

# AC-5101 ENGINEERING CHEMISTRY

L T P  
3 1 0

Credits:4

## UNIT-I

**REDOX REACTION AND ELECTRO CHEMISTRY:** 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<sub>2</sub>SO<sub>4</sub>-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  $\lambda_{max}$ , 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  
3 1 0

Credits-4

## UNIT-I

**BONDING AND MOLECULAR STRUCTURE:** 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 diatomic 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, Schottky and non-stoichiometric 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 CHEMISTRY:** 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 & 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  $\lambda_{max}$ , 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 |
| 7. Fundamentals of Analytical Chemistry | Skoog & West           |
| 8. Solid State Chemistry                | Antheny West           |
| 9. Supramolecular Chemistry             | Atwood                 |

# AM-5101 ENGINEERING MATHEMATICS-I

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3 1 0

Credits:4

## 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-IV

**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.Spiegel, Advanced Calculus – Theory and Problems, Schaum Publications, New York

**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

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3 0 0

Credits:3

### 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  
3 1 0

Credits:4

## 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, Schrodinger'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 BF<sub>3</sub> 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<sub>2</sub> 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 State Physics(John-Wiley&Sons) Engineer

### Reference Books

Serway, Moses and Moyer Modern Physics (Thomson)

# CH-5101 CHEMICAL PROCESS CALCULATIONS

L T P  
3 2 0

Credits:5

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

## CH-5102 FLUID FLOW

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3 1 0

Credits:4

### 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 & Banchemo

Introduction to Chemical Technology

Tata McGraw Hill

Foust

Principles of Unit Operation

John Wiley



## CH-5103 UNIT OPERATIONS

L T P  
3 1 0

Credits:4

### 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 Gyrotory 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 FILTRATION:** Screening, Screen analysis, Screening equipment namely stationary Screens & Grizzlies, 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 bowl centrifuge, disc type centrifuge, Centrifugal decanters, Centrifuge theory & calculations, rate of separations.

(10 Hrs)

### Recommended Books:

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

# CH-5201 HEAT TRANSFER

L T P  
3 2 0

Credits:5

## 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, Prandtl, 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, absorptivity, 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
<b>Text Books</b>		
Holman, J.P.	Heat Transfer	McGraw Hill
Kreith	Principles of Heat Transfer	Harper & Row
<b>Reference Books</b>		
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.

**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 INDUSTRIES AND ELECTROTHERMAL INDUSTRIES:** 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:**

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

# CH-6101 MASS TRANSFER

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3 1 0

Credits:4

## 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.

Mass Transfer

McGraw Hill

R.Wilkes

**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 &

John Wiley, 3rd

Mass Transfer

Ed

Skelland

Diffusion Mass Transfer

John Wiley

**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:**

<b>AUTHOR</b>	<b>TITLE</b>	<b>PUBLISHER</b>
<b>Text Books:</b>		
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.
<b>Reference Books:</b>		
Dodge	Chemical Engg. Thermodynamics	-do-
Rao, YVC	Chemical Engineering Thermodynamics	University Publications

# CH-6103 INTRODUCTION TO POLYMER SCIENCE & TECH.

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3 1 0

Credits:4

## 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  $M_n$ ,  $M_z$ ,  $M_v$  and  $M_w$  and measurement techniques, Functionality principle, Glass transition temperature and its measurement, Theory of polymer solutions: solubility parameter, Mark-Houwink-Sakurada 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
<b>Text Books:</b>		
Premamoy Ghosh	Polymer Science & Technology of Plastics and Rubbers	Tata McGraw Hill
Billmeyer	Text Book of Polymer Science	John Wiley
Flory	Polymer Chemistry	Cornell Uni.
<b>Reference Books:</b>		
Ferdinand Rodriguez	Principles of Polymer Systems	Tata McGraw Hill
Gowariker	Polymer Science	Wiley Eastern
E. Gurvella	Polymer Science & Technology	Springer Verlag
Gupta, s. Kumar	Fundamentals of Polymers	McGraw Hill

# CH-6104 INTRODUCTION TO PAPER TECHNOLOGY

L T P  
3 1 0

Credits:4

## 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
<b>Text Books:</b>		
Smook	Handbook for Pulp and Paper Technology	TAPPI
Kocurek	Pulp & Paper manufacture Vol. 1	TAPPI
Macdonald	Pulping of Wood, Vol. 1	TAPPI
<b>Reference Books:</b>		
Kourek	Pulp & Paper manufacture	TAPPI
Casey	Pulp & Paper Chemistry and Chemical Technology, Vol. 1	Wiley



# CH-6201 CHEMICAL PROCESS INSTRUMENTATION

L T P  
3 1 0

Credits:4

## 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
<b>Text Books</b>		
Eckman, D.P.	Industrial instrumentation	Wiley Eastern
Weber	Introduction to Process Dynamics & Control	John Wiley
<b>Reference Books</b>		
Harriott & Peter	Process control	Tata McGraw Hill
Coughanour	Process Systems Analysis & Control	McGraw Hill
Pollard	Process Control for chemical and allied industries	Heinemann

# CH-6202 CHEMICAL REACTION ENGINEERING-I

L T P  
3 1 0

Credits:4

## 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
<b>Text Books</b>		
Levenspiel	Chemical Reaction Engg.	John Wiley
Fogler, Scott	Elements of Chemical Reaction Engg.	Prentice Hall India
<b>Reference Books</b>		
Smith	Chemical Engg. Kinetics	McGraw Hill
Hougen & Watson	Chemical Process Principle	Asia Publishing House

## CH-6203 PROCESS EQUIPMENT DESIGN

L T P  
3 2 0

Credits:5

### 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 Cylindrical 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 tall vertical vessels.

(10 Hrs)

### Recommended Books:

AUTHOR	TITLE	PUBLISHER
<b>Text Books</b>		
Sinnot R.K.	Coulson & Richardson's Chemical Engg	Elsevier
Bhattacharya B.C.	Int. to Chemical Equipment Design	CBS
<b>Reference Books</b>		
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  
3 2 0

Credits:5

## 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
<b>Text Books</b>		
Joel R. Fried	Polymer Science & Technology	PHI
Brydson	Rubber Chemistry	Elsevier Appl.
<b>Reference Books</b>		
Ferdinand Rodrigues	& Principles of Polymer Systems	TMH
Gowariker	Polymer Science	Wiley Eastern

# CH-6205 PULPING PROCESSES

L T P  
3 2 0

Credits:5

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

L T P  
3 1 0

Credits:4

**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; Routh 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:**

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

L T P  
3 1 0

Credits:4

**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:**

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

**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:**

<b>AUTHOR</b>	<b>TITLE</b>	<b>PUBLISHER</b>
<b>Text Books</b>		
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  
3 1 0

Credits:4

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

**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, Rheometric 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 &amp; 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

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Credits:4

## 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

**Unit -I**

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

**Black Liquor 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 & causticizing 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
<b>Text Books:</b>		
Kocurrek	Pulp & Paper Manufacture, Vol. 5	TAPPI
Smook	Handbook for Pulp & Paper Technology	TAPPI
<b>Reference Books:</b>		
Macodonald	Pulping of Wood, Vol. 1	TAPPI
Casey	Pulp & Paper Chemistry & Chemical Technology, Vol. 2,3	Wiley

L T P  
3 0 0

Credits:3

**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 design and its strategy, scale up criteria and regime concepts.

(10 Hrs)

**Recommended Books:**

<b>AUTHOR</b>	<b>TITLE</b>	<b>PUBLISHER</b>
<b>Text Books:</b>		
Richardson Coulson	& Chemical Engineering Design Vol. 6	Butterworth- Neinemann
Peters Timmerhaus	& Plant Design & Economics for Chemical Engineers	McGraw Hill
<b>Reference Books:</b>		
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

**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 equation, 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, Weinsten, Muller method, Numerical integration algorithm; Euler method, Runge-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:**

<b>AUTHOR</b>	<b>TITLE</b>	<b>PUBLISHER</b>
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

**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	Marshall 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

**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 &amp; Hall

Powell

Engineering with Polymers

-do-

Smith

Manufacture of Plastics

Van Nostrand

Morton Jones

Polymer Process

Chapman Hall



**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:**

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

L T P  
3 0 0

Credits:3

**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, Klemm 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:**

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

# CS-5101/5201 OBJECT ORIENTED PROGRAMMING

L T P  
3 0 0

Credits-3

## 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
Let us C++	<b>Text</b> Yashwant kanetkar	
Turbo C++	Robert Lafore	
Thinking in C++	<b>Reference</b> P B Mahapatra	
Complete Reference C++		TMH

# CS-5102 PROGRAMMING METHODOLOGY

L T P  
3 1 0

Credits-4

## 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
<b>Text</b> Turbo C++ Let Us C++	Robert Lafore Yashwant Kanetkar	Pearson India BPB
<b>Reference</b> Thinking In C++	P B Mahapatra	PHI

# CS-5103 DISCRETE MATHEMATICAL STRUCTURE

L T P  
3 1 0

Credits-4

## 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, Recursive 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
<b>Text</b>		
Discrete Mathematics & its Application	K.H. Rosen	McGraw-Hill
Elements of Discrete Mathematics	C.L.Liu	McGraw-Hill
<b>Reference</b>		
Discrete structure of Computer science	Levy	Wiley Eastern
Elements of Discrete	Levis	McGraw-Hill
Maths Foundation of Discrete Maths	Joshi	Wiley Eastern

# CS-5202 DATA STRUCTURES & ALGORITHMS

L T P  
3 2 0

Credits:05

## UNIT-I

**Introduction:** Basic concepts and notations: Data structures and Data Structures operations; Mathematic Notations and Functions; Algorithmics complexity and time space trade off.

**Recursion:** Recursion; Types of recursion; Examples Of Recursion The exponential power of a numbers, Fibonacci numbers, the greatest common devices, Towers Of Hanoi.

**Arrays:** Introduction; One-dimension array storage, Traversing, Inserstion,Deletion, Searching;Multidimensional array Two dimensional array, Gernal multi-dimensional array.String proccessing and Manipulation.

(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; Implementation of queues; Circular Queues; Double ended queues; Priorities Queues

(12 Hrs)

## UNIT-III

**Trees:**Inroduction:Binary trees; Complete binary trees; Extended binary trees; Representation of binary trees; Insertion, and deletion from the Binary trees; Tree traversal using in-order, pre-order and post-order; Representation of Binary tree; Application of Binary tree; Search tree; Heap tree, Balanced Binary tree;B-trees.

(12 Hrs)

## UNIT-IV

**Graphs:**Basic concepts & definitions; Representation of Graph; Adjacency list; Adjacency Matrix, Path Matrix, Graph Traversal; Shortest Path Alogorithms.

**Sorting & Seraching:** Linear search; Binary Searching; Bubble sort; Insertion Sort; Quick sort; Selection; Merge sort; Heap sort; Selection sort, Hashing Technoques.

### Recommended Books;

Title	Author(s)	Publisher
<b>Text</b> Data Structures	Lipschutz, Schaum series	TMH
Data Structure using C and C++	A. M. Tanenbaum	Pearson Education
<b>References</b> Introduction to Data Structure with Applications	Trembley Sorenson	TMH
Data Structures	Harowitz & Sahni	Galgotia Publications

# CS-5203 DATA COMMUNICATION

L T P  
3 1 0

Credits:04

## UNIT-I

**Concepts & terminology:** Data representation, Data Transmission, Modes of data transmission, Signal Encoding, Transmission channel, Directional capabilities of data exchange.

## UNIT-II

**Transmission media:** Wire pairs, Microwave, Coaxial cable, Satellite communication, Optical Fibers, Modulation techniques AM, FM & PM, Digital modulation method ASK, FSK & PSK, Multilevel modulation, Synchronous and Asynchronous modulation, Modems & Line drivers, Data Multiplexing Techniques- FDM, TDM & STDM, Multiplexing common carrier system, Multiplexing satellite signals concentrations, Data compression Haffman code, Adaptive scanning, Facsimile compression.

(12Hrs)

## UNIT-III

**Transmission Impairments:** Factors contributing Errors, Major impairments Random & Now Random, Error control method, coding for Error deletion and correction , Error detection methods Parity checking, checksum error detection & CRC, forwarded Error correction methods block parity, Hamming code & convolution code, reverses Error correction method stop & wait, Go back by N & Selective retransmission.

(12 Hrs)

## UNIT-IV

**Classification of Data link and controls:** Line control method. Error handling method, Flow control, communication protocol XMODEM Protocol, Kermit Protocol, HDLS & SDLC. Network Architecture Layered Protocol TCP/IP and OSI model, LAN protocol CSMA/CD, Token bus, Toking & FDDI, IEEE standred 802.I-II.

(12 Hrs)

### Recommended Books

Title	Author(s)	Publisher
<b>Text</b>		
Data Communication & Distributive Networks	Uyless D. Black	PHI
Data communication	Prakash C-Gupta	PHI
<b>Reference</b>		
Computer Networks		PHI
Data communication	Andrew S. Tancubarm	PHI
William Stalling		

# CS-5204 COMPUTER ARCHITECTURE AND ORGANISATION

L T P  
3 1 0

## UNIT-I

**Credits:04**

**Introduction:** Historical overview, economic trends, underlying technologies, Data Representation-Data Types, Complete. Fixed-Point Representation, Floating –Point Representation. Error Detection and Correction. Addition, Subtraction, Multiplication and Division algorithms and hardware.

**Register Transfer and Microoperations:** Register transfer language, bus and memory transfers, and arithmetic, logic and shift micro-operations. Construction an arithmetic shift unit.

(12 Hrs)

## UNIT-II

**Basic Computer Architecture and Design:** Computer registers, Computer instructions-Instruction Set Completeness. Classifying Instruction Set Architecture. Basic steps of Instruction Execution, Hardwired Control.Microprogrammed Control. Horizontal and Vertical Microprogramming Interrupts.

(12 Hrs)

## UNIT-III

**Central Processing Unit:**General Register Organization. Stack Organized CPU. Instruction formats, Addressing Modes . Data Trasfer and Manipulation, RISC Vs CISC. Introduction to Parallel and pipeline Processing.

(12 Hrs)

## UNIT-IV

**Input Output Organization:** Peripheral devices, I/O interfaces, Asynchronous data transfer, modes of transfer, I/O Modes-Programmed I/O, Interrupt Initiated I/O and DMA. Input Output Processor.

**Memory Organization:** Memory System: principle of Locality, principles of memory hierarchy Caches, associative memory, main memory, Virtual memory, Paging and Segmentation, Memory.

(12 Hrs)

### Recommended Books

Title	Author(S)	Publisher
Computer Organization Text	Hamacher, Vrenesic	McGraw Hill
Computer Organization	Stalling	TMH
<b>Reference</b>		
Computer Architecture And Organization	John. P. Hays	McGraw Hill
Computer Architecture & Organization	Carpirdli, Pearson Education	Asia
Computer Architecture & Organization	M.Mano	PHI



# CS-5104 DIGITAL LOGIC DESIGN

L T P  
3 1 0

Credits-4

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

# CS-6101 RELATIONAL DATABASE MANAGEMENT SYSTEM

L T P  
3 1 0

Credits-4

## 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 constraints, Referential integrity, entity integrity, functional dependencies, pitfalls 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, 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
<b>Text</b> Database system concepts	Korth, H. F. & A Silberchatz	MGHISE
Fourth Generation Languages	Martin, James	Prentice Hall
<b>Reference</b> Introduction to Database system . Database Systems	Date. C.J. Bipin Desai	Addison Wesley TMH

# CS-6102 MICROPROCESSOR AND APPLICATIONS

L T P  
3 1 0

Credits-4

## 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
Microprocessor Architecture. Programming and Applications with the 8085/8080A	R. S. Gaonkar	Wiley Eastern Ltd
Microprocessor Interfacing, programming & Hardware,	D.V. Hall	PHI.
<b>Reference</b>		
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  
3 1 0

Credits-4

## 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
<b>Text</b> Operating System Concepts	Peterson, Silberschatz	Addison Wesley
Operating Systems	Milenkovic	MacGraw Hill
<b>Reference</b> Operating systems – A systematic view	Davis,Rajkumar	Pearson
Operating systems	Dhