope of instrumentation, important process variables & their Units, applications of measurement system, elements of generalized measurement system, input-output configuration, methods for correction for interfering & modifying inputs

2. **Errors** **6 hrs**
   Error Sources, types of errors, statistical treatment of data, analysis, Probability of errors, rejection of data based upon confidence level, method of least squares, graphical presentation of data

Unit-II

3. **Static Characteristics** **12 hrs**
   Various static characteristics, static calibration, calibration curve, static correction, scale range, scale span, reproducibility, drift, repeatability, hysteresis; accuracy & precision, significant figures, static sensitivity, threshold, dead time, dead zone, input & output impedances, loading effects due to shunt series connected instruments,

generalized impedance & stiffness concepts, impedance matching & maximum power transfer

Unit-III

4. **Dynamic Characteristics**   **12 hrs**
   Dynamic response, measuring lag, fidelity, dynamic error, transfer function , order of the system, types of test inputs, step response of 1st & 2nd order systems & study of characteristic indices

Unit-IV

5. **Display & Recording Methods**   **6 hrs**
   Indicating methods, analogue & digital comparison, LED, LCD as display units, 7 segment, 14 segment & dot matrix display, Nixie tube display, difference between integrating & recording methods, recording requirements, various methods of strip chart recording, potentiometer & null balance type of recorders
6. **Cathode Ray Oscilloscope**   **6 hrs**
   CRT, its main parts, electrostatic focusing & deflection, deflection sensitivity, post deflection acceleration, types of screens for CRT, aquadag color, CRTs, various time base & amplifiers oscilloscope circuits, method of synchronization, various controls on CRO.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Electrical & Electronic Measurement and Instt.	A K Sawhney	Dhanpat Rai
2. Measurement Systems Applications & Design	EO Doebelin	TMH
3. Mechanical Measurements	T G Beckwith	PHI
4. Transducers and instrumentation	DVS Murthy	Dhanpat Rai

IE – P6202 Sensors & Signal Processing

	L	T	P	Credits
	3	0	0	3

Unit I

1. **Introduction**   **12hrs**
General Concept of Measurement: Basic block diagram stages of generalized measurement system state characteristics; accuracy, precision, resolution, reproducability, sensitivity, zero drift, linearity, Dynamic characteristics, zero order instrument first order instrument, time delay.

Unit II

2. **Sensors**   **12 hrs**
Sensors and Principles: Resistive sensors, Potentiometer and strain gauges, Inductive sensors: Self inductance type, mutual inductance type, LVDT, Capacitive sensors, piezoelectric sensors thermocouples, thermistors, radiation pyrometry, Fibre optic sensors, temperature sensor, photo electric sensors, pressure and flow sensors.

Unit III

3. **Signal Conditioning**   **12 hrs**
Signal conditioning: Amplification, Filtering, Level conversion, Linearisation, Buffering, sample and hold circuit, quantization, multiplexer/ demultiplexer, analog to digital converters, digital to analog converters.

Unit IV

4. **Data Acquisition**   **06 hrs**
Data acquisition and conversion: General configuration, single channel and multichannel data acquisition system, Digital Filtering, data logging data conversion, introduction to digital transmission systems, PC based data acquisition system.

5. **Interfacing**   **06 hrs**
Interface systems and standards: Block diagram of a typical interface IEE 488 standard bus British Standard interface (BS 4421) CAMAC Interface MEDIA interface RS232C standard.

RECOMMENDED BOOKS

	Title	Author	Publisher
1.	Instrumentation -Devices and Systems	Rangam, Sarma & Mani	TMH
2.	A Course in Electrical and Electronic	A.K. Sawhney	Dhanpat Rai &

	Measurements and Instrumentation		Sons
3.	Measurement Systems	E.O. Doeblin	McGraw Hill
4.	Instrument Measurement & Analysis	Nakara	PHI

IE-P6203- Elements of Power Systems

	L	T	P	Credits
	3	0	0	3

Unit-I

1. **Supply System**   **06 Hrs**
   Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission & distribution, economic size of conductors - Kelvin's law, Radial & mesh distribution networks, Voltage regulation

2. **General**   **06 Hrs**
   Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency

Unit-II

3. **Transmission Line Parameters**   **05 Hrs**
   Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors

4. **Performance Of Transmission Lines**   **07 Hrs**
   Representation of short transmission line, medium length line (nominal T & II circuits). long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation

Unit-III

5. **Circle Diagram And Line Compensation**   **12 Hrs**
   Receiving end circle diagram for long transmission lines based on ABCD constants, equivalent T circuits , power loss, surge impedance loading, reactive power requirement of system series and shunt compensation, Synchronous phase modifiers , rating of phase modifiers

Unit-IV

6. **Underground Cables**   **12 Hrs**
   Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines

RECOMMENDED BOOKS

Title	Author	Publisher
Text books		
1. Course in Electrical Power	C.L. Wadhwa	New Age
2. Power System Analysis	Nagrath and Kothari	TMH
Reference Books		
3. Electrical Energy System Theory- An introduction	O.L. Elgerd	TMH
4. Elements of Power System Analysis	W.D. Stevenson Jr	TMH
5. Power System Analysis & Design	B.R. Gupta	Wheeler

IE-P6204- Bio-Sensors & MEMS

	L	T	P	Credits
	3	0	0	3

Unit-I

1. **Overview**   **12 hrs**
Overview of biosensors and their electrochemistry: Molecular reorganization: enzymes, Antibodies and DNA, Modification of bio recognition molecules for Selectivity and sensitivity Fundamentals of surfaces and interfaces

Unit-II

2. **Bioinstrumentation**   **12 hrs**
Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, FETs and Bio-MEMS, Introduction to Chemometrics, biosensor arrays; electronic nose and electronic tongue

Unit-III

3. **MEMS Technology**   **12 hrs**
MEMS Technology: Introduction Nanotechnology and MEMS, MEMS design, and fabrication technology, Lithography, Etching, MEMS material, bulk micromachining, Surface micromachining, Microactuator, electrostatic actuation , Micro-fluidics

Unit-IV

4. **Applications**   **12 hrs**
MEMS types and their applications : Mechanical MEMS � strain and pressure sensors, accelerometers etc., Electromagnetic MEMS, micromotors, wireless and GPS MEMS etc Magnetic MEMS, all effect sensors, SQUID magnetometers, Optical MEMS, micromachined fiber optic component, optical sensors, Thermal MEMS, thermo-mechanical and thermo-electrical actuators, Peltier heat pumps

RECOMMENDED BOOKS

	Title	Author	Publisher
1.	Foundation of MEMS	Chang	Illinois Ece Series
2.	Microsensors, MEMS and Smart Devices	Julian W. Gardner, Vijay Varadan & Osama O. Awadelkarim	Wiley
3.	Biosensors: Theory and Applications	Donald G. Buerk	CRC
4.	Electrochemical Sensors, Biosensors and their Biomedical Applications	Xueji Zhang, Huangxian Ju & Joseph Wang	Academic Press

ME-P6201   INDUSTRIAL ENGINEERING

L T P   **Credits:3**
3 0 0

Unit - I

Introduction: Industrial Engineering. Definition and Evolution, Understanding Industrial System Focus: Production/Service System. Performance measures of a Production System -Production, Productivity, Efficiency, Effectiveness, Quality, Flexibility, Agility etc.

Classical Industrial Engineering: Classical Industrial Engineering -Work Study: Method Study and Time Study, Human Factors, Ergonomics, Motivation Recent and Emerging Applications of IE –Role of IT in Systems– MIS, FMS etc.

(12 Hrs)

Unit - II

Value Engineering: Concept of value analysis, Aim and objectives, Phases in value analysis, Test for value analysis advantages.

Product Design & Development: Product Development life cycle, Product standardization, simplification, specialization, Diversification, Break-even analysis, BEP.

Production and Process Planning: Objectives of PPC, Component of PPC, Phases of PPC, Process planning, steps in process planning for flow shop scheduling, types of scheduling systems, master scheduling, order scheduling.

(12 Hrs)

Unit - III

Sales Forecasting Techniques: Types of forecasting, importance of demand planning, methods of sales forecasting, Qualitative and Quantitative methods of demand planning.

Inventory Control & Management : Introduction, Inventory, Deterministic model of EOQ, EOQ, Selective Inventory Control, Japanese Influences: Just in Time (JIT), Kanban etc.; Increasing Integration in Industrial Enterprises: From MRP to ERP to Supply Chain Management.

(12 Hrs)

Unit – IV

Recent Development in Manufacturing Systems: Performance improvement by IT skills - Decision Support System (DSS), Intelligent Systems. Engineering Managers, System and Process (ERP) Specialists, Change Managers, study the concept of SCM, TQM, TPM, CRM, and QFD etc.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Industrial Engineering	Ravi Shankar	Galgotia
Industrial Engineering & Management	O.P.Khanna	Khanna
Production Management	Ronald Mayer	TMH
Industrial Engineering & Management	Telesang	S.Chand

ME-P6202   PRODUCTION PLANNING & CONTROL

L T P   **Credits:3**
3 0 0

Unit – I
Introduction and Planning Phase of PPC: Components of PPC, Planning, routing, loading, scheduling and despatching, objectives and principles of PPC, Phases of PPC, factors affecting PPC, organization set up of PPC, types of production, Job Production, Batch production and Continuous production, Introduction to value analysis.

(12 Hrs)

Unit - II
Planning Phase of PPC: Definition and concept of forecasting, objectives and types of forecasting, Routing, function of routing, routing procedure, documents of routing, factors affecting routing procedure, its advantages and limitations.

(12 Hrs)

Unit - III
Process Planning: Sequencing: Johnson' rule for sequencing, types of sequencing, Scheduling, objectives of scheduling, functions, types of scheduling: Master scheduling, order scheduling, Index method of scheduling, Gnatt chart.

(12 Hrs)

Unit - IV
Action Phase of PPC and Control Phase of PPC: Despatching, duties of despatcher, despatch procedure, centralized and decentralized dispatching, Inventory control, objectives of inventory control, Economic Order Quantity, Progress reporting, Corrective action, Expediting and Replanning.

(12 Hrs)

Recommended Books

Title	Author(s)	Publisher
Industrial Engineering and Management	M. S Mahajan	Dhanpat Rai
Industrial Engineering and Management	O. P Khanna	Dhanpat Rai
Production Planning & inventory Control	Narisimtan Mcleavy Billington	PHI
Production and Operation Management	B.S. Goel	Pragati Prakashan
Production Planning & Inventory Control	P. S. Eilon	Rivermead Books.

ME-P6203   PLANT LAYOUT AND MATERIAL HANDLING

L T P   **Credits:3**
3 0 0

Unit - I
PLANT LAYOUT: Definition, Principle of plant layout, objectives, Classification of layout-static & mixed layout,
Advantages & limitations of layout: Analytical tools/procedures of layout ie operation process charts, flow process charts, flow diagrams, templates, scale model.

(12 Hrs)

Unit - II
Facility Location: Introduction, importance of plant location, factors affecting plant layout & location ,break even analysis, single & multi facility location problem, model for multifacility location problem, Minimax location problem

(12 Hrs)

Unit – III
Layout design: Production line techniques, prerequisites factors influencing layout design, storage space requirement, flow pattern, layout design procedure, SLP, ALDEP,CORELAP, CRAFT, Line balancing, assembly operations, numerical problems.

(12 Hrs)

Unit – IV
Material handling: Introduction, functions of material handling, engineering & economic considerations, principle of material handling, selection of material handling devices, classification of material handling equipments, material handling in process layout, & line layout.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Facility Layout & Location	Francis, R.L	Prentice hall Inc
Plant layout & material handling	Moore	John Wiley
Industrial Engineering Handbook	H.B Maynard	Mc Graw Hill
Industrial Engineering & production Management	M. Mahajan	Dhanpat Rai
Industrial Engineering & management	S. Dalela	Standard Publisher

ME-P6204   NON DESTRUCTIVE TESTING & FAILURE ANALYSIS

L T P   **Credits:3**
3 0 0

Unit - I
Introduction: Weld quality, Introduction to NDT, industrial importance of NDT, comparison between destructive and non-destructive testing.
Quality Concept and NDT: NDT as a quality tool, benefits from NDT, visual examination, liquid penetration and magnetic particle tests
(12 Hrs)

Unit - II
Ultrasonic Examination: Principles of wave propagation, ultrasonic fields and their characteristics, generation of US waves, piezoelectric and magnetostrictive effects, calibration and control of ultrasonic testing equipment, ultrasonic testing of materials, pulse echoes, through-transmission and resonance methods of testing.
Radiography: X-ray and Gamma ray sources, equipments and accessories, radiography techniques, image quality indicators and screens, X-ray films, film processing and interpretation, radiation safety, fluoroscopy, Xero-radiography.
(12 Hrs)

Unit – III
Recent Methods used in the NDT: Principles of acoustics emission, instrumentation and application, optical and acoustical holography, neutron radiography, thermography, and real time imaging.
(12 Hrs)

Unit - IV
Failure Analysis: Material failure and failure due to the environmental effects, common causes of failure in metals and alloys, failure due to the improper heat treatment (e.g. overheating, burning, improper quenching, decarburizing etc.), embrittlement of metals, residual stresses in metals and their effects, defects in production/manufacturing e.g. segregation, blow holes etc., fundamentals of crack propagation.
(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Metallurgy of Failure Analysis'	Das A.K	Tata Mc Graw Hill
Analysis of Metallurgical Failures'	Colangelo V.A. Heisler F.A.	John Wiley and Sons
Practical Non Destructive Testing'	Baldev Raj Jayakumar T	Narosa Publishing House

CH-7202A   ENERGY AUDIT & MANAGEMENT

L T P   **Credits:3**
3 0 0

Unit –I

Energy Scenario: Primary and Secondary Energy, Conventional and non-conventional energy, Energy Security, Energy Conservation and its importance, Energy conservation Act., Thermal Energy basics, Energy Audit its definition & methodology, Energy Audit Instruments, Benchmarking for energy performance, Energy Action Planning, Duties and responsibilities of Energy Manager; Energy financial management, Project Management, Energy monitoring and targeting, pinch technology.

Fuels and Combustions, Types of fuels, Important properties of fuels, calorific values, proximate and ultimate analysis of fuel, storage, handling & preparation of coal properties of gaseous fuels, combustion and combustion calculations, 3T's of combustion, Burners, Turndown ratio, draft.

(10 Hrs)

Unit –II

Boilers: Introduction, different types and their classification, performance evaluation of boilers, Thermal efficiency and its determination by direct and indirect method, Blow-down, boiler water treatment, external water treatment, feed water preheating, combustion air preheating, excess air control, energy saving opportunities in boilers. Fluidized bed boilers: principles of fluidization, circulating fluidized bed, bubbling bed boilers, pressurized fluid bed combustion, advantages of fluidized bed combustion boilers.

Industrial furnaces- Types & classifications of furnaces, shanky diagram, Performance and its evaluation of a typical furnace, Heat losses in a furnace, furnace efficiency, Determination using direct and indirect methods, fuel economy measures in furnaces, Heat distribution in a reheating furnace, furnace draught, optimum capacity utilization, waste heat recovery from flue gases

(12 Hrs)

Unit –III

Fans and Blowers: Difference between fans, blowers and compressors, Fan types, a centrifugal fans, arial flow fans, fan laws, fan design and selection criteria's, flow control strategies, fan performance, assessment, energy saving opportunities in fans.

Pumps & Pumping System: Types of pumps, pump curves, factors affecting pump performance, flow control strategies, Energy conservation opportunities in pumping system

(12 Hrs)

Unit –IV

Cooling Towers, flow control strategies, Energy saving options in cooling towers.

Refrigeration System: Introduction, types of refrigeration system, Performance assessment of a refrigeration system, COP, factor affecting performance, energy savings opportunities in refrigeration systems.

Compressed Air System: Compressor Type, free air delivery, efficiency of compression, leak test, energy efficiency opportunities in compressed air systems

(10 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
	Technical Literature published by Petroleum Conservation Research Association.	
Dr. Clive Beggs	Energy Management Supply & Conservation	Budseworth Heinemann- 2002
Albert Treemann & Paul Mehta	Handbook of Energy Engineering	The Fiarmout Press Inc
	Website of Bureau of Energy Efficiency	

CH-7202B   RUBBER TECHNOLOGY

L T P   **Credits:3**
3 0 0

Unit –I
General Introduction: Basic concept & definition, Rubber Plantation & Production of Natural Rubber, Degradation & Aging of rubbers

(08 Hrs)

Unit –II
Compounding: Types of additive used, Mastication for compounding, rubber: Carbon black, Rubber compounding & mixing, plasticizer, Zinc Oxide, Sulpher accelerators, Oxidents.

(12 Hrs)

Unit –III
Vulcanisation: Vulcanisation system (EV,Semi EV, CV) , Mechanism of vulcanisation.

(10 Hrs)

Unit –IV
Synthetic Rubber: Choloroprene Rubber, Silicone Rubber, SBR, Nitrile Rubber, Butyl rubber, Polyisobutylene; PU elastomer; Floroelastomer, Ethylene Propylene-Diene Elastomer.
Formation of Ruber products; Hose, Belt.

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Text Books:		
M. Morton	Rubber Technology	Van Nostrand Reinhold Co. (ACS)
J.A. Briston	Rubber Materials	
Reference Books:		
G. Alliger, I.J. Sjothun	Vulcanization of Elastomers	Robert E. Krieger Pub. Co., New York
Roberts	Natural Rubber Science & Technology	

CH-7202C   PETRO-CHEMICAL TECHNOLOGY

L T P   **Credits:3**
3 0 0

Unit –I
Feed Stock: Feedstock for petrochemical industry and their choice for different classes of products

(10 Hrs)

Unit –II
Conversion and Recovery: Conversion processes: Cracking reforming aliglation, cooking oxidation, Per sulpherization and sulpher recovery

(10 Hrs)

Unit –III
Separation and Purification: Techniques for separation of product and their purification

(10 Hrs)

Unit –IV
Applications: Petrochemical products and their uses in other industries such a Fertilizers, synthetics, lubricants etc

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
W.c. Nelson	Petroleum Refining Engineering	McGraw Hill
B.K. B.Rao	Modern Petroleum Refining Processes	Oxford IBH
P.Belov	Fundamentals of Petroleum Chemical Technology	Mir Pub. Moscow
A.L. Woddams	Chemical from Petroleum	GPC
B.K. Bhaskar Rao	A Text book on Petrochemicals	Khanna Pub. Co.

CH-7202D   SEPARATION PROCESSES

L T P   **Credits:3**
3 0 0

Unit –I
Introduction and Chromatographic Techniques: Introduction, classification, characteristics of separation processes, General theory, Column chromatography HPLC, GLC & affinity chromatography

(10 Hrs)

Unit –II
Ion Exchange Separation Techniques: Introduction of Ion exchange resins, Ion chromatography, electro-deposition, electro-phoresis.

(10 Hrs)

Unit –III
Separation Involving Floatation Etc: Foam fractionation, Gas & Liquid floatation, Separation by thermal definition, crystallization

(10 Hrs)

Unit –IV
Membrane Separation Processes: Osmosis and reverse osmosis, dialysis and electro dialysis, filtering & sieving, introduction to liquid membrane, per evaporation

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
Clifton,E. Meloan	Chemical Separations	John Wiley
Coulson & Richardson	Chemical Engineering, Vol. 2	Elsevier Publishers

CH-7202E   CORROSION ENGINEERING

L T P   **Credits:3**
3 0 0

Unit –I
Basic Concepts: Fundamentals of corrosion, corrosion rates and measurements, corrosion monitoring

(10 Hrs)

Unit –II
Types of Corrosion, High temperature corrosion, Environmental assisted corrosion, and Microbial corrosion, corrosion in water systems, Dry and wet corrosion

(10 Hrs)

Unit –III
Corrosion Prevention: Corrosion control or prevention, inhibitors, Organic barriers (coating), Inorganic barriers (Metallic linings), Electro-chemical protection, cathodic and anodic protection, passivation, Corrosion Resistant alloys

(10 Hrs)

Unit –IV
INDUSTRIAL Application: Chemical process industries, power generation, energy conversion, environmental protection, Railways, Automobiles, Aircrafts, case study for design alternatives in material selection for corrosion protection.
Polymer in corrosion: corrosion resistant polymer and their applications, Paint, coatings, lacquers, varnishes

(12 Hrs)

Recommended Books:

AUTHOR	TITLE	PUBLISHER
H.U. Uhlig	Corrosion and corrosion Control	John Wiley and Sons Inc.
L.L. Shrier	Corrosion Vol. 1 & 2	George Newns Ltd. London
W.J. Patton	Material in Industry	Prentice Hall
F.W. Baity	Fundamentals of Engineering Metallurgy	Cassel Publications
SISCO, F.T. Advisory Editor	Pitman Metallurgical Series	Pitman Publications.

CH-7202F   POLYMER MEMBRANES

L T P   **Credits:3**
3 0 0

Unit -I
Introduction: Basic understanding of modern separation processes such as Micro filtration, Ultra filtration and Nano filtration, Reverse Osmosis, Electro osmosis, Dialysis and Electro dialysis, Liquid and Gas permeation, Ion exchange separation and Pervaporation

(08 Hrs)

Unit -II
Mechanism: Characteristics of separation processes, Diffusion and Permeability, Membrane materials, Mechanism of transport: Transport through porous media, Solution diffusion transport, Facilitated and coupled transport, Transport through Ionomers

(06 Hrs)

Unit-III
Preparation and classification: Micro porous membrane, Asymmetric membrane, Coated asymmetric and Composite membranes. Preparation methods: Leaching, Phase inversion, Sintering, Stretching, Thermally induced phase separation, Trace etching

(08 Hrs)

Unit –IV
Characterization: Pore size and distribution, Bubble point test, Factors affecting retentively, Concentration and gel polarization, Fouling, Cleaning, Regeneration of membranes, Fuel cell, Application of membranes

(08 Hrs)

Recommended Books:

TEXT BOOKS:
Chemical Engg. Vol. 2   Coulson and Richardson   .
Synthetic Polymeric Membranes   Khulbe, Kailash C**.,** Feng, C.Y., Matsuura, Takesi

REFERENCE BOOKS:
Polymer Science and Technology   Joel R. Fried

CS-7104A   ADVANCE DATABASE MANAGEMENT

SYSTEMS

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction of DBMS: Types of DBMS and their advantages and disadvantages, Introduction of RDBMS, Types of relational query language, Normalization, Query optimization.

(12 Hrs)

UNIT-II
Database protection in RDBMS: Integrity, Concurrency control, Recovery.
Distributed Database: Concepts, structure, trade-offs.
Methods of data distribution: Fragmentation, replication, design & advance concepts of DDBMS.

(12 Hrs)

UNIT-III
Introduction to object oriented databases, Deductive databases.
Data warehousing Concepts: Architecture, Data-flows, Tools & Technologies, Data Marts

(12 Hrs)

UNIT-IV
Data Mining & Online Analytical Processing, Spatial & Multimedia databases, Mobile Computing & Mobile Databases.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Fundamentals of Database Systems	Elmasri, Navathe	Pearson Education.
Database Concepts	Henry F. Korth, A Silberschatz	Tata Mc Graw Hill.
Reference		
Database Systems	Thomas Conolly, Carolyn Begg	Pearson Education.

CS-7104B   CRYPTOGRAPHY

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction: Terminology: Security, Security Attacks, Security Services, Security Mechanisms, OSI Security Architecture, A Model for Inter-network Security, Internet Standards.

(12 Hrs)

UNIT-II
Symmetric Ciphers: Symmetric Cipher model, substitution techniques, Transposition techniques, Rotor machines, Steganography, Block Cipher principles, Data Encryption standard, Strength of DES, Differential and Linear Crypto-analysis, Block Cipher Design principles

Advanced Encryption Standard: Evaluation Criteria for AES, The AES Cipher, Multiple Encryption, Triple DES, Block Cipher modes of Operation.

(12 Hrs)

UNIT-III
Key Encryption and Hash functions: Public Key Cryptography Principles, Public-Key Cryptography Algorithms, Key Management, Diffie-Hellman Key exchange, Digital Signatures, Digital signature standard, Authentication protocols, Cryptography and Message Authentication, Approaches to Message Authentication, Secure Hash Functions and HMAC.

(12 Hrs)

UNIT-IV
Network Security Applications: Authentication Applications, Kerberos, X.509 Directory Authentication Service, Public Key Infrastructure, Kerberos Encryption Techniques Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME, Introduction to Firewalls.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Cryptography and Network Security	Principles and practices	William Stallings, PHI.
Network Security Essentials	William Stallings	PHI
Reference		
Computer Networks	A.S. Tanenbaum	PHI

CS-7104C DIGITAL SIGNAL PROCESSING

L T P   **Credits-4**
3 1 0

UNIT-I
Discrete Time Signals and Systems: Classification of signals, transformation of independent variable, Concept of frequency in discrete time sinusoidal and harmonically related complex exponential, Interconnection of systems, LTI systems: properties, impulse response convolution sum, Response of LTI systems to arbitrary input; LTI systems characterized by linear constant coefficient difference equations, structures for realization of LTI systems, recursive and non recursive realization of FIR systems.

(12 Hrs)

UNIT-II
Z-Transform: Introduction Z-transform pair, properties of region of convergence (ROC) for the Z-transform, properties of Z-transform, analysis and characterization of LTI systems using Z-transforms .System functions for interconnection of LTI systems. Block diagram representation for causal LTI systems described by difference equations and rational system functions.

(12 Hrs)

UNIT-III
Discrete Fourier Transform (Dft): Frequency domain sampling and reconstruction of discrete time signals, DFT, inverse DFT (IDFT), DFT as a linear transformation, relation ship of the DFT to other transforms, properties of DFT, use of DFT in linear filtering, filtering of long sequences, frequency analysis of signals, using DFT.
Fast Fourier Transform Algorithms: Direct computation of DFT, divide and conquer approach to computation of the DFT, radix-2 FFT algorithms, use of FFT algorithm efficient computation of the DFT of two real sequences, and of the DFT of a 2N point real sequence.

(12 Hrs)

UNIT-IV
Implementation Of Discrete Time Systems: Introduction, structures for FIR systems: Direct form, cascade form and lattice structure, structures for IIR systems: Direct form, cascade form, parallel form and lattice structures. Fixed point representation of numbers, errors resulting from rounding and truncation.
Design of Digital Filters: General considerations, causality and its implications, characteristics of practical frequency selective filters, design symmetric linear phase FIR filters using rectangular and hamming window.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Digital Signal Processing	A.V Oppenheim and R.W.Schafer	Pearson Ed.
Digital Signal Processing	S. Salivaharan, A Vallavraj C Granapriya	TMH
Reference		
Digital Signal Processing	Proakis & Manolakis	Pearson.

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CS-7104D   EMBEDDED SYSTEMS

L T P   **Credits-4**
3 1 0

UNIT-I
Introduction Review of Embedded Hardware: Terminology, Gates, Timing Diagram, Memory, Microprocessor Buses, Direct Memory Access, Interrupts, Built instructions on the Microprocessor. Conventions used on Schematic, Interrupts, Microprocessor Architecture, Interrupt Basic, Shared Data Problem,Interrupt Latency.

(12 Hrs)

UNIT-II
PIC Micro controller & Interfacing: Introduction, CPU Architecture, Registers, Instruction Sets, Addressing Modes, Programs, Interfacing Methods, Parallel I/O Interface, Parallel Port Interface, Memory Interfacing, High Speed I/O Interfacing, Interrupts – Interrupt Service Routine – features of Interrupts – Interrupt vector & Priority, Timing Generation & Measurements, Input Capture, Output Compare, Frequency Measurement, Serial I/O Device RS232, RS845, Analog Interfacing, Applications.

(12 Hrs)

UNIT-III
Software Development & Tools: Embedded System Evolution Trends, Round – Robin, Robin with Interrupts, Function Scheduling architecture, Algorithms, Introduction to assembler, Compiler and Cross compilers and Integrated Development Environment IDE, Object Oriented Interfacing, Recursion, Debugging Strategies, Simulators.

(12 Hrs)

UNIT-IV
Real Time Operating Systems: Task And Task States, Tasks and Data, Semaphores and shared data, operating system services, Message queues, Timer Function, Events, Memory Management, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Specification and Design of Embedded Systems	D. D. Gajski, F. Vahid J. Gong, S. Narayan	Prentice Hall.
Embedded systems Design	Steve Heath, Newnes	
Reference		
Hardware Software Co-design of Embedded Systems .	F. Balarin, Chiodo,	Academic Publishers

CS-7104E   NATURAL LANGUAGE PROCESSING

L T P   **Credits-4**
3 1 0

UNIT-I

Goals of NLP: Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, Language processors: recognizers, transducers, parsers, generators, Language as a rule-based system, Language understanding as an inferential activity.

(12 Hrs)

UNIT-II

Resources for NLP: lexicons and knowledge bases, Elements of formal language theory: alphabet, string, language, grammar, productions, symbol vocabulary, generator, recognizer, procedure, Types of grammar, the Chomsky Hierarchy.
Computational morphology: lemmatization, Part-of-Speech Tagging, Finite-State Analysis.

(12 Hrs)

UNIT-III

Parsing: Definition of a parser; derivations, basic parsing strategies for context free grammars, determinism and non-determinism; decidability, data structures and algorithms for parsing ,unification based grammar formalisms.

(12 Hrs)

UNIT-IV

Ambiguity and its resolution: Syntactic ambiguities and heuristics, lexical ambiguities and selectional restrictions, indeterminacy of reference
Generation and Dialogue: Syntactic generation algorithms and reversibility, text planning, modeling dialogue agents.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Natural language understanding	Allen, J.	Redwood City.
Readings in natural language processing	Grosz, B.J., Sparck Jones	B.L. (eds)
Reference		
Speech and Language Processing: An Introduction to Natural Language Processing,.	Jurafsky, D. & J. Martin.	Prentice Hall

CS-7104F   Operating Systems

L T P   **Credits:04**
3 1 0

UNIT-I

Operating System services.
Operating System classifications. Single user, multi-user, simple monitor, batch processing, Multiprogramming, Multiprocessor systems, Multitasking, time sharing, real time operation system.

Processor Management
Process Overview, process states, multiprogramming, levels of scheduler and scheduling algorithms, multiple-processor scheduling, Process,Threads, Process Scheduling objects and techniques.   12hrs

UNIT-II

Memory Management
Partition, paging and segmentation; types of memory management schemes, virtual memory-

demand paging, Page Replacement Algorithms, allocation Algorithms, Thrashing.

12hrs

UNIT-III

File Management
File supports, access methods, and allocation contiguous method, linked and index allocation; Directory, systems-single level, tree structured, cycle graph and general graph directory, file protection.

Resource Protection
Mechanism, policy and domain of protection, access matrix and its implementation, dynamic protection structure, protection problems, security.   12hrs

UNIT-IV

Deadlocks Characteristics
Prevention, avoidance, detection and recovery, Concurrent Process. Precedence graph, Berntein's condition, process hierarchy, critical section, semaphores, classical process co-ordination problems   12hrs

Recommended Books

Title	Author(s)	Publisher

CS-7104G   Algorithms & Simulation Techniques

L T P   **Credits: 4**
3 1 0

UNIT-1

System Models
Introduction to systems; scientific and nonscientific systems; discrete & continous systems; characteristics of systems ; different views of systems; Modeling of systems; physical and symbolic models; examples of models from various disciplines. Computer systems; electrical systems, economic system & inventory system.

UNIT-2

System Simulation
Continous systems simulation; analog versus digital simulation; basic operation & notation

for analog simulation; linear systems & simulationeous equation representation; digital

computer simulation; simulation of a real life time –dependent system via a programming

language such as Fortran/Pascal.

UNIT-3

Discrete system simulation-event, activity & process; representation of time: fixed stem vs. event-to-event model; analysis of a discrete system; generation of random number generation for microcomputers; testing of pseudo-random numbers; Monte Carlo computation; simulation of a real life discrete system.

UNIT-4

Introduction to Algorithm Analysis
Algorithm; Analyzing Algorithms; Designing Algorithms
Mathematical Foundations

Growth of functions-Asymptotic notation, standard notations & common function ;
Recurrences- substitution method, iteration method, recursion tree method, master method
Sorting and order Statistics

Recommended Books

Text

Title	Authors	Publisher

Simulation and modeling	Liffick	TMH
System Simulation with Digital Computer	Deo	PHI
Introduction to Algorithms	Coreman	PHI
Algorithm Analysis & Design	Harwitz and Sahni,	Galgotia Publications

Reference

Title	Authors	Publisher
Computer Simulation and Modeling	Neelamkavil,	John-Wiley
System Simulation	Gorden	**PHI**
The Design and Analysis of Computer Algorithms,	Aho, Hopcaroft, Ullman	Pearson

CS-7104H   Database Management System

L T P   **Credits:04**
3 1 0

UNIT-I

Introduction To Database Concepts

Difference between Database and non database system, Data independence, 3 level architectures, components of a database system, Example of transaction processing. Advantages and disadvantages of Database system.

Data Modeling

Data associations and Data relationships, ER Model;Design, issues, Mapping constraints, keys, ER diagram, weak entity sets, extended ER features, Design of an ER Database schema, Reduction of an ER Schema to tables.   12 hrs

UNIT-II

Database Design

Integrity Constraints: Domain constrants, Referential integrity, entity integrity, functional dependencies, pitfully in Relational database design, Decomposition, Normalization using FD's MVD's and JD's Domain key normal form, Denormalization, Approaches to database design.   12 hrs

UNIT-III

Relation Algerbra

SQL & Relational Calculus Query optimization
Introduction, overview of optimization process, expression transformation, Database statistics, A divide and conquer strategy, Implementing the relational operators. 12 hrs

UNIT-IV

Transaction processing

Transaction Concept, Transaction state, Implementation of Atomicity, and durability, concurrent execution, serializability, Recoverability, implementation of isolation, transaction   definition in SQL.

Overview of Backup and recovery process

Failure classification, storage structure, Recovery and atomicity, Log based recovers, shadow paging, Recovery with concurrent transaction, buffer management, failure with loss of non volatile storage, Advanced recovery techniques.   12 hrs

Recommended Books

Title	Author(s)	Publisher
Text		
Database system concepts	Korth, H. F. & A Silberchatz	MGHISE
Fourth Generation Languages	Martin, James	Prentice Hall
Reference		
Introduction to database system .	Date. C.J.	Addison Wesley
Database Systems	Bipin Desai	TMH

CS-7105A   OPERATING SYSTEMS INTERNALS

L T P   **Credits-4**
3 1 0

UNIT-I
Overview of the Operating System: Operating system, purpose and basics, services, assumptions about hardware, introduction to the kernel, system concepts, kernel data structures, system administration, architecture of the unix and windows NT operating systems.

(12 Hrs)

UNIT-II
Internal representation of files: Buffer headers, structures of the buffer pool, reading and writing disk blocks, advantages & disadvantages of buffer cache, structure of regular files, directories, i-nodes, conversion of pathnames to an in order superblock, allocation of disk blocks, open read & write file, file creation, change directory & root, change owner & mode, pipes, dup, link, unlink, mounting & unmounting file systems, file system abstractions & maintenance.

(12 Hrs)

UNIT-III
The structure of processes & process control: The process states & transitions, layout of system memory, context of a process, saving the context of a process, manipulation of process address space, process creation, signals, process termination, user id of a process, changing the size of a process, the shell, process scheduling, system calls, Intercrosses communications, process tracing, network communications, sockets.

(12 Hrs)

UNIT-IV
Memory management policies: Swapping and paging, demand paging, a hybrid system with swapping and demand paging, memory management in multi user operating systems.
Multiprocessor systems: Driver interfaces, disk drivers, terminal drivers, streams, problems of multiprocess systems, semaphores, solutions with master and slave processors, solutions with semaphores.

(12 Hrs)

Recommended Books:
Title   **Author(s)**   **Publisher**
Text
The design of the Unix O/S   Marrice J Back   PHI

CS-7105B   REAL TIME SYSTEMS

L T P   **Credits-4**
3 1 0

Unit I
Typical Real Time Applications: Digital Control, High level Controls, signal Processing other Real Time Application.
Hard v/s Soft real Time Systems: Jobs & Processors (Release time, Deadlines and timing Constraints, Hard and Soft timing Constraints, Hard and Soft Real time Systems.

(12 Hrs)

Unit II
A reference Model of Real Time System: Processors and Resources, Temporal Parameters of real time workload, Periodic Task Model, Precedence constraints and Data Dependency, other type of dependencies Functional Parameters, Resource Parameters of jobs and Parameters of Resources, Scheduling Hierarchy.
Commonly Used Approaches to Real – Time Scheduling: Clock driven approaches, weighted Round – Robin Approach, Priority – Driven Approach Dynamic Vs Static System, Effective release times and deadlines, Optimality of the EDF and LST Algorithms, Challenges in Validating timings Constraints in priority Driver system, Off line Vs online Scheduling.

(12 Hrs)

Unit III
Clock Driven Scheduling: Notations and assumptions, static, Timer – Driven Scheduler, General Structure of cyclic Schedules, Cyclic executives, Improving the average Response Time of Aperiodic Jobs, Scheduling Sporadic Job's, Practical considerations and generalisation, Algorithms for constructing static schedules, Pros & Cons of clock driven scheduling.
Priority – Driven Scheduling of Periodic Tasks: Static Assumptions, Fixed – priority Vs Dynamic Priority Algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM Algorithms.

(12 Hrs)

Unit IV
Multiprocessor Scheduling, Resource Access Control and Synchronization: Model of Multi processor & distributed Systems, Task Assignment, Multiprocessor Priority – Ceiling Protocol, Element of Scheduling Algorithms for End- to – End Periodic Tasks, Schedulability of Fixed – Priority End – to – End Periodic Tasks in Heterogeneous systems, Predictability and validation of Dynamic Multiprocessor systems.
Real-Time Communication: Model of Real Time Communication, Priority-based service Disciplines for switched networks, Weighted Round Robin Service Disciplines, Medium Access – Control Protocols of Broadcast networks, Internet and Resource Reservation protocols, Real – Time Protocols, Communication in Multicomputer Systems.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		

| Real Time Systems | Jane W.S. Liu | Pearson Education |
| Real Time Systems | C.M. Krishna, Kang G. Shin | McGraw Hill, |

CS-7105C   FAULT TOLERANT COMPUTING

L T P   **Credits-4**
3 1 0

Unit-I
Introduction: Fundamentals of fault tolerance: safety critical systems, dependability, maintainability, fault error failure, redundancy and dependability evaluation techniques.

(12 Hrs)

Unit-II
Hardware Architectures for Fault Tolerance: Fault tolerant Architectures –high availability systems, long-life systems and critical computations, fault tolerant multiprocessors and distributed architectures-forward recovery schemes. Fault tolerance in interconnection networks. Case studies of fault tolerant multiprocessors and distributed systems.

(12 Hrs)

Unit-III
Analysis of dependability of computer systems: Application of various statistical techniques to design, prototype and operational phases, reliability estimation techniques.

(12 Hrs)

Unit-IV
Fault Tolerant Software: Design diversity, Software reliability modes, acceptance tests, exception handling System level diagnostic techniques: bounded and probabilistic models.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Fault Tolerant Computer system design, Software Fault	D.K. Pradhan,	Prentice Hall
Tolerance Techniques and Implementation, Hardware and Software	Laura L.Pullum,	Artech
Architectures for Fault Tolerance: Experiences and Perspectives,	Michel Banatre,	Springer
Reference		
Coding Approaches to Fault Springer Tolerance in combinational and Dynamic Systems,	C N Hadjicostis	

CS-7203A   DIGITAL IMAGE PROCESSING

L T P   **Credits-4**
3 1 0

Unit-I

Image model, human vision, digital images representation, image acquisition, storage, processing, communication and display, Image Geometry, Image transformations, Discrete Fourier transformation, Fast Fourier Transformation, other represent able image transformation.

(12 Hrs)

Unit-II

Image enhancement, special domain and frequency domain methods, enhancement by point frequency, special filtering, enhancement in frequency domain, color image frequency.

(12 Hrs)

Unit-III

Image restoration, degradation model, algebraic approval to restoration, constrained least square restoration, Interactive restoration, restoration in special domain.

(12 Hrs)

Unit-IV

Image compression, image compression models, loss less and glossy image compressions methods. Image segmentation, detection of discontinuities, edge detection and boundary detection, shareholding, Region oriented segmentation.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Digital image processing,	Rafacl C. Gonzalez,	Addison Wesley
Digital Image Processing,	Jain Tenber,	PHI
Introductory Computer		
Reference		
Vision and Image Processing,	Adrian Low,	MCGraw Hill
Digital Processing,	Rasenfeld P Kak,	Academic Press

CS-7203B   SOFTWARE RELIABILITY & TESTING

L T P   **Credits-4**
3 1 0

Unit-I
Introduction: Software Reliability & Hardware Reliability, Basic Concepts, Availability, Modeling.
Selected Models: Execution Time Component, Calendar Time Component, Model Choice.

(12 Hrs)

Unit-II
Applications: System Engineering, Project Management, Management of Operational Phase, Evaluation of S/W Engg Technologies.

(12 Hrs)

Unit-III
System Definition: Failure definition, System Configuration, Text Run Selection.
Parameter Determination: Execution Time Component, Calendar Time Component.

(12 Hrs)

Unit-IV
Project Specific Techniques: Unobserved Failures, Failure Time Measurement, Evolving Programs, Changes in Environment, Other Consideration.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Software Engineering concepts	Pressman	TMH

CS-7203C   NETWORK PROGRAMMING

L T P   **Credits-4**
3 1 0

UNIT-I

Introduction: OSI model, processes, client server model, signals, process control, daemon processes Interprocess Communication, File and record locking, pipes, streames and messages, name spaces, message queues, semaphores, shared memory.

(12 Hrs)

UNIT-II

Communication Protocols: Formats of the TCP/IP,XNS, SNA ,NetBIOS, OSI Protocols and UUCP, Protocols comparison.

(12 Hrs)

UNIT-III

Berkley Sockets: Unix Domain Protocols, socket addresses, reserved ports, stream pipes, Asynchronous I.O, Input /Output Multiplexing, socket system calls, socket implementation.
Transport Layer Interfaces: Transport End point addresses, streams, and TLI implementation.

(12 Hrs)

UNIT-IV

Trivial File Transfer Protocol: Data formats, connection, client user interface, UDP implementation, TCP implementation.
Remote Login: Terminal Line disciplines, Pseudo Terminals, Terminal modes, Windowing environment, rlogin client/server
Remote Procedure Calls: Transparency issues, Sun RPC, Xerox Courier.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Unix Network Programming	Richard Stevens	PHI

CS-7204A MOBILE & CELLULAR TECHNOLOGIES

L T P **Credits-4**
3 1 0

UNIT I
The Mobile Radio Environment: Representation of a mobile radio signal, Causes of propagation path loss and fading, Classification of channels, Definitions of necessary terms (averages, pdf, CPD etc.), Delay spread and coherence bandwidth, Diversity schemes, Combining techniques.

(11 Hrs)

UNIT II
Mobile Radio Interference: Co-channel and adjacent-channel interference, Near-and-to-far end ratio, Inter symbol and Simulcast interference.
Frequency Plans & Cellular Concept: Channelized schemes and frequency reuse, FDM, TDM, Spread Spectrum & Frequency hopping, Cellular concept, Frequency reuse and cell separation, HO, Spectral efficiency and cellular schemes, Separation between co-channel cells.

(13 Hrs)

UNIT III
Design Parameters: At the Base Station: Antenna locations, Antenna spacing and height, Noise environment. At the Mobile Unit: Antenna spacing and height, Mobile unit standing still and in motion.
Signaling & Channel Access: False alarm & Word-error rates (Gaussian environment), Channel assignment, Frequency assignment, Under Lay and Overlay Configurations.

(13 Hrs)

UNIT IV
Cellular CDMA: Narrowband & Wideband wave propagations, Key elements in designing cellular, Spread Spectrum techniques in modulation, Capacities of multiple-access schemes, DS-CDMA, FH-DCMA, TH-CDMA.
Microcell: Design of a conventional cellular system, Description of new micro cell system design.

(11 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Mobile Communications Design Fundamentals	W.C.Y. Lee	John Wiley & Sons.
Mobile Cellular	W.C.Y. Lee	Telecommunication Systems.
Reference		
Wireless and Cellular Communications	William C. Y. Lee	McGraw-Hill

CS-7204B   SIMULATION & MODELLING

L T P   **Credits-4**
3 1 0

UNIT-I
System Models: Introduction to systems; scientific and nonscientific systems; discrete & continuous systems; characteristics of systems; different views of systems; odeling of systems; physical and smbolic models; examples of models from various disciplines, Computer systems; electrical systems, economic system & inventory system.

(12 Hrs)

UNIT-II
System Simulation: Continuous system simulation; analog versus digital simulation; basic operation & notation for analog simulation; linear systems & simultaneous equation representation; digital computer simulation; simulation of a real life time-dependent system via a programming language such as Fortran/Pascal.

(12 Hrs)

UNIT-III
Discrete system simulation-event, activity & process; representation of time; fixed stem vs. event-to-event model; analysis of a discrete system; generation of random number generation for microcomputers; testing of pseudo-random numbers; monte-carlo computation; simulation of a real life discrete system.

(12 Hrs)

UNIT-IV
Computer language for simulation of continuous & discrete systems; characteristics of a simulation language; introductory discussion of CSMP, GPSS and SIMSCRIPT.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Simulation and Modeling	Liffick	TMH
System Simulation with Digital Computer	Deo	PHI
Reference		
Computer Simulation and Modeling	Neelamkavil,John-Wiley	
System Simulation	Gorden	PHI

CS-7204C   OPERATIONS RESEARCH

L T P   **Credits-4**
3 1 0

UNIT I
Linear Programming: Basic concepts and notations. Mathematical formulation of linear programming problem(L.P.P.), Graphical solution, Fundamental theorem, Standard format, Simplex method, Two phase method, Big M method, Degeneracy, Primal and Dual, Solution of primal and Dual and vice versa, Complementary slackness condition.

(13 Hrs)

UNIT II
Transportation and Assignment Problem: Basic concepts and notations. Balanced and unbalanced transportation problems. Initial BFS of TP using North West corner rule, Matrix Minima method and Vogel's approximation method, Improving an initial BFS to optimum BFS, Transshipment problem, Definition of assignment problem, Hungarian method to solve assignment problem.

(11 Hrs)

UNIT III
Network Analysis and Models: Notations and definitions, Arrow diagram, CPM (Critical Path Method) and PERT (program evaluation and Review Technique), Crashing, Maximum Flow Problem (MFP) and Shortest Path Problem (SPP).
Game Theory: Introduction, Maximum and Minimum criterion, Saddle point, Games without a saddle point, 2*2 games with and without saddle point (Mixed strategies), Two persons zero sum 2*n or n*2 games, Dominance rule, Graphical method solution.

(13 Hrs)

UNIT IV
Queuing Theory: Notation and basic concepts, Analysis of M/M/1/FCFS and M/M/1/C/FCFS with poisson pattern of arrivals and exponentially distributed service time).

(11 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Operation Research	A.H. Taha	PHI Pvt. Ltd.
Operation Research	S.D. Sharma, Kedar Nath Om Prakash	
Reference		
Operation Research	D.S. Hira, P.K. Gupta,	S. Chand & Co.

CS-7204D   DISTRIBUTED OPERATING SYSTEMS

L T P   **Credits-4**
3 1 0

UNIT-I

Introduction to Distributed Systems: Advantages of distributed systems over centralized systems, hardware concepts, bus based and switched multi-processors, based and switched multi-computers, software concepts- network operating system, true distributed systems, design issues: transparency, flexibility, reliability, performance and scalability.

(13 Hrs)

UNIT-II

Communication in distributed systems: Layered protocols, asynchronous transfer mode, networks, client server models, remote procedure calls, introduction to group communication, Synchronization in distributed systems, Clock synchronization, mutual exclusion algorithms, election algorithms, atomic transactions, deadlocks in distributed systems.

(13 Hrs)

UNIT-III

Processes and processors in distributed systems: Threads, system models, processor allocation models, scheduling in distributed systems, fault tolerance, real time distributed systems.

(11 Hrs)

UNIT-IV

Distributed file systems: Design, implementation, trends in distributed file systems, Distributed shared memory concepts, consistency models, page based shared variables and object based distributed shared memory.

(11 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Distributed Operating Systems	Andrew S. Tanenbaum	Pearson Education
Distributed operating Systems	Pradeep K. Sinha	PHI
Reference		
Distributed Operating Systems and Algorithm Analysis	R. Chow, T. Johnson	Pearsaon

CS-7204E   SOFT COMPUTING

L T P   **Credits-4**
3 1 0

Unit-I

Fuzzy Set Theory: Introduction to Fuzzy Sets, Operation on Fuzzy Arithmetic and Fuzzy Relations.

Fuzzy Rules and Fuzzy Reasoning: Multi-valued logics, Fuzzy propositions, Fuzzy Quantifiers, Linguistic Hedges, Fuzzy Inference and Reasoning, Rules Composition and Defuzzification, Examples of use of Fuzzy logic in control of real world systems.

(12 Hrs)

Unit-II

Genetic Algorithms: Biological background of Genetic Algorithms; Simple Genetic Algorithm, Chromosome representations; crossover operations; Mutation operations, Operational Rates; concept of exploration and exploitation , Selection Schemes; Fitness function design; Population size; Replacement Schemes; Parameter tuning and control, Convergence of algorithm, Application of Genetic Algorithms.

(12 Hrs)

Unit-III

Artificial Neural Networks: Introduction to Biological Neuron, Architecture, Learning: Supervised and Unsupervised, Back-propagation and Feed-forward Networks, Perceptron, Adaline, Back-propagation Multilayer Perceptrons, Back-propgation Learning Rule, Methods of Speeding, Radial Basis Function Networks, Support Vector Machine. Competitive Learning Networks, Kohonen self-organizing networks, The Hopfield Network.

(12 Hrs)

Unit-IV

Neuro- Fuzzy Modeling: Neural Networks and Fuzzy Logic, Fuzzy Neuron, Fuzzy Perceptron, Fuzzy classification Networks using Backpropogation, Fuzzy Neural Inference System, Fuzzy Adaptive Resonance Theory, Fuzzy Associative Memory, Neural-Fuzzy Systems, Neuro Fuzzy Evolutionary Integration.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Neural Networks, Fuzzy Sets and	Satish Kumar,	TMH
Fuzzy Logic: Theory and Applications,	George J, Bo Yuan,	PHI
Reference		
Genetic Algorithms: Concepts and Designs,	Man and Kwong ,	Springer Verlag

EC-7104A   OPERATION RESEARCH

L T P   **Credits:4**
3 1 0

Unit I
Scope of Operations Research: Introduction to linear and non-linear programming Formulation of different models.
Linear Programming: Geometry of linear programming, Graphical method, Linear program in standard form, Solution of LP by Simplex and Revised Simplex methods, Exceptional cases in LP, Duality theory, Dual Simple method, and Sensitivity analysis.

(12 Hrs)

Unit II
Network Analysis: Transportation problem (with transshipment), Assignment problem, Traveling-salesman problem, Shortest route problem, Minimal spanning tree, Maximum flow problem. Branch and bound algorithm, Traveling salesman problem.
Dynamic programming: Forward recursions, General problem, Reliability problem, Capital budgeting problem, and Cargo-loading problem.

(12 Hrs)

Unit III
CPM and PERT: Drawing of networks, Removal of redundancy, Computing Earliest occurrence time, Latest occurrence time, Free slack, Total slack, Crashing, Resource allocation. Non-Linear Programming: Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions, One dimensional search methods, Fibonacci and golden section method, Optimization using gradient methods for unconstrained problems.

(12 Hrs)

Unit IV
Nature and objectives of research: Methods of Research, historical, descriptive and experimental Alternative approaches to the study of the research problem and problem formulation. Formulation of hypotheses, Feasibility, preparation and presentation of research proposal.
Sampling: Primary and secondary data, their collection and validation, methods of sampling: Simple random sampling, stratified random sampling and systematic sampling.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Research Methodology	C.R. Kothari	Wishwa Prakashan
Research Methodology	P.G. Tripathi	S. Chand & Sons

Reference Books

Title	Author	Publisher
Statistical Analysis for Engineers & Scientists	J.W. Barnes	McGraw Hill, N. York
Measurement & Prediction	Stoufferetal	Wiley, N. York
Business Research Methods	Donald Cooper	TMH

EC-7104B   MOBILE COMMUNICATIONS

L T P   **Credits:4**
3 1 0

Unit I

Introduction: History of wireless communication, Need of mobility, Application of wireless communication, Cellular concept.
First Generation (1G) Mobile Systems: Advanced Mobile Phone System (AMPS) and Nordic Mobile Telephony (NMT), frequency allocation, channels, modulation, multiple access scheme, network operation.
(12 Hrs)

Unit II

Second Generation (2G) Mobile Systems: Network architecture, channels and operation of GSM, CDMAOne (IS-95), and IS-41, mobility management, Network operations of GPRS, CDMATwo (IS-95B), CDPD, and HCSD.
(12 Hrs)

Unit III

Third Generation (3G) Mobile Systems: 3G spectrum requirements, enabling technologies, service classes, applications and radio access standards (WCDMA and CDMA2000), Introduction to EDGE and WLAN. Introduction to 4G.
(12 Hrs)

Unit IV

Network Layer Mobility: Mobile IP, Goals, Assumptions and requirements, Entities and terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunnelling and Encapsulation , Optimisation , Reserve Tunnelling, ipv6 Protocol, Dynamic Host configuration Protocol(DHCP), Micro-mobility.
(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Mobile Communications	J.Schiller	Pearson Education

Reference Books

Title	Author	Publisher
Obaidat	Nicopolitidis	Papadimitriou
Wireless Networks	Pomportsis	John Wiley and Sons

EC- 7104C   ELECTRONIC INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Basic Concepts of Measurement, measurement system, basic characteristics of measuring devices.
Transducers: Transducers: Measurement of displacement, strains, vibration, pressure, flow, level, temperature, light, PH, humidity, performances, characteristics, characteristics and selection for a given application.

(12 Hrs)

Unit II
Electronic Measuring Instruments: Advanced Sernescope and displays, high speed oscilloscope, sampling oscilloscope, DSO wave analyzer, distortion analyzer, modulation analyzer, spectrum analyzer, wave meters, digital phase meters, frequency synthesizer, logic state analyzer, LCR meters.

(12 Hrs)

Unit III
Data Acquisition and Transmission: Objectives of DAS, signal conditioning of inputs, single channel DAS, multi-channel DAS, computer based DAS, data loggers, sensors based computer data system, electromechanical ADC, digital transducer, data transmission system, comparison of analog and digital data transmission, modems.

(12 Hrs)

Unit IV
Recorders and Display Devices: Strip chart recorder, Galvanometer type recorder, null type recorder, circular chart recorder, X-Y recorder, magnetic recorders, FM recording, digital data recording, potetiometric recorder, digital memory waveform recorder, digital display system and indicators, classification of displays, LED, seven segment display, LCD, Nixie tube.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Electrical and Electronics Measurements and Instrumentation	AK Sawhney	Dhanpat Rai and Co, New Delhi

Reference Books

Title	Author	Publisher
Electronics Measurement and Instrumentation	HW Cooper	Prentice Hall India Ltd
Principles of Measurement System	J P Bartley	Longman London

EC-7104D   SOFTWARE TOOLS FOR ELECTRONIC DESIGN

L T P   **Credits:4**
3 1 0

Unit I
Introduction: What is VHDL, History, Capabilities, Hardware abstraction, Basic terminology, Entity declaration, Architecture body, Configuration declaration, Package declaration, package body.

(12 Hrs)

Unit II
Behavioral Modeling: Entity declaration, Architecture body, Process assignment statement, Signal assignment statement, Wait statement, If statement, Case statement, Null statement, Loop statement, Exit statement, Next statement, Assertion statement, other sequential statements, Multiple processes, Postponed Processes.

(12 Hrs)

Unit III
Dataflow Modeling And Structural Modeling: Concurrent signal assignment statements, Concurrent versus sequential signal assignments, Delta delay revisited, Multiple drivers, conditional and Selected signal assignment statements, Block statement, Concurrent assertion statement, component declaration, Component instantiation, Resolving signal values.

(12 Hrs)

Unit IV
Graphical Programming in Lab VIEW: Lab VIEW basics, Lab VIEW environment, panel and diagram windows, virtual instruments, front panel, block diagram, building virtual instrument, data flow programming, building VI using express VIs, simple worked examples

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
VHDL Primer	J. Bhasker	Pearson Education
Learning with Lab VIEW 7 Express by	Robert H. Bishop	Pearson Education

Reference Books

Title	Author	Publisher
VHDL Programming by Example	Dougles L. Perry	Tata Mcgraw Hill
Introductory VHDL from Simulation to Synthesis using Lab VIEW.	Sudhakar Yatamanchili	Pearson Education

(12 Hrs)

EC-7105A   TELEVISION ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Fundamentals Of Television: Characteristics of eye and television pictures – Resolution and brightness gradation. Theory of Scanning. Camera tubes – Vidicon and Silicon diode array vidicon, Monochrome picture tube, Composite.

(12 Hrs)

Unit II
Monochrome Television Receiver: Transmission and Propagation of TV signal, TV antenna, Receiver: VHF Tuners, Vision IF subsystem, Inter carrier sound system, Video amplifiers, Synchronous separation AFC and deflection Oscillators frame and line deflection circuits.

(12 Hrs)

Unit III
Color Television Systems: Color Characteristics– Color cameras Color picture tubes, Color signal generation and encoding, NTSC, PAL and SECAM Systems.
Color Television Receivers: Block diagram of PAL-D receivers, Luminance channel, Chrominance amplifier, Color burst separation and burst phase discriminator, Sub carrier Oscillator AGC circuits, Ident and color killer circuits, U and V demodulators, R, G, B matrix and drivers.

(12 Hrs)

Unit IV
Special Topics In Television: The dimensions of video signals, dimensions of the Nyquist volume, significant frequencies in the Nyquist volume, signal distinctions in the Nyquist volume, distinctions by energy levels, distinctions by modulation method, distinctions by filtering, cooperative three dimensional filtering.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Modern Television Practice	Gulati.R.R	New Age Int.

Reference Books

Title	Author	Publisher
Television and Video Engineering	Dhake.A.M	McGraw
Basic television and video systems	Grob.B	McGraw

EC-7105B   RELIABILITY ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Reliability concepts and patterns of failure, Reliability management, Reliability for system effectiveness.

(12 Hrs)

Unit II
Reliability And Hazard Rates: Failure data, reliability function, failure rate and hazard rate, common distribution in failure mechanism, exponential weibusi-gamma,log normal extreme value, model selection for component failures, failure analysis.

(12 Hrs)

Unit III
Reliability Prediction And Analysis: Reliability prediction based on exponential distribution, system reliability analysis-block diagram method, fault tree and secon tree method, luen tree method, and failure mode and failure mechanisms.

(12 Hrs)

Unit IV
Reliability Design: Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Reliability Engg & Technology	A.K Gupta	Macmillan India ltd Delhi

Reference Books

Title	Author	Publisher
Introduction to Reliability engineering	E S Lewis	John Viley & sons New York

EC-7105C   EMBEDDED SYSTEMS

L T P   **Credits:4**
3 1 0

Unit I

Introduction: An Introduction to Embedded Systems, Real-Time Systems, Hard Real-Time, Soft Real-Time. Real-Time Embedded Systems, Embedded Processors, The Advent of PC Embedded Systems, PC Hardware Components, Embedded system Design, Tools and components.

(12 Hrs)

Unit II

8051 Microcontroller: Embedded System Hardware Approach, Overview of 8051 family, ADC /DAC Interface issues, Timer/Counter Programming in the 8051, 8051 Serial Communication, Interrupts Programming, Real World Interfacing, Sensors, Stepper Motor, Keyboard, DAC, 8051/31 Interfacing to External Memory.

(12 Hrs)

Unit III

80196 Microcontroller: Intel 80196 micro controller – CPU operation – Memory space – software overview – Peripheral overview – Interrupts -Programming concepts (Not in detail). Peripheral Interface Controller (PIC)-General architecture-PIC16F84-Architecture-Addressing modes-Instruction set-Simple Programming (Not in detail)

(12 Hrs)

Unit IV

Real Time Operating Systems: Embedded System Software: Round Robin with Interrupts, Function-Queue-Scheduling Architecture, Introduction to Real-Time Operating Systems, Real-Time Operating System Architecture, Selecting Architecture, Tasks and Task States, Tasks and Data, Real Time and Embedded Linux: Features.

(12 Hrs)

EC-7105D   COMPUTER ARCHITECTURE DESIGN

L T P   **Credits:4**
3 1 0

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
The 8051 Micro controller and Embedded Systems	M. A. Mazidi and J. G. Mazidi	
Real-Time Programming: A Guide to 32-bit Embedded Development	R. Grehan, R. Moote, and I. Cyliax	Pearson Education

Reference Books

Title	Author	Publisher
An Embedded Software Primer	D. E. Simon	Pearson Education
Embedded Linux: Hardware, Software, and Interfacing	C. Hollabaugh	Pearson Education

Introduction: Evolution of computer, hardware, software and firmware, Computer architecture, Types of computer, future trends, Different types of buses

(12 Hrs)

Unit II

Computer Instruction Set: Introduction, opcode encoding, Addressing modes, Instruction types, data transfer, arithmetic, logical, program and system control, Reduced Instruction set computers, Introduction to parallel processing.

(12 Hrs)

Unit III

Execution Unit: Introduction, general register and combinational shifter design, flag register, Adders, ALU design, bit slice processor, Coprocessors.
Control Unit: Introduction, basic concepts, Design methods: hardware control design and micro programmed control unit

(12 Hrs)

Unit IV

Memory Organization: Introduction, characteristics of memory systems, main memory design, popular electromechanical memory devices, memory hierarchy, cache memory. Associative memory, virtual memory and memory management concepts
Input/Output: Basic concepts programmed I/O, standard vs memory mapped /o, Interrupt I/O, Direct Memory address.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Modern Computer Architecture	RAFIQUZZAMAN and CHANDRA,	Galgotia

Reference Books

Title	Author	Publisher
Computer Architecture	HAYES	McGraw Hill

EC-7105E   STATISTICAL AND COMMUNICATION THEORY

L T P   **Credits:4**
3 1 0

Unit I

Review of Signals and Systems: System theory, Stochastic process, Representation of Stochastic Process, Likelihood and Sufficiency.

(12 Hrs)

Unit II

Random processes: Review of Probability Theory, Random variable, Two random variables, Random Process classification, Stationary and non-stationary process, correlation functions, Stochastic Integrals, Fourier transform of random process, Ergodicity and power spectral density, transformation of random process by linear systems, Representation of random processes, White Gaussian Noise, Shot noise processes, Markov processes.

(12 Hrs)

Unit III

Detection Theory: CFAR Detection, Sequential detection, Walds test, Detection of known signals in white noise, the correlation receiver, Detection of known signals in coloured noise, Maximum SNR Criteria.

(12 Hrs)

Unit IV

Estimation Theory: Bayes estimation, Real parameter estimation, Maximum likelihood estimation, Cramer Rao inequality, lower bound on the minimum mean square error in estimating a random parameter, General gaussian problem.

Estimation of Waveforms: Linear MMSE of waveforms, Estimation of stationary process, The Wiener Filter, Estimation of non-stationary process, The Kalman filter.

(12 Hrs)

EC-7105F   DIGITAL LOGIC CONTROLS

RECOMMENDED BOOKS:

Text Books

Title	Author	Publisher
Statistical Theory of Communication, 2nd edition	Yuk Wing Lee	
Statistical Communication Theory	B.P. Lathi	

Reference Books

Title	Author	Publisher
Probability random variables and stochastic processes, 4th edition	Athanasios Papoulis	
Digital communication" 2nd edition	Bernard Sklar	

L T P   **Credits:4**

3 1 0

Unit I

Transform Analysis of Sample Data System: Introduction to sampling data control system, Linear difference equations, input model of discrete time system, pulse response,

Z-transform, linear discrete systems (LDS), inverse Z-transform and response of linear discrete systems, Z and S domain relationship, stability analysis.

(12 Hrs)

Unit II

Digital Control System: Introduction, sampled signal representation, hold device, pulse transfer function, block diagrams, transient response, design of digital controller, process delays, digital controller for dead beat response, discrete time state equations, similarity transformations, system representation in Jordan Canonical form, Cayley-Hamilton theorem, state equations for sampled data system.

(12 Hrs)

Unit III

Sequence Control: Input and output devices, logic functions and diagrams, fluidic devices including logic elements, operations using fluidic elements, , ladder diagrams, Relay ladder diagrams, timers, hydraulic and pneumatic actuating systems, programmable logic controllers.

(12 Hrs)

Unit IV

Programmable Logic Control: Characteristics function of PLC, block diagram of PLC and applications, PLC hardware, input/output modules, processor, power supply, programmable devices, memory organization, programming basics, ladder logic diagram, ladder programming basic instructions, simple programming example of a manufacturing unit., introduction to distributed control system and their application in process control automation.

(12 Hrs)

EC-7105G   NEURAL NETWORKS, FUZZY LOGICS AND GENETIC ALGORITHMS

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Digital Control System	C.H. Hosteller	McGraw Hill
Digital Control System	Nagrath Gopal	Wiley Easten

Reference Books

Title	Author	Publisher
Digital Control System	Chan. Mourad	Prentice Hall
Digital communication" 2nd edition	Bernard Sklar	

L T P   **Credits:4**
3 1 0

Unit I

Neural Networks characteristics: History of development in neural Networks Principles, Artificial Neural Net terminology, Model of a neuron, topology, learning types of learning supervised unsupervised, re-inforcement learning.

Basic Hopfield Model: the perceptron, linear separability, Basic learning laws: Hebb's rule,Delta rule, Widrow & Hoff LMS learning rule, correlation learning rule, instar and outstar learning rules.

(12 Hrs)

Unit II

Unsupervised learning: competitive learning, K-means clustering algorithm, Kohonen's feature maps.

Radial Basis: Function neural networks, basic learning Laws in RBF nets, Recurrent networks, recurrent back propagation, and Real Time Recurrent learning algorithm. Introduction to counter Propagation networks, CMAC networks, ART networks.

Applications of neural nets such as pattern recognition: optimization, associative memories, vector quantization, control, Applications in speech and decision-making.

(12 Hrs)

Unit III

Fuzzy Logic: Basic concepts of Fuzzy Logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of fuzzy sets, fuzzy IF-THEN rules, variable inference, techniques, defuzzication techniques, basic fuzzy inference algorithm, Applications of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.

(12 Hrs)

Unit IV

Introduction to Evolutionary Computation: Biological and artificial evolution, Evolutionary computation and AI, Different historical branches of EC, e.g., GAs, EP, ES, GP, etc., A simple evolutionary algorithm, genetic algorithmic methods and applications.

(12 Hrs)

EC-7203A   HDTV ENGINEERING

L T P   **Credits:4**
3 1 0

Text Books

Title	Author	Publisher
Neural Networks	Simon Haykin -	Pearson Ed

Reference Books

Title	Author	Publisher
Fuzzy Systems Design Principles, Building Fuzzy IF-THEN Rule Bases	By Riza C. Berkin & Trubatch, JeeeBcss	Chand Publishers
"An Introduction to Genetic Algorithms for Scientists and Engineers"	David A Coley,	World Scientific Publishing Company, (1997).

Unit I

High Definition Television-Its Status and Rospectus: Introduction, Aspect ratio, Viewing distance, HDTV channel requirements, Compatibility, Outlook for Direct Broadcast Satellite Service, Out looks for Videotape and discs.

Techniques of Advanced Television System: Improvement in horizontal resolution, Improvement in vertical resolution, Display dimensions, Luminance-chrominance filtering in transmission, Signal compression for satellite service- The MAC system, The MUSE system, Bandwidth requirements for HDTV distribution system, Bandwidth requirements for terrestrial HDTV service, Signal occupancy within conventional channels.

(12 Hrs)

Unit II

Visual Aspects of High Definition Images: Objectives of HDTV service, Foveal and peripheral vision, Vertical details and viewing distance, Horizontal detail and picture width, Total details content of the image, Perception of depth, Contrast and tonal range, Luminance and chrominance, Chromatic aspects of vision, temporal factors of illumination, Continuity of motion, Smear and related effect, Flicker, Defects of interlaced scanning.

Digital Operations In Video Systems: Post detector digital processing, Line, field and frame stores, Digital filters, Digital processing of television sound.

(12 Hrs)

Unit III

Space And Time Components Of Video Signals: The dimensions of video signals, dimensions of the Nyquist volume, significant frequencies in the Nyquist volume, signal distinctions in the Nyquist volume, distinctions by energy levels, distinctions by modulation method, distinctions by filtering, cooperative three dimensional filtering.

Compatibility In HDTV Systems: Definition of compatibility, compromises in compatibility system, classes of compatibility, the transcoding functions, single and wide channel compatibility, simulcasting.

(12 Hrs)

Unit-IV

The 1125 Line HDTV System: Status of the 1125 line system, Basis of NHK 1125 line system, Equipment development, Transmission and modulation methods, Noise in 1125 line MUSE service, signal compression in MUSE system.

Picture Displays: Classification, Format development, cathodes ray tube displays, Flat panel displays, CCD displays.

(12 Hrs)

EC 7203B   INDUSTRIAL AUTOMATION

L T P   **Credits:4**
3 1 0

Unit I

Mechatronics, Sensors and Transducers: Introduction to mechatronics systems, utility of automation, automation process, simple example, sensors for displacement, position, proximity, velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light,

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
HDTV	K. Blair Benson & Donald G. Fink	McGraw Hill

Reference Books

Radio and TV Engg	G. K. Mittal	Khanna Publisher
Electronic Communication systems	Kennedy	MacGraw Hill
Monochrome and Colour TV	R. R. Gulati	Dhanpat Rai & Sons

selection criterion, digital transducers including encoders, optical encoders, rotational speed sensors and tacho-generators, robotics and tactile sensors, smart sensors.

(12 Hrs)

Unit II

Control Actions and Components: On-off, proportional, PI, PD, PID actions, pressure transmitters, temperature transmitters, flow transmitters, limit, proximity, magnetic switches and relays.

(12 Hrs)

Unit III

Telemetry: Land-line telemetering system including voltage, current and position telemetring systems, radio frequency telemetry, pulse amplitude modulation telemetry, pulse-code modulation telemetry, radio link, complete telemetry package including transmitting and receiving systems, transmission channels and media, industrial remote control system with remote terminal units details, control center details, communication between control centers, control center and remote terminal units.

(12 Hrs)

Unit IV

Computer Based Instrumentation System: Measurement concepts, computer based data-acquisition system, sensors, measurand and sensor types, equivalent circuits and loading, sensors with electrical current output, variable resistance sensors, errors in measurement systems, signal conditioning, single ended versus differential amplifiers, ground loops, noise, aliasing, quantization noise, introduction to virtual instrumentation.

(12 Hrs)

EC 7203C   MEDICAL ELECTRONICS

L T P   **Credits:4**
3 1 0

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Mechatronics	V.S.Bagad	Technical Publications
Transducers and Instrumentation	M.G. Joshi	Luxmi Publications (P) Ltd.
Reference Books		
Sensors and Transducers	D Patranabis	Wheeler Publishing
Telemetry Principle	D. Patronabis	TMH
A Course in Electrical and electronic Measurements and Instrumentation	A.K.Sawhney	Dhanpat Rai and Co.

Unit I

Physiological Control Systems: Human physiological systems including cardiovascular system, respiratory system, nervous system, physiological control systems, linear model of respiratory and muscle mechanics, static analysis of cardiac output, glucose and ventilation regulation, time domain analysis of neuromuscular reflex motion.

(12 Hrs)

Unit II
Bioelectric Potential And Electromyographic Measurements: Biometrics, man-instrument system, bioelectric potential sources, resting potential, action potential, electrode theory, bio-potential electrodes, biochemical transducers, electro-myogram, electro-cardiogram, and electro-encephalogram, electromyography, electro-myograph electrodes and electromygraph.

(12 Hrs)

Unit III
Respiratory And Cardiovascular Measurements: Electrocardiography, blood pressure measurement, blood flow measurement, plethysmography, heart sounds measurement, pacemakers, defibrillators, instrumentation for breathing mechanics, respiratory therapy equipment.

(12 Hrs)

Unit IV
Electroencephalographic And Sensory Measurements: Electro-encephalography, EEG electrodes, EEG electrode configuration, electroencephalograph, psycho-physiological measurements, instrumentation for testing motor responses and audiometer.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Biomedical Instrumentation and Measurements	Cromwell, Weibell and Pfeiffer	(PHI)
A Handbook of Biomedical Instrumentation	R.S. Khandpur	Tata McGraw-Hill
Reference Books		
Physiological Control Systems	Michael C.K.Khoo	(PHI)
.A Systems Approach to Biomedicine by	W. B. Blesser	(McGraw Hill)

EC-7203D   MICROWAVE COMMUNICATION

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Microwave frequency spectrum, familiarization with bands and wavelength.
(12 Hrs)

Unit II
Microwave Components: Wave guides, wave guide coupling, ferrite devise faraday rotation, isolators, circulators, detector mounts, magic tee, frequency meter, cavity resonator, microwave filters, directional couplers, loop directional couplers two hole directional couplers, phase Shifters, attenuators, introduction to S parameters.
(12 Hrs)

Unit III
Microwave Tubes: Problem with conventional tubes, limped elements at microwave frequencies velocity modulations, multi cavity, klystron, mathematical analysis of two cavity klystrons, performance, reflex klystron, mathematical analysis, repeller voltage, accelerating Voltage mode, frequency tuning, Magnetrons, constructional features of cavity magnetron cylindrical magnetron oscillations strapping, pushing and pulling traveling wave tube, Performance and application.
(12 Hrs)

Unit IV
Semiconductor Microwave Devices: Transistors, integrated circuits, advantages of MIC"s varactor diodes, step recovery diode, frequency multipliers, parametric amplifier, basic principles tunnel diode, principles, Gunn effect, Gunn diode application, avalanche effect impatt diode, trappat diode, characteristics and application of avalanche diode, principle of pin diodes & its application, schottky barrier diode, backward diode.
(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Microwave	Gupta	Wiley
Reference Books		
Microwave laboratory manual	Sisodia	Wiley
Microwave principles	Reich	EWP

EC –7203E   SATELLITE COMMUNICATION

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Origin of satellite communication, current state of satellite communication, orbital aspect of satellite communication and orbital effects in satellite communications, system performance.
Earth Station Technology: Earth station design including antenna, tracking small earth station antennas, equipments for earth stations video receive-only stations and frequency co-ordination.

(12 Hrs)

Unit II
Satellite Link Design: Basic transmission theory, system noise temperature and G/T rate, design of downlinks domestic satellite systems using small earth stations, up line design, design of satellite link for specified (C/N).

(12 Hrs)

Unit III
Modulation Techniques: Analog telephone and television transmission, energy dispersal, digital transmission, digital modulation and demodulation, digital transmission of voice, digital TV and bandwidth compression, TDM.

(12 Hrs)

Unit IV
Propagation On Sateliite-Earth Paths And Its   Influence On Link Design: Quantifying attenuation and depolarization, interference effects, rain and ice effects, monitoring propagation effects, advanced topics: - Forbid VSAT technology, mobile satellite N/W's, applications of satellite communication.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Digital Satellite Communication	Tri T HA	Pratt Publishers

Reference Books

Satellite Communication	Timothy Pratt	Pratt Publishers

EC-7203F   WIRELESS NETWORKS

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Differences between wireless and fixed telephone networks, Evolution of wireless networks, Examples of Wireless Communication Systems: Paging Systems, Cordless Telephone Systems, Cellular Telephone Systems, Comparison of common Wireless Communication systems, Traffic routing in wireless networks: circuit switching and packet switching.

(12 Hrs)

Unit II
Wireless Local Area Networks: Introduction, WLAN topologies, requirements, working and function of physical layer and MAC layer, IEEE standards for wireless networks, WiFi, Bluetooth, WiMax.

(12 Hrs)

Unit III
Wireless Internet: Mobile IP components, process of agent discovery, registration and de-registration, care-of-address, concept of tunneling, Limitations of Mobile IP, introduction to micro-mobility protocols.

(12 Hrs)

Unit IV
Ad Hoc Wireless Networks: Introduction, Challenges in ad hoc networks: spectrum allocation, media access, routing, multicasting, energy efficiency, security and privacy; problems in ad hoc channel access, receiver-initiated MAC protocols, sender-initiated MAC protocols and existing ad hoc MAC protocols; Ad hoc routing protocols: Destination sequenced distance vector (DSDV), Ad hoc on demand distance vector routing (AODV), Dynamic source routing (DSR), Temporally ordered routing algorithm (TORA).

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Wireless communications: Principles and practice	Theodore S. Rappaport	Third Indian reprint Pearson Education Asia 2003.
Wireless Networks	P. Nicopolitidis	M. S. Obaidat

Reference Books

Mobile and Personal Communication systems and services	Raj Pandya	Prentice Hall of India, 2001
Ad Hoc Mobile Wireless Networks	C. K. Toh	Pearson Education

EC-7203G   ELECTRONIC SYSTEM DESIGN

L T P   **Credits:4**
3 1 0

Unit I
Design of Regulated Power Supplies: Design of regulated power supply, stabilization, reference element, Zener shunt regulator, emitter follower regulator, series-ass regulator, feedback regulator, series voltage regulators, IC voltage regulators and design of IC regulated power supply using three terminal regulators.

(12 Hrs)

Unit II
Design of Switch-mode and Uninterruptible Power Supplies: Comparison of switch-mode and linear power supplies, working principle of SMPS, fly-back converter, forward type converter, component selection for SMPS, control IC for SMPS, type of UPS, selection of UPS components and design of heat sink.

(12 Hrs)

Unit III
Design of Amplifiers and Oscillators: Selection of transistor type and important parameters, impedance levels, By-pass and coupling capacitor, selection, dynamic load line, operating point, transistor at high frequency, transistor parameters and design of composite feedback and power amplifiers, design considerations for oscillators.

(12 Hrs)

Unit IV
Design of Communication System: Design of diode modulator, transistor modulator, transistorized class-C modulators, detection, conversion and mixing, Super-Heterodyne radio receiver, AVC design considerations and radio transmitter design considerations.

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
A Monograph of Electronic Design Principle	NC Goyal and RK Khetan	Khanna Publishers
Reference Books		
Electronic Fundamentals and Applications	J.D. Ryder	PHI, New Delhi
Electronics and Radio Engineering	FE Terman	McGraw Hill

EC- 7204A   OPTICAL NETWORKS

L T P   **Credits:4**
3 1 0

Unit I

Introduction: Historical perspective, Fibre Characteristics, Group Velocity Dispersion, Different propagation Regimes, Dispersion Induced pulse broadening, higher order Dispersion, Dispersion Slope, Growth of optical communication systems to its current scenario.

(12 Hrs)

Unit II

Fiber nonlinearties: Fiber nonlinearties: SPM and XPM Induced Nonlinear effects, Nonlinear Birefringence Effects, XPM induced Modulation Stability, spectral & temporal Effects, XPM induced Non reciprocity, Implications for Optical Communication Systems.

(12 Hrs)

Unit III

Parametric Process: Four Wave Mixing, Second harmonic Generation Parametric Gain, Phase Matching Techniques, parametric Amplifications & its applications, Dispersion Management**.**

(12 Hrs)

Unit IV

Optical Networks: Introduction to optical networks, LAN, WAN and MAN, Various Optical topologies, Wavelength Routers, wavelength Converters, Survivability and multicast in ptical networks.

DWDM: Dense wavelength Division multiplexing, Optical switches, EDFA, PDFA, & NDFA Optical amplifiers & their characteristics, Simulation results of DWDM systems.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Optical Networks	Black	Pearson Ed.

Reference Books

Title	Author	Publisher
Non linear Fiber Optics	G.P. Aggarwal	Academic Press INC

EC- 7204B COMPUTATIONAL METHODS FOR ELECTRONICS & COMMUNICATION ENGINEERING

L T P   **Credits:4**
3 1 0

Unit I
MATLAB Fundamentals: Basics of MATLAB, MATLAB windows, file types, general commands, working with arrays of numbers, creating and plotting simple plots, creating, saving and executing script and function files.

(12 Hrs)

Unit II
MATLAB Interactive Computation: Matrices and vectors, matrix and array operations, arithmetic operations, relational operators, logical operators, elementary math functions, matrix functions, character strings.

(12 Hrs)

Unit III
MATLAB Programming: Script files, function files, language specific features, advanced data objects.

(12 Hrs)

Unit IV
MATLAB Applications: MATLAB applications in Linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration ordinary differential equations, nonlinear algebraic.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Getting Started with MATLAB 5 by	Rudra Pratap	Oxford University

Reference Books

Title	Author	Publisher
Applied Numerical Methods with MATLAB for Engineers and Scientists	Steven C Chapra	TMH

EC-7204C   DIGITAL IMAGE PROCESSING

L T P   **Credits:4**
3 1 0

Unit I
Introduction to Electronic Image Processing: historical background, visual perception, Image formation, sampling & Quantization & application of image Processing.
Transforms used in Electronic Image Processing: Review of 1-D & 2-D Fourier Transforms, Discrete Fourier transforms & other image transforms.

(12 Hrs)

Unit II
Image Enhancement by Point operation: An overview of point Processing, constant & non-linear operations between image & histogram techniques.
Spatial Filtering & Fourier frequency Method: Noise in image, Spatial & Special Frequency filtering, image restoration.

(12 Hrs)

Unit III
Non-Linear image processing techniques: Non-linear Spatial/Mean/Adaptive & Homomorphic Filters.
Color Image Processing: Color Models, examples of color image processing, Pseudocoloring & color displays.

(12 Hrs)

Unit IV
Image segmentation & Representation: Image Thresh-holding, Edge/Line &Point direction, Region based segmentation & Image representation.
Introduction to Morphological filters & Image Compression

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Digital Image Processing	Rafael C. Gonzale & Richard E. Woods	Pearson Education Asia (2nd edition 2002)
Fundamentals of digital image processing by	A.K. Jain	Prentice Hall Englewood Cliffs, N.J.

Reference Books

Title	Author	Publisher
Fundamentals of electronic image processing	Arthur R. Weeks, Jr	Eastern Economy Edition 2003, SPIE Press, Prentice hall of India New Delhi

EC- 7204D   MICRO ELECTRO MECHNICAL SYSTEM

L T P   **Credits:4**
3 1 0

Unit I

Lithography: Introduction – Alternative – X-ray – Emerging lithography technologies – proximal probe – holographic – Stereo lithography / micro photo forming process.
Additive Techniques: Physical Vapor Deposition – Chemical Vapor Deposition – Electrochemical Deposition – Doping.

(12 Hrs)

Unit II

Dry Etching: Introduction – Physical Etching – Ion Beam Etching – Dry Chemical Etching – Plasma Jet – Dry Etching for Polymeric Materials – Application in IC Technology – Combination of Wet and Dry Etching.
Wet Bulk Micro Machining: Silicon Crystallography – Wet Isotropic and Anisotropy Etching – Etching Stop Techniques – Electrochemical Etching – Stop Techniques – Photo Etching – Assisted Electrochemical Etching Stop (for n – type silicon).

(12 Hrs)

Unit III

LIGA: LIGA processes – Application – micro-fluidic elements, micro-optical components, interlocking gear, and electro static actuators – technological barriers and competing technologies.
Surface Micromachining: Process – poly-silicon surface Micro aching modifications.
Micro Fabrication Applications: Sensors – actuators – gas sensors, solid-state gas sensors and micro machining – gas chromatography.

(12 Hrs)

Unit IV

MEMS Design: MEMS Design Considerations, Design for Fabrication - PolyMUMPS - Example of development of a pressure sensor through PolyMUMPS technique - MEMS Packaging.
MEMS Characterization Techniques: Scanning Probe Microscopy (SPM), Magnetic Force Microscopy (MFM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Scanning Electron Microscopy (SEM).

(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Fundamentals of Micro fabrication	Marc Modu,	CRC Press Boca Rato

Reference Books

Title	Author	Publisher
Nanotechnology Press, 1996.	Norio Taniguchi	Oxford University

EC-7204E   NANO TECHNOLOGY

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Introduction to nanoscale systems, Length energy and time scales, Top down approach to Nano lithography, Spatial resolution of optical, deep ultraviolet, X-ray, electron beam and ion beam lithography, Single electron transistors, coulomb blockade effects in ultra small metallic tunnel junctions.

(12 Hrs)

Unit II
Quantum Mechanics: Quantum confinement of electrons in semiconductor nano structures, Two dimensional confinement (Quantum wells), Band gap engineering, Epitaxy, Landaeur–Buttiker formalism for conduction in confined geometries, One dimensional confinement, Quantum point contacts, quantum dots and Bottom up approach, Introduction to quantum methods for information processing.

(12 Hrs)

Unit III
Molecular Techniques: Molecular Electronics, Chemical self assembly, carbon nano tubes, Self assembled mono layers, Electromechanical techniques, Applications in biological and chemical detection, Atomic scale characterization techniques, scanning tunneling microscopy, atomic force microscopy.

(12 Hrs)

Unit IV
Nano material and Applications: Nanoscale Manufacturing, Nanomanipulation, Nanolithography, Nanoscale Materials and Structures, Nanocomposites, Safety issues with nanoscale powders, Quantum wells, wires, dots and nanoparticles, Applications in energy, informatics, medicine, etc.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Quantum Transport in Semiconductor Nanostructures in Solid state Physics"	Beenaker and Van Houten	Ehernreich and Turnbell, Academic press
Transport in Nano structures	David Ferry	Cambridge University press 2000

Reference Books

Introduction to Mesoscopic Physics	Y. Imry	Oxford University press 1997
Electron Transport in Mesoscopic systems	S. Dutta	Cambridge University press 1995
Single charge Tunneling"	H. Grabert and M. Devoret	Plenum press 1992

EC 7204F   VLSI DESIGN

L T P   **Credits:4**
3 1 0

Unit I
Review Of Mos Technology: Basic MOS transistor, enhancement and depletion mode transistors, nMOS and CMOS processes, thermal aspects of processing, production of masks.
Electrical Properties Of Mos Circuits: Parameters of MOS transistor, pass transistor, nMOS inverter, CMOS inverter, MOS transistor circuit model, latch up in CMOS circuits.
(12 Hrs)

Unit II
Design Processes: MOS layers, stick diagrams, design rules, double metal single polysilicon CMOS process.
Basic Circuit Concepts: Sheet resistance, area capacitance, delay unit, inverter delay, propagation delays (super buffer).
(12 Hrs)

Unit III
Cmos Logic Structures: CMOS complementary logic, BiCMOS logic, pseduo nMOS, dynamic CMOS, clocked CMOS, pass transistor logic, CMOS domino logic, NP domino logic, cascade voltage switch logic, source follower pull up logic.
Scaling Of Mos Circuits: Scaling factor, limitations, scaling of wires and interconnections.
(12 Hrs)

Unit IV
Subsystem Design And Layout: Architectural issues, gate logic, design of PLA, 4-bit arithematic processor, 4-bit shift register, and lambda based design rule.
(12 Hrs)

RECOMMENDED BOOKS:
Text Books

Title	Author	Publisher
Basic VLSI design, systems and circuits	Pucknell DA and Eshraghian K.	PHI

Reference Books

Title	Author	Publisher
VLSI design techniques for analog and digital circuits	Geiger Rr, Allen PE, Strader NR	TMH

EC-7204G   ATM NETWORKS AND B-ISDN

L T P   **Credits:4**
3 1 0

Unit I
Introduction: ATM, Communication networking technique, OSI, Data link layer, HDLC protocol, TDM, LLC layer, X.25, IP, Frame relay.

(12 Hrs)

Unit II
ATM Architecture: Structure of ATM cell header, ATM protocol stack, ATM interfaces, the physical layer, UTPOIA and WIRE, ATM adaptation layer, space division switch architecture, shared memory ATM switch architecture, shared medium ATM switch architecture, nonblocking switches with output buffer, multicasting, congestion control in ATM networks, deployment of ATM networks, Signaling.

(12 Hrs)

Unit III
Introduction to B-ISDN: Broadband networks: driving forces, LAN, WAN, possible application, function and physical topologies, random access for functional Bus-LAN, slotted aloha system, CSMA, CSMA with collision detection, throughput analysis of Tokin ring, short bus architecture, packet switching interconnection fabrics.

(12 Hrs)

Unit IV
Metropolitan Area Networks and B-ISDN: Distributed queue dual bus, DQDB segmentation, reassembly, protocol data unit, delay and blocking performance, delay and blocking performance of FDDI, Broadband ISDN and ATM, B-ISDN protocol reference model.

(12 Hrs)

RECOMMENDED BOOKS
Text Books

Title	Author	Publisher
Introduction to ATM networks	Harry G. Perros	Johan Wiley

Reference Books

An Introduction to Broadband Networks	Anthony S. Acampora	Springer

IE-7105A   POWER PLANT INSTRUMENTATION

L T P   **Credits:4**
3 1 0

Unit I
Introduction: Various types of power plants, energy policy of India, priority for sources for power generation, selection of sites and unit size.

(04 Hrs)

Steam Power Plant: Operation of steam power plant, choice of steam pressure and temperatures, Rankine cycle and its analysis, Reheat and regenerative cycle, classification of steam turbines and their working, velocity diagrams, Governing of steam turbines, layout of steam power plant, Steam condensers, vacuum efficiency, and performance of cooling towers, Fuel handling, combustion equipment, Ash handling, Heat exchangers, reheaters, feed water reheaters and evaporators.

(08 Hrs)

Unit II
Nuclear Power Plant: Advantages and disadvantages, Generation of nuclear energy by fission, Nuclear reactor, nuclear reactions, types and applications, Layout of Nuclear plant.

(12 Hrs)

Unit III
Hydro Power Plant: Advantages and disadvantages, hydrological cycle, hydro-graph, flow duration curve, mass curve, selection of site, essential features of a hydro plant, selection of water turbines for a given hydro power plant, layout of a hydro power plant.

(12 Hrs)

Unit IV
Instrumentation: Instrumentation needed in steam power plants for plant supervision, safety and plant performance, Governing and controls needed for water flow, drum level, air/gas flow, coal flow, combustion control, control for furnaces, controls for turbine, condenser safety.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Power Plant Engineering	Varma	Metroplitan Publication
Power Plant Control and Instrumentation	David M. Lindsley	IEE
Reference Books		
Nuclear Power	Loftness D Van Nostrand	McGraw Hill
A Text Book on Power System Engineering	M L Soni , P V Gupta & A Chakraborty	Dhanpat Rai and Co
Nuclear Power Plant System and Equipment	Lish	Industrial press

IE-7105B   OPTO-ELECTRONIC INSTRUMENTS

L T P   **Credits:4**
3 1 0

Unit-I
Ray Tracing: Paraxial optics, matrix method in paraxial optics.

(06 Hrs)

Lasers: Principle of laser, He-Ne, CO2 & ruby lesser constructions.

(06 Hrs)

Unit-II
Image Defects: Theories of image defects, aberrations, coma, distortions, astigmatism, chromatic aberrations their removal.

(12 Hrs)

Unit-III
Optical Devices: Principle & theory of telescopes reflecting & astronomical telescope& microscopes, principle &applications of ordinary camera.

(06 Hrs)

Holography: Principle of holography, theory & applications.

(06 Hrs)

Unit-IV
Design Criteria Of Opto-Electronic Systems: Prism & gratings, spectrophotometer, flame photometer, introduction to laser based instruments.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Optics	Ajoy Ghatak	TMH
Optics & Atomic Physics	D P Khandelwal	Himalaya Publishers
Reference Books		
Optics	Jenkins & White	Mc Graw Hill
Laser Physics	Tarasov	Meer Publishers

IE-7105C   MECHATRONICS

L T P   **Credits:4**
3 1 0

Unit-I
Introduction: Integrated Mixed Systems, Integration of Mechanical Engineering, Electronics & Control Engg and Computer Science.

(06 Hrs)

Dynamic Systems Modeling and Simulation: Equations of motion, transforming, physical model to Math, Model, linearization, Frequency response.

(06 Hrs)

Unit-II
Control Systems: Performance specifications, Transfer functions, Stability, Controller types and their design using frequency domain and Laplace domain method, PID control, Digital Control, z-transforms, problems in analogue to digital conversion-Nyquist frequency, Digital controller design.

(12 Hrs)

Unit-III
Sensors and Actuators: Temperature-Sensing Thermocouples, Stress, Strain and Force measurements using strain gauges, Piezoelectric strain sensors and Accelerometers, Analog / Digital Position Measurements, Velocity Measurements. Direct Current Motors, Stepper Motors, Piezoelectric Actuators.

(12 Hrs)

Unit-IV
Electronics: AD and DA converters, Op Amps, Microprocessors, Digital signal processing, Logic Circuit Devices, Gates- AND, OR, NAND etc. and combinations, Study of Some Mechatronics Devices: Hard disk drive, dot matrix printer, optical sensing and control mechanism in NC machine tools etc.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Mechatronics	HMT	TMH
Introduction to Mechatronics and	Michael B. Histand &	McGrawHill
Measurement System	David G. Alciatore.	
Reference Books		
Introduction to Robotics	John J Craig	AWL
Feedback Control System	Kuo	PHI

IE-7105D   ELEMENTS OF COMMUNICATION ENGINEERING

L T P   **Credits:4**
3 1 0

Unit-I
Review Of Communication Engineering: Introduction, AM, FM, their side bands, comparison, sampling theorem, different pulse modulation techniques- PAM, PWM, PPM and PCM, FDM, TDM. Introduction to Fourier series and Fourier transform of periodic signals. Transfer functions and properties of practically realizable filters.

(12 Hrs)

Unit-II
Radio Transmitters: Block diagram explanation of low and high level AM transmitter, AM broadcast transmitter, DSB transmitter, SSB transmitter and Independent sideband transmitter, block diagram explanation of reactance tube and Armstrong FM transmitters, Stereophonic FM broadcast transmitter.

(12 Hrs)

Unit-III
Radio Receivers: AM diode detector, characteristics of radio receiver: sensitivity, selectivity, fidelity and image rejections, classification of radio receivers, TRF receiver and super heterodyne receiver, block diagram explanation of AM receiver, AM receiver using PLL, DSB and SSB receiver, Independent sideband receiver, AM broadcast receiver, noise in AM systems, FM detection, block diagram explanation of FM receiver and stereophonic FM broadcast receiver, noise in FM systems.

(12 Hrs)

Unit-IV
Television Engineering: Principle of camera, introduction of picture tube, scanning, frame, field, sync video signal, vestigial sideband transmission, block diagram of TV receiver and working, TV transmitter.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Radio and TV Engg	G. K. Mittal	Khanna Publisher
Electronic Communication systems	Kennedy	MacGraw Hill
Reference Books		
Electronic Communications	Sanjeev Gupta	Khanna Publisher
Principles of Communications	Taub & Schilling	MacGraw Hill
Monochrome and Colour TV	R. R. Gulati	Dhanpat Rai & Sons

IE-7105E   OPTIMIZATION TECHNIQUES

L T P   **Credits:4**
3 1 0

Unit-I
Vector Spaces: Vector spaces, subspaces, span, linear dependence & independence, dimensions, basis.

(06 Hrs)

Linear Transformation: Representation of linear transformation with respect to basis, Rank and nullity. Numerical linear algebra: - direct and iterative methods of solution of linear equations, matrices, norms, least square problems, Eigen value problems.

(06 Hrs)

Unit-II
Classical Optimization Techniques: Single variable optimization, multivariable optimization with no constraints, multivariable optimization with equity constraints, and multivariable optimization with inequity constraints, Linear programming, standard form of L.P.P., formulation of models, simplex methods, duality in L.P., transportation problems.

(12 Hrs)

Unit-III
Non-Linear Programming: One-dimensional search, Fibonacci and golden section method, unconstrained optimization –steepest descent /ascent method, constrained optimization - penalty function methods.

(12 Hrs)

Unit-IV
Dynamic Programming: Multistage decision process and concept of sub optimization, Bellemen's optimality principle, recursive relation – backward and forward recursion, inventory problem, capital budgeting and path finding problem by dynamic programming.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Optimization-Theory and applications	S. S. Rao	Wiley Eastern
Optimization Methods	K. V. Mittal	Wiley Eastern
Reference Books		
Linear Algebra	K. Hoffman, R. Kunze	Prentice Hall
Non-Linear Programming Theory and Algorithms	Bazara, Sherali Shetty	John Wiley

IE-7105F   ENERGY MANAGEMENT & RENEWABLE ENERGY SOURCES

L T P   **Credits:4**
3 1 0

Unit I
Energy scenario: Commercial and non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, air pollution, climate change, energy security, energy conservation and its importance, energy strategy for the future.

(12 Hrs)

Unit II
Energy management and audit: Definition, energy audit – need, types of energy audit, energy management (audit) approach – understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximising system efficiencies, optimising the input energy requirements, fuel and energy substitution, energy audit instruments. (06 Hrs)

Energy action planning: Key elements, force field analysis, energy policy purpose, perspective contents, formulation, ratification, organising, location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability, motivating - motivation of employees, information system designing barriers, strategies, marketing and communicating, training & planning.

(12 Hrs)

Unit III
Solar Energy: Introduction to solar radiation and its measurement, Introduction to Solar energy Collectors and Storage, Application of solar energy: Solar thermal electric conversion, Thermal electric conversion systems, Solar electric power generation, Solar photo-voltatics, Solar Cell principle, Semiconductor junctions, Conversion efficiency and power output, Basic photo-voltaic system for power generation. (06 Hrs)

Wind Energy: Introduction to wind energy conversion, the nature of the wind, Power in the wind, Wind Energy Conversion: Wind data and energy estimation, Site Selection considerations, basic Components of a Wind energy conversion system, Classification of WEC Systems, Schemes for electric generation using synchronous generator and induction generator, wind energy storage.

(06 Hrs)

Unit IV
Energy from Biomass: Introduction: Biomass conversion technologies, photosynthesis, Bio-gas generation, types of bio-gas plants, Biomass as a Source of Energy: Methods for obtaining energy from Bio-mass, Bio-logical conversion of Solar energy. (04 Hrs)

Direct Energy Conversion Processes: Magneto Hydro Dynamic Power Generation: Principles of MHD power generation, Open cycle systems, Closed cycle systems, Voltage and power output, Materials for MHD generators; Thermo-Electric Generation: Basic principles of thermo-electric power generation, Seeback, Peltier, Thomson effects, Thermo-Electric power generator, Analysis materials; Thermionic Generation: Thermionic emission and work function, Basic thermionic generator; Fuel Cells: H2, O2 cells, classification of fuel cells, types, Advantages, Electrodes, Polarization.

(08 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Guide to Energy Management	B. L. Capehart, Wayne C. Turner, William J. Kennedy	Fairmont Press
Energy Management	P R Trivedi, B R Julka	Commonwealth
Reference Books		
Renewable energy sources and conversion technology	Bansal N K, Kleemann M, Heliss M	Tata McGraw Hill
Non Conventional Sources of Energy	Rai G D	Khanna Publishers
Renewable Energy	Sorensen Bent	Academic Press

IE-7205A   ELEMENTS OF POWER SYSTEM

L T P   **Credits:3**
3 0 0

Unit-I
Supply System: Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission & distribution, economic size of conductors - Kelvin's law, Radial & mesh distribution networks, Voltage regulation.

(06 Hrs)

General: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency.

(06 Hrs)

Unit-II
Transmission Line Parameters: Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors.

(05 Hrs)

Performance Of Transmission Lines: Representation of short transmission line, medium length line (nominal T & II circuits). long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation.

(07 Hrs)

Unit-III
Circle Diagram And Line Compensation: Receiving end circle diagram for long transmission lines based on ABCD constants, equivalent T circuits , power loss, surge impedance loading, reactive power requirement of system series and shunt compensation, Synchronous phase modifiers , rating of phase modifiers.

(12 Hrs)

Unit-IV
Underground Cables: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text books		
Course in Electrical Power	C.L. Wadhwa	New Age
Power System Analysis	Nagrath and Kothari	TMH
Reference Books		
Electrical Energy System Theory- An introduction	O.L. Elgerd	TMH
Elements of Power System Analysis	W.D. Stevenson Jr	TMH
Power System Analysis & Design	B.R. Gupta	Wheeler

IE-7205B   NEURAL NETWORK AND FUZZY LOGIC

L T P   **Credits:3**
3 0 0

Unit I
Introduction: History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning.

(12 Hrs)

Unit II
Supervised Learning: Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules, Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps.

(12 Hrs)

Unit III
Radial Basis Function: Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm.

(04 Hrs)

Counter Propagation Networks: Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memories, vector quantization, control.

(08 Hrs)

Unit IV
Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, Operation of fuzzy set, Fuzzy IF THEN rules, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Fuzzy System Design Principles	Riza Berkin and Trubatch	PHI
Neural Networks	Simon Haykin	Pearson Education
Reference Books		
Artificial Neural Networks	Yegna Narayenan	MGH
An Introduction to Neural Networks	J A Anderson	PHI

IE-7205C　　　MICROWAVE INSTRUMENTATION

L T P　　　　　　　　　　　　　　　　　　　　　　　　　**Credits:3**
3 0 0

Unit I
Introduction: Introduction to electromagnetic spectrum and microwaves, microwave propagation, microwave radiation hazards and applications of microwaves.　　　　　　　(04 Hrs)
Microwave Tubes And Circuits: Microwave triodes. Frequency limitation of gridded tubes, UHF triodes and circuits, operation and practical consideration of multi-cavity klystron, reflex klystron, magnetrons and traveling wave tube (TWT)types, performance and applications of magnetron and TWT ,other microwave , tubes such as crossed field amplifiers, backward wave oscillators and miscellaneous tubes.

(08 Hrs)

Unit II
Waveguides, Resonators And Components: Types of wave -guides, introduction to rectangular wave-guides, reflection of waves from a conducting plane and parallel plane wave-guide, various modes in wave - guides cutoff, wavelength; iA1"wave-guides"guide' wavelength in phase velocity. characteristic wave impedance, circular and other waveguides; wave guides coupling, matching and attenuation, methods of exciting wave-guides, wave-guides joints, basic accessories, multiple junctions, impedance matching and tuning, bends, taper, twists, irises, attenuation in wave guides, resistive attenuators, Fundamentals and practical consideration of cavity resonators, auxiliary components. Directional couplers, isolators, circulators, mixers, detectors, detectors, detector mounts, switches microwave antennas-horn and lens antennas.

(12 Hrs)

Unit III
Semiconductor Microwave and Circuits: Passive microwave circuits-stripline and microstrip circuits and saw ; detectors, performance and applications of microwave transistors and integrated circuits- high frequency limitations, varactor diodes, step recovery diodes and frequency multipliers basic principles and circuits of parametric amplifiers, tunnel diodes, negative resistance amplifiers, tunnel diode applications, gunn effect, gunn diodes and their applications, avalanche effect, IMPATT and TRAPATT diodes, performance and applications of avalanche diodes, PIN diodes, Schottky barrier diodes and backward diodes, simulated emission, fundamentals of MASERSA, practical masers and their applications, fundamentals of lasers, CW lasers and their communication applications and other opto-electronic devices.

(12 Hrs)

Unit IV
Microwave Sensors and Measurements: Measurement of power, frequency and wavelength measurements, attenuation measurements, SWR measurements, Q-measurements of microwave cavities, introduction to microwave sensors, microwave passive sensors, block diagram of multi-meter-wave imaging radiometer, active microwave sensors, block diagram of pulsed radar, block diagram of CW radar sensor, altimeter (block diagram of FM-CW radar censors), rate of climb meter, synthetic aperture radar sensor.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Electronic communication systems	George Kennedy	TMH
Microwave Techniques	A. Kumar	Newage International
Reference Books		
Principles of communication Engg	Umesh Sinha	Satya Prakashan
Electronics Communications	Sanjeev Gupta	Khanna Publishers

IE-7205D   ADVANCED INSTRUMENTATION

L T P   **Credits:3**
3 0 0

Unit-I
Electronic Measuring Instruments: Advanced semescope and displays, high speed oscilloscope, sampling oscilloscope, DSO wave analyzer, distortion analyzer, modulation analyzer , spectrum analyzer, wave meters, digital phase meters, frequency synthesizer, logic state analyzer, LCR meters.

(12 Hrs)

Unit-II
Advanced Sensors: Current &.voltage sensors, intelligent pressure transducer, turbidity Measurement, microwave sensors as proximity sensors, semi-conductor displacement laser sensor, ceramic sensor as gas sensor.

(08 Hrs)

Vision Sensors: Overview, illumination consideration, vision sensors generalities, 2D sensor, 3D sensors, Interfacing of vision sensors.

(04 Hrs)

Unit-III
Optical Fiber Sensors: Introduction, Extrinsic & dynamic fiber optic sensor, elementary Principles ,the design of the optical fiber sensor, development of optical fiber sensor, phase modulated optical fiber sensors, frequency modulation in optical sensors, polarization modulation In fiber sensors, distributed optical fiber sensing (DOFS), distributed micro-bend strains sensor, distributed optical fiber temperature sensor, using the optical Kerr Effect, distributed optical fiber sensor for chemical species, fiber optic Sensor for air pollution, optical fiber pressure sensor, optical fiber pressure sensor ,optical fiber temperature sensor, optical fiber sensor for humidity.

(12 Hrs)

Unit-IV
Ultrasonic Instrumentation: Sirens, whistles, the wretch whistles, the liquid ultrasonic, generators, solid transducers, Piezoelectric transducers, magneto-strictive transducers, the production of very light intensities, depleted layer transducers, applications of ultrasonic processing, uses of ultrasonic in measurement & control , flow detection, application of ultrasonic to boilers.

(09 Hrs)

Tactile Sensors: Overview, touch sensing, tactile sensing, interfacing of tactile sensors.

(03 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Principles of Measurement & Instrumentation	Allan Morris	PHI
Principles of Measurement System	J P Bartley	Longman London
Reference Books		
Sensors & Control System in manufacturing	Sabrie Soloman	McGraw Hill
Instrument Transducers	H K P Newbert	Clarendon
Modem Electronic Instrumentation & Measurement Techniques	Cooper & Helfrick	PHI

IE-7205E   WIRELESS AND MOBILE COMMUNICATION

L T P   **Credits:3**
3 0 0

Unit-I
Introduction to Wireless Communication Systems: Performance Criteria, Voice Quality, Service Quality, coverage and required grade of service The Cellular Concept, co-channel interference, Frequency reuse, determining the frequency reuse distance, channel assignment strategies, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting, sectoring Mobile Radio Environment.

(12 Hrs)

Unit-II
Mobile Radio Propagation: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, small scale multipath propagation, types of small-scale fading, fading effects due to Doppler spread, diversity techniques.

(12 Hrs)

Unit-III
Modulation techniques: Introduction to linear modulation techniques, Minimum shift keying (MSK), Gaussian minimum shift keying (GMSK), OFDM, spread spectrum, correlation function, PN code generation, DS-SS, and FH-SS systems, performance of modulation schemes, RAKE receiver.

(12 Hrs)

Unit-IV
Multiple Access Techniques: Frequency management, fixed channel assignment, non-fixed channel assignment, FDMA, TDMA, spread spectrum multiple access, space division multiple access, spectral efficiency, capacity of cellular system.

(06 Hrs)

Concept of cellular communication: Basic wireless cellular system, mobile unit (MU), Base station, Mobile switching center, Introduction to GSM.

(06 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Mobile cellular Tele-communication	William, C Y Lee	McGraw Hill
Wireless communication: Principles & practice	Theodore S. Rappaport	Pearson
Reference Books		
Wireless Digital Communication	Kamilo Feher	PHI
Digital Communication	J.G. Proakis	McGraw Hill

IE-7205F   BIO-SENSORS & MEMS

L T P   **Credits:3**
3 0 0

Unit-I
Overview: Overview of biosensors and their electrochemistry: Molecular reorganization: enzymes, Antibodies and DNA, Modification of bio recognition molecules for Selectivity and sensitivity Fundamentals of surfaces and interfaces.

(12 Hrs)

Unit-II
Bioinstrumentation: Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, FETs and Bio-MEMS, Introduction to Chemometrics, biosensor arrays; electronic nose and electronic tongue.

(12 Hrs)

Unit-III
MEMS Technology: MEMS Technology: Introduction Nanotechnology and MEMS, MEMS design, and fabrication technology, Lithography, Etching, MEMS material, bulk micromachining, Surface micromachining, Microactuator, electrostatic actuation Micro-fluidics.

(12 Hrs)

Unit-IV
Applications: MEMS types and their applications : Mechanical MEMS � strain and pressure sensors, accelerometers etc., Electromagnetic MEMS, micromotors, wireless and GPS MEMS etc Magnetic MEMS, all effect sensors, SQUID magnetometers, Optical MEMS, micromachined fiber optic component, optical sensors, Thermal MEMS, thermo-mechanical and thermo-electrical actuators, Peltier heat pumps.

(12 Hrs)

RECOMMENDED BOOKS:

Title	Author	Publisher
Text Books		
Foundation of MEMS	Chang	Illinois Ece Series
Microsensors, MEMS and Smart Devices	Julian W. Gardner, Vijay Varadan & Osama O. Awadelkarim	Wiley
Reference Books		
Biosensors: Theory and Applications	Donald G. Buerk	CRC
Electrochemical Sensors, Biosensors and their Biomedical Applications	Xueji Zhang, Huangxian Ju & Joseph Wang	Academic Press

IT-7104A   OBJECT ORIENTED MODELING AND DESIGN

L T P   **Credits-4**
3 1 0

UNIT I

Object oriented concept: Object Oriented Concept- Object Oriented Development and Themes, Object Oriented Modeling Techniques – object model, dynamic model, functional model, and relationship among model.

Object Modeling – Objects & Classes, Object Diagram, Attributes, Operation and Methods, Link and Association, Advanced Link Association Concepts - roll names, ordering, qualification, aggregation, generalization and inheritance, overriding features, Advance Object Modeling – aggregation vs. association, aggregation vs. generalization, propagation of operation, abstract classes, overriding operation, multiple inheritance, metadata, candidate keys, constraints.

(13 Hrs)

UNIT II

Dynamic Modeling - Events and States, Operations, Nested State Diagram, Advance Dynamic Modeling Concepts, Relation of Object and Dynamic Model.

Functional Modeling – Functional Model, Data Flow Diagrams, Specifying Operation, Constraints, Relation of Functional to Object and Dynamic Models.

(10 Hrs)

UNIT III

System Design – Overview of System Design, Breaking System into Subsystem, Identifying Concurrency, Allocating Subsystem to Processors and Tasks, Management of Data Stores, Handling Global Resources, Handling Boundary Conditions, Common Architecture Frameworks.

Object Design – Designing Algorithms, Design Optimization, Implementation of Control, Adjustment of Inheritance, Design of Association, Object Representation & Comparison of Design Methodologies – SA/SD, OMT and JSD.

(13 Hrs)

UNIT IV

From Design to Implementation, Object oriented programming style – reusability, extensibility, robustness, Translating Design to Implementation – class definition, creating objects, calling operation, using inheritance, implementing associations, Object Oriented Language Features.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Object Oriented Modeling & Design	James Rumbaugh	PHI
Object Oriented Software construction	Bertrand Meyer	PHI
Reference		
Object Oriented Programming	Brad J.CoX,	Addison Wesley

IT-7105A   DISTRIBUTED COMPUTING

L T P   **Credits-4**
3 1 0

Unit I
Introduction to Distributed Systems: Definition of distributed systems, their objectives, types, hardware and software concepts, architecture, introduction to XML, SOAP, Web and Grid services concepts.

(12 Hrs)

Unit II
Communication: Interprocess communication, Remote Procedure Call (RPC), Remote Method Invocation (RMI), Remote Object Invocation, Message Oriented Communication.
Processes: Introduction to threads, Threads in distributed and non distributed systems, Client side software, Design issues for Servers, Software agents.

(12 Hrs)

Unit III
Naming: General issues with respect to naming, Name resolution, implementation of a name space, Domain name Systems, X.500 name space.
Security: Introduction to security in distributed systems, General issues in authentication and access control, Security management: Key management, secure group management, authorization management; examples: Kerberos, x.509 certificates.

(12 Hrs)

Unit IV
Distributed Object-based Systems: Introduction to distributed object based systems, Overview of CORBA and DCOM and their comparison.
Distribute File System and Document-based Systems: Introduction to distributed file system, distributed document-based systems, their examples.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Distributed Systems, Principles and Paradigms	Andrew S Tanenbaum, and Maarten van Steen	Pearson Education
Distributed Systems Concepts and Design	George Coulouris, Jean Dollimore, TIM Kindberg,	Addison Wesley

IT-7105B   CLIENT SERVER ARCHITECTURE

L T P   **Credits-4**
3 1 0

Unit I
Fundamental of Distributed Systems: Client/Server technology an introduction, Classification – Mainframe, File sharing, Client/Server, Distributed/Collaborative architecture, Distributed Computing Environment–DCE architecture, Type of Client/Server Architecture – Two- tier architecture, Three-tier architecture, Distributed/Collaborative enterprise architecture, Complementary Technologies to 3-tier – Object – oriented Design, Database Two Phase Commit Processing, Remote Procedure Call, Message Oriented Middleware.

(12 Hrs)

Unit II
Distributed Computing Environment: Structure – Client/Server Model, Defining distributed Environment, Motivation for Distributed Computing, Developing the Distributed Computing Architecture Framework, Fundamental Technologies & Design Mechanism.
Remote Method Invocation: Distributed Object Model, RMI System Overview, Client interfaces, Registry interfaces, Remote object interface, Stub interface, Exception in RMI.

(12 Hrs)

Unit III
Distributed Component Object Model: The DCOM Architecture, Component & Reuse, Location Independence, Language Neutrality, Connection Management, Scalability, Performance, Bandwidth & Latency, Security, Local Balancing, Fault Tolerance, Ease of Deployment, Protocol Neutrality, Platform Neutrality, Seamless Integration with other Internet Protocols.

(12 Hrs)

Unit IV
The Common Object Request Broker: Overview of CORBA, The object request Broker, OMG Interface Definition Language, Language Mapping, Interface Repository, Stubs & Skelations, Dynamic Invocation & Dispatch, Object Adapters, and Introduction about Java IDL (Interface Deference Language).

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Object-oriented Design, Architecture and Implementation.	P.M. Heinchieus	Addison Wesley
Reference		
An Advance Course on Distributed Computing	Fingerlakes,	ACM Press Publication.

IT-7203A   DATA MINING & WAREHOUSING

L T P   **Credits-4**
3 1 0

Unit-I

Data Mining: Introduction, Relational Databases, Data Warehouses, Transactional databases, Advanced database Systems and Application, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining.

(12 Hrs)

Unit-II

Data Warehouse: Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining.

Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept Hierarchy Generation, Data Mining Primitives, Languages and System Architecture: Data Mining Primitives, DMQL, Architectures of Data Mining Systems.

(12 Hrs)

Unit-III

Concept Description: Data Generalization & Summarization – Based Characterization, Analytical Characterization, Mining class Comparisons, Mining Descriptive Statistical Measures in Large Databases.

Mining Association Rules in Large Databases: Association Rule Mining, Single – Dimensional Boolean Association Rules, Multilevel Association Rules from Transaction Databases, Multi Dimensional Association Rules from Relational Databases, From Association Mining to Correlation Analysis, Constraint – Based Association Mining.

(12 Hrs)

Unit-IV

Classification and Prediction: Classification & Prediction, Issues Regarding Classification & Prediction, Classification by decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification based on concepts & Association Rule, Other Classification, Prediction, Classification Accuracy.

Cluster Analysis: Types of Data in Cluster Analysis, Partitioning methods, Hierarchical methods, Density – Based Methods, Grid – Based Methods, Model – Based Clustering Methods, Outlier Analysis.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
Data Mining Concepts & Techniques	Jiawei Han &, Micheline Kamber	Harcout India,
Data Mining	I.H. Witten E. Frank,	Morgan Kaufman
Reference		
Mastering Data Mining	Michael J.A. Berry, Gorgon S. Linoff	Wiley Publication.

IT-7203B   VISUAL PROGRAMMING

L T P   **Credits-4**
3 1 0

UNIT-I

Introduction: Visual programming basics, Application framework fundamental, windows programming (Win32 programming), and visual c++.memory management, DLLs,Win32 API.

(12 Hrs)

UNIT-II

Visual C++ components: Resource compiler, MFC, modal Dialog, Windows Common Control, the Modeless Dialog and Windows Common Dialogs, ActiveX Control, Bitmap, Reading and Writing Documents, SDI,MDI applications.

(12 Hrs)

UNIT-III

Socket Programming using Win Sock, TCP/IP, Document-View Structure, MFC Libraries viz Cview, Cfile, Cpoint, Cdialog.

(12 Hrs)

UNIT-IV

WIN32 Programming: WIN32 programming, Difference between a Windows program and a typical DOS program, Windows Programming modal, Windows Memory management, A skeletal Windows Application: WinMain function, Window Function, Componants of a Skeletal Application, Windows style, Device context, Creation of LISTBOX class, Dialog Boxes and SCROLLBAR class.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
VISUAL C++ programming	David J. Kruglenski	Microsoft Press
WIN32 Programming	Newcomer	Addison – Wesley
Reference		
Programming Windows 3.1	Charles Petzold	Microsoft press.

IT-7204A   INTERNETWORKING WITH TCP/IP

L T P   **Credits-4**
3 1 0

UNIT-I

Introduction: Layering, TCP/IP Layering Internet Addresses The Domain Name System Client Server Model, Port Numbers Implementations and Application Programming Interfaces.

The Link Layer: Ethernet and IEEE 802 Encapsulation Trailer Encapsulation SLIP: Serial Line IP, Compressed SLIPP PPP: Point – to Point Protocol.

(12 Hrs)

UNIT-II

IP The Internet Protocol: IP Header, IP Routing, Subnet Addressing, Subnet Mask, Special Case IP Addresses.

Introduction to ARP and RARP: ARP packet format, Proxy ARP, RARP Packet Format

ICMP: Introduction, ICMP, Message Types, ICMP Address, Mask Request and Reply.

(12 Hrs)

UNIT-III

IP Routing: Routing Principles, Introduction to Dynamic Routing

UDP: UDP Header, UDP Checksum

DNS: DNS Basics, DNS Message Format, security.

(12 Hrs)

UNIT-IV

TCP: TCSP Services, TCP Header, TCP Connection Establishment and Termination, TCP Timeout and Retransmission, Repacketization.

Telnet and Rlogin, FTP

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
TCP/IP Illustrated	Richard Stevens	Addison Wesley
Internetworking	Comer	PHI
with TCP/IP		

IT-7204B   MULTIMEDIA TECHNOLOGIES

L T P   **Credits-4**
3 1 0

UNIT-I

Basics of Multimedia Technology: Computers, communication and entertainment; multimedia an introduction; framework for multimedia systems; multimedia devices; CD-Audio, CD-ROM, CD-I, presentation devices and the user interface; multimedia presentation and authoring; professional development tools; LANs and multimedia; internet, World Wide Web & multimedia distribution network-ATM & ADSL; multimedia servers & databases; vector graphics; 3D graphics programs; animation techniques; shading; anti aliasing; morphing; video on demand.

(12 Hrs)

UNIT-II

Image Compression & Standards: Making still images; editing and capturing images; scanning images; computer color models; color palettes; vector drawing; 3D drawing and rendering; JPEG-objectives and architecture; JPEG-DCT encoding and quantization, JPEG statistical coding, JPEG predictive lossless coding; JPEG performance; overview of other image file formats as GIF, TIFF, BMP, PNG etc.

(12 Hrs)

UNIT-III

Audio & Video: Digital representation of sound; time domain sampled representation; method of encoding the analog signals; subband coding; fourier method; transmission of digital sound; digital audio signal processing; stereophonic & quadraphonic signal processing; editing sampled sound; MPEG Audio; audio compression & decompression; brief survey of speech recognition and generation; audio synthesis; musical instrument digital interface; digital video and image compression; MPEG motion video compression standard; DVI technology; time base media representation and delivery.

(12 Hrs)

UNIT-IV

Virtual Reality: Applications of multimedia, intelligent multimedia system, desktop virtual reality, VR operating system, virtual environment displays and orientation making; visually coupled system requirements; intelligent VR software systems, Applications of environment in various fields.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Text		
An introduction to Multimedia	Villamil & Molina	Mc Milan
Multimedia: Sound & Video	Lozano	PHI
Reference		
Multimedia: Production, planning and delivery	Villamil & Molina, Que	
Multimedia on the PC	Sinclair	BPB
Multimedia: Making it work	Tay Vaughan	TMH
Multimedia in Practice	Jeff coate Judith	PHI
Multimedia Systems	Koegel	AWL
Multimedia Systems	John .F. Koegel, Buford.	

IT-7204C   CYBER LAWS & IPR

L T P   **Credits-4**
3 1 0

UNIT-I
Basics of Computer & Internet Technology: Internet, ISP & domain name; Network Security; Encryption Techniques and Algorithms; Digital Signatures.
Introduction to Cyber World: Introduction to Cyberspace and Cyber Law; Different Components of cyber Laws; Cyber Law and Netizens.

(11 Hrs)

UNIT-II
E-Commerce: Introduction to E-Commerce; Different E-Commerce Models; E-Commerce Trends and Prospects; E-Commerce and Taxation; Legal Aspects of E-Commerce.

(11 Hrs)

UNIT-III
Intellectual Property Rights (IPR): IPR Regime in the Digital Society; Copyright and Patents; International Treaties and Conventions; Business Software Patents; Domain Name Disputes and Resolution.

(13 Hrs)

UNIT-IV
IT Act, 2000: Aims and Objectives; Overview of the Act; Jurisdiction; Role of Certifying Authority; Regulators under IT Act; Cyber Crimes-Offences and Contraventions; Grey Areas of IT Act.
Project Work: Candidates will be required to work on a project. At the end of the course students will make a presentation and submit the project report.

(13 Hrs)

Recommended books:

Title	Author(s)	Publisher
Text		
A Guide to Cyber Laws & IT Act 2000 with Rules & Notification	Nandan Kamath.	
Cyber Cops, Cyber Criminals & Internet	Keith Merill & Deepti Chopra	
References		
Information Technology Law	Diane Row Land	
Handbook of Cyber Laws	Vakul Sharma	Mc Millian

ME-7106A   MAINTENANCE ENGINEERING

L T P   **Credits:4**
3 1 0

UNIT-I
Concept and Objectives of Maintenance: Introduction to maintenance, function, objectives, Types of maintenance, maintenance organizations and its types, training of maintenance personal, need of training on job and off job training, concept of reliability, availability, maintainability, MTBF,MTTF

(12 Hrs)
UNIT-II
Maintenance Planning and Scheduling: Maintenance planning, benefits of planning, types of maintenance plans, manpower planning, job planning, maintenance planning, maintenance scheduling, maintenance literature like maintenance manuals, work order, job order, history cards, master inspection check list.

(12 Hrs)
UNIT-III
Preventive Maintenance and Failure Analysis: Elements of preventive maintenance, simple examples of preventive maintenance, procedures in industry. Defect generation, Types of failure, defect reporting, defect analysis, equipment downtime analysis, break down analysis (FTA, FMEA, FMECA).

(12 Hrs)
UNIT-IV
Computer Managed Maintenance System: Objectives, approach towards computerization, equipment classification, classification of breakdown, material and facilities, job sequence and preparation of work order and schedules, Material management module, cataloguing and codification of spares and consumables. Introduction to CBM, online offline monitoring, visual monitoring, temperature monitoring, leakage monitoring

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Industrial Maintenance Management	Sushil Kumar Srivastava	S Chand & Co.
Maintenance Engineering	H. P. Garg	S Chand & Co.
Maintenance Engineering Hand Book	Higgens & Lindlay	
Maintenance Engineering	Mishra	PHI

ME-7106B   CONCURRENT ENGINEERING

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Concurrent Engineering Definition, Product life cycle, quality products, evaporative markets, globalization and concurrent engineering

(12 Hrs)

UNIT-II
Concurrent Engineering Techniques: Review of concurrent engineering techniques like DFM (design for manufacture). DFA (design for assembly), QFD (quality function deployment), RP (rapid prototyping), TD (total design) for integrating these technologies.

(12 Hrs)

UNIT-III
Product Design & Development Process: Product information systems and their Mechanical Engineering architecture, Information environment for Suppliers, management, testing & inspection design engineering, purchasing, process control, manufacturing, support plans, operators, quality control, servicing and maintenance.

(12 Hrs)

UNIT-IV
Product and Process Integration: Product information modeling, Integration of information models and end users applications, Computer aided simultaneous engineering systems, Integrated concurrent design and product development, Constraint networks.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Integrated Product and Process Development	John M. Usher, Utpal Roy and H. R. Parasaei	Tata McGraw Hill
Product Design and Manufacture	A. K. Chitale and R. C. Gupta	PHI
Engineering Design and Design for Manufacturing: A structured approach	John R. Dixon and Corrodo Poli	Field Stone Publishers, USA
Material Selection in Mechanical Design	M. F. Ashby	Elsevier
Concurrent Engineering	Biren Prasad	Prentice Hall
Product Design & Development	Karl T. Ulrich, Steven D. Eppinger	TMHI

ME-7106C   ARTIFICIAL INTELLIGENCE

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Artificial intelligence, importance of AI, AI and related fields, Historical background of AI.
Knowledge: Knowledge based systems, LISP and other AI programming languages system and numeric fns, Functions, predicates, conditionals, input, output and local variables, iteration and recursion, property lists and arrays, PROLOG and other AI programming languages.

(12 Hrs)

UNIT-II
Knowledge Representation: Formalized symbolic logics, dealing with inconsistencies and uncertainties, trut.h maintenance systems: default reasoning and closed world assumption, Model and temporal logics, fuzzy logic and Natural language computations, probabilistic reasoning, Bayesian probabilistic inference, possible world representations, Dampster-Shafer theory, Adhoc methods, heuristic reasoning methods. Structured knowledge: graphs, frames and related structures. Object oriented representations.

(12 Hrs)

UNIT-III
Knowledge Organization and Manipulation: Search and control strategies, matching techniques, fuzzy matching algorithms, knowledge organization and management.
Knowledge Perception and Communication: Natural language processing, pattern recognition - the recognition and classification process, learning classification patterns, Recognizing and understanding speech, Visual image understanding**.**

(12 Hrs)

UNIT-IV
Knowledge Acquisition: General concepts, type of learning, general learning model, performance measures, Genetic algorithms, intelligent editors, learning by induction, Analogical and explanation-based learning.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
AI	Rich	McGraw Hil
Principles of AI	Neilson	Springer Verlag
AI	Winston	Addison Wesley
Introduction to AI and expert systems	Don W. Patlason	Eastern Eco

ME-7106D   COMPOSITE MATERIALS

L T P   **Credits:4**
3 1 0

UNIT-I
General Introduction: Historical background; Definition; Types of composite: polymer matrix composite, metal matrix composite, ceramic matrix composite; interaction between constituents and the concept of load transfer
Fibers and Matrices: Reinforcements; strength of reinforcement. Matrices Different types: Polymer matrix material; metal matrix material; ceramic matrix material

(12 Hrs)

UNIT-II
Strength of Composites: Failure modes of long fiber composites; tensile failure; failure in compression; shear failure
Composite Models: Law of mixtures, shear lag model, laminated plate model, Eshelby's model, others models

(12 Hrs)

UNIT-III
Fabrication of Composites: Fabrication of polymer matrix composite: liquid resin impregnated routes, pressurized consolidation of resin prepegs, consolidation of resin moulding compounds, injection moulding of thermoplastics, hot press moulding of thermoplastics.
Fabrication of Ceramic Composites: powder based routes, reactive processing, layered ceramic composites

(12 Hrs)

UNIT-IV
Processing of Metal Matrix Composites: Diffusion bonding, casting fiber reinforced metal matrix composite, powder techniques in processing of metal matrix composites, deposition technologies for MMC fabrication, In-situ reinforcement of MMC
 Application of Composites: Some case studies and examples

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Composite Materials	S. C. Sharma	Narosa Publishers
Metal Matrix Composites	R.K.Everett & R.J Arsenault	Academic press
Introduction to Metal Matrix Composite	T.W Clyne & P. J. Wither	Cambridge Univ. Press

ME-7106E   SYSTEM DYNAMICS & CONTROL

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Introduction to Physical System Dynamics
Modeling of Physical System Dynamics: A Unified Approach, Physical systems, Introduction to Bond graphs, Ports, Bonds and Power; Elements of Bond graphs:1-port elements – resistor R, Stiffness C, and Inertia I, Source of Effort Se and Flow SF; 2-port elements – Transformer TF and Gyrator GY, with modulation, Junction elements 1 and 0; Causality, Causality for basic 1-port and multi-ports, Derivation of System equations from Bond graphs in first order state space form.
Bond Graph Modeling of Multi-energy Systems: Mechanical Systems, Translation and rotation (about a fixed axis)

(12 Hrs)

UNIT-II
Electrical Systems, Electromechanical Systems, Fluid systems, Transducer models–cylinder, rack and pinion, electromechanical transducers, pumps – positive displacement and centrifugal pump, gear trains, etc.
Analysis of Linear Systems: Free & forced response for first and second order systems, Undamped & damped oscillator, Derivation of Signal flow graphs from Bond graphs, Derivation of Transfer functions

(12 Hrs)

UNIT-III
Bode plots, State Variable Analysis, State transition matrix, Characteristic equation, Eigen values and Eigen vectors, their impact on system response, Similarity transformations and their properties, Controllability and Observability, Canonical forms, Controllable, Observable, Diagonal

(12 Hrs)

UNIT-IV
Stability Criteria: Routh-Hurwitz criterion
Controllers: Proportional Integral and Derivative feedback
Simulation: Computer simulation of Dynamic Systems using Bond graphs

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
System Dynamics: Modeling and Simulation of Mechatronics Systems	Karnopp, Margolis, Rosenberg	Wiley
System Dynamics: A Unified Approach	Karnopp, Margolis & Rosenberg	Wiley
Modeling & Simulation of Engineering Systems through Bond Graphs	Amalendu Mukherjee R. Karmakar	Narosa
Bond Graph in Modeling, Simulation and Fault Identification	Amalendu Mukherjee, Ranjit Karmakar Arun Kumar Samantaray	I. K. Int. Pub. House
System Dynamics & Control	Eronini Umez-Eronini	Cole Publishing Co.
Feedback Control Systems	B.C.Kuo	Prentice Hall.
Modern Control Engineering	K.Ogata	Prentice Hall
Control Systems Design	Bernard Friedland	McGraw-Hill

ME-7106F   NON CONVENTIONAL ENERGY RESOURCES

L T P   **Credits:4**
3 1 0

UNIT-I

Introduction: Renewable and non-renewable energy sources, their availability and growth in India: energy consumption as a measure of Nations Development: strategy for meeting the future energy requirements.
Solar Energy: Solar radiations-beam and diffuse radiations; earth sun angles, attenuation and measurement of solar radiations; Optical properties of materials and selective surfaces.

(12 Hrs)

UNIT-II

Solar Energy Equipments: Principles, introduction to different types of collectors, flat plate, cylindrical and parabolic collectors; Solar energy storage systems-their types, characteristics and capacity; solar ponds. Application of solar energy in water, space and process heating, solar refrigerant and air conditioning; water desalination and water pumping; Solar thermal power generation; solar cells and batteries
Wind Energy: Principle of wind energy conservation; basic components of wind energy conversion systems; wind mill components, various types and their constructional features; wind data and site selection considerations.

(12 Hrs)

UNIT-III

Direct Energy Conversion Systems: i) Magnetic Thermodynamic (MHD) Generators; Operating principle, types and working of different MHD system –their relative merits; MHD materials and production of magnetic fields ii) Thermo-Electric Generators; Thermo-electric effects and materials; thermoelectric devices and types of thermo-electric generators; thermo-electric refrigeration iii) Thermionic Generators; Thermionic emission and materials; working principle of thermionic convertors iv) Fuel Cell; Thermodynamic aspect; types, components and working of fuel cell. Performance, applications and economic aspects of above mentioned direct energy conversion systems.

(12 Hrs)

UNIT-IV

Miscellaneous Non-Conventional Energy Systems: i) Bio-Mass; Concept of bio-mass conversion, photo-synthesis and bio-gasification; bio gas generators and plants, their types constructional features and functioning; fuel properties of bio gas and community bio gas plants ii) Geothermal; Sources of geothermal energy types, constructional features and associated prime movers iii) Tidal and Wave Energy; Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices, Advantages/disadvantages and applications of above mentioned energy systems.

(12 Hrs)

**Recommended Books*:*

Title	Author(s)	Publisher
Solar Energy: Fundamentals and Applications	Jai Prakash, H.P. Garg	Tata McGraw-Hill.
Solar Energy: Principles of thermal collection & storage .	S.P. Sukhatme	Tata McGraw-Hill
Solar Engineering of Thermal Process, Energy conversion.	Duffie Beckman Chang	John Willey Publishers Prentice Hall.

ME-7106G   MECHANICAL VIBRATIONS

L T P   **Credits:4**
3 1 0

UNIT-I
Mechanical Vibrations: Basic Concepts :Importance and scope, definition and terminology, vector method of representing harmonic motions, introduction to various types of vibrations and types of excitation .

Undamped Free vibrations: Single degree of freedom: D'Alembert's Principle, Energy method, Rayleigh method, simple applications of these methods, equivalent spring stiffness.

(12 Hrs)

UNIT-II
Damped Free Vibrations: Single degree of freedom systems: viscous damping, different types of damping, sub-critical, critical and over-critical damping, logarithmic decrement frequency of damped-oscillations

Damped Force Vibrations: Single degree of freedom systems: Steady state solution with viscous damping, simple harmonic excitation, base excitation, vibration isolation and transmissibility, principles of vibration measuring and seismic instruments, whirling of shafts without friction

(12 Hrs)

UNIT-III
Two Degree of Freedom Systems: Normal modes vibrations, natural frequencies, amplitude ratio, force harmonic vibrations

Applications: Vibrations absorber-principle, centrifugal pendulum vibration absorber, torsional vibration damper, untuned vibration damper , gyroscopic effect on rotating shafts, torsional vibration of two rotor systems

(12 Hrs)

UNIT-IV
Multi-Degree of Freedom Systems: Undamped free vibrations: Reciprocity theorem, Rayleigh and Dunkerely methods, simple torsional and geared systems

Continuous Systems: Vibration of a string, longitudinal vibrations of bars, Euler's equation of motion for beam vibration, natural frequencies for various end conditions torsional vibrations of circular shafts.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Mech. Vibrations	A.H. Church-	John Wiley & Sons
Engg. Vibration	Lyark S. Jacobsen	McGraw Hill Book Co.
Vibration Problem in Engg.	S. Timoshenko	Van Nostrand Co.
Vibration for Engineers	K.K. Pujara	Dhanpat Rai & Sons
Mechanical Vibrations	G.K. Grover	New Chand, Roorkee
Mechanical Vibration	Tse-Morse & Hinkle	

ME-7207A   FINITE ELEMENTS METHODS

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Historical Background, Stresses and equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Vectors and Matrices.

Introduction & Fundamental Concepts: Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method.

(12 Hrs)

UNIT-II
1-D FE Modeling: Finite Element Modeling, Coordinates and Shape Functions, The Potential Energy Approach, The Galerkin Approach, Assembly of Global Stiffness matrix and Load vector, Properties of Stiffness Matrix, Treatment of Boundary Conditions and Temperature Effects.

2-D FE Modeling: Finite Element Modeling, Constant Strain Triangle (CST).

(12 Hrs)

UNIT-III
2-D FE Modeling: The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle.

Truss: Introduction, Plane Trusses, Assembly of Global Stiffness Matrix and Load Vector, (For 1D and 2D problems only).

(12 Hrs)

UNIT-IV
Scalar Field Problems: Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in ducts.

Dynamic Considerations: Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors. (Introduction only)

Computer Implementation: Introduction; Computer Program Organization for Calculation of System Matrices

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Introduction to Finite Elements in Engineering	Chandrupatla, Belegundu	PHI
Finite Element Procedures	Bathe	PHI
An Introduction to Finite Element Method	Reddy	TMH

ME-7207B   REFRIGERATION & AIR CONDITIONING

L T P   **Credits:4**
3 1 0

UNIT-I
Air Refrigeration Systems: Introduction, types of air refrigeration systems, reversed control cycle, Bell Coleman air refrigerator, Necessity of air-craft refrigeration, regenerative and reduced ambient type cycles, compression and bootstrap cycle.

(12 Hrs)

UNIT-II
Refrigeration Systems: Vapor compression refrigeration system,T-S,H-S,P-H diagram for VCR, COP. Performance of VCR, advantages and disadvantages, Methods for improving COP, Multiload system, Single and multi stage compressions, Introduction, actual aqua ammonia absorption system, electrolux refrigerator, COP Compression between VCR and absorption refrigeration system.

(12 Hrs)

UNIT-III
Refrigerants and Refrigeration Equipments: Classifications of refrigerants, properties of ideal refrigerants, anti-freeze solutions, selection of refrigerants, nomenclature of refrigerants, Ozone layer depletion, eco-friendly refrigerants, Construction details of different types of compressors, condensers, evaporator, expansion devices, dehydrators.

(12 Hrs)

UNIT-IV
Air Conditioning Systems: Types of air-conditioning systems, central AC, unitary AC load circulation load calculation based on various parameters, like solar radiations, transmission through building, fresh air ventilation occupancy load, internal heat gain such as lights, appliances, machine etc, state and quantity of supply air for different type of air-conditioning system.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Refrigeration and Air conditioning	C. P. Arora	TMH
Refrigeration and Air conditioning	Domkondwar	Khanna
Refrigeration and Air conditioning	Balleney	Khanna
Ref and Air Conditioning	Gupta & Prakash	New Chand

ME-7207C   ROBOTICS ENGINEERING

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction to Robotics- Kinematics & Dynamics of Robotic Linkages (Open Ended Type Manipulators): Frames, Transformations, Translation and rotation, Denavit-Hartenberg parameters, Forward and Inverse Kinematics

(12 Hrs)
UNIT-II
Jacobian, Equations of motion, Newton-Euler formulations

(12 Hrs)
UNIT-III
Sensors and Actuators: Strain gauge, resistive potentiometers, Tactile and force sensors, tachometers, LVDT, Piezo-electric accelerometer, Hall effect sensors, Optical Encoders, Pneumatic and Hydraulic actuators, servo valves, DC motor, stepper motor, drives

(12 Hrs)
UNIT-IV
Control of Manipulators: Feedback control of II order Linear systems, Joint control, Trajectory control, Controllers, PID control
Robot Programming: Language-overview, commands for elementary operations.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Introduction to Robotics: Mechanics and Control	John J. Craig	Addison-Wesley
Foundations of Robotics	Tsuneo Yoshikawa	MIT Press
Robot Dynamics and Control	Spong M.W., Vidyasagar M	John Wiley & Sons
A Mathematical Introduction to Robotic Manipulation	Murray R. M., et al	CRC Press
Kinematics, Dynamics and Design of Machinery	Waldron K.J., Kinzel, G.L.,	John Wiley & Sons
System Dynamics & Control, Brooks	Eronini Umez-Eronini	Cole Publishing Co.
Bond Graph in Modeling, Simulation and Fault Identification	Amalendu Mukherjee, Ranjit Karmakar Arun Kumar Samantaray	I. K. International Pub. House Pvt. Ltd.

ME-7207D   MANAGEMENT INFORMATION SYSTEM

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction: Definition of data and information, Value of Information, types of information and their characteristics, data management, knowledge Management, concept of management information, decision support system, system approach, MIS organization within organization

(12 Hrs)

UNIT-II
Organizational Issue: Types of organizations, Management and organizational behavior, impact of information system on the organization, organizational structure and individuals, top management and information systems, impact of computing, information processing & technology, management committees, holistic system approach.

(12 Hrs)

UNIT-III
Information System for Decision Making: Evaluation of information system, basic information system, basic information systems, decision assisting information systems and end user computing. Decision making and MIS, MIS as a technique for making programmed decision

Strategic and Project Planning of MIS: General business planning, appropriate MIS response, General MIS planning.

(12 Hrs)

UNIT-IV
Conceptual System Design: Defining the problem, system objectives, system constraints, information needed, information sources, development of alternative, conceptual designs and selection of optimum one, documentation of system, conceptual design reports, implementation of MIS and future trends.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Management Information System	Rober G and Murdick	Prentice Hall
Information System Concepts for Management	Henry Lucas	McGraw-Hill,
Hand Book of Engineering Management	Dennis Lock	Gower Publishing Company

ME-7207E   AUTOMOBILE ENGINEERING

L T P   **Credits:4**
3 1 0

UNIT-I
Introduction-Automobile Engine Components: Engine fundamentals, engine operations, engine type and construction, connecting rods, rod bearings, piston rings, crank shaft, cylinder blocks, valves & valves train, engine measurement and performance.

(12 Hrs)

UNIT-II
Automotive Engine System: Automotive engine fuels, fuel and exhaust system, carburetors, carburetor fuel system service, diesel fuel engines injection system, gasoline fuel injection system, engine lubricating system, engine cooling systems, emission control & tune up.

(12 Hrs)

UNIT-III
Automotive Chassis: Spring and suspension system, steering systems, automobile clutches, hydraulically operated clutch, pressure plate, fly wheel, adjusting wheel, spacing, and automotive brake system.
Automotive Transmission: Gear ratio, types of gear, types of gear box, working of gear box, Gear selector mechanism, planetary type gear box, universal joints, and differentials and drive axles.

(12 Hrs)

UNIT-IV
Automotive Electronic and Electrical Equipment: The automotive electrical system, starting system, central point ignition, electronic ignition system, automotive battery.

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Automobile Engineering	Nakra	Standard
Automobile Mechanics	Crouse	Tata McGraw-Hill
Automobile Engineering	Kirpal Singh	Standard
A Text Book of IC Engine	Mathur & Sharma	Dhanpat Rai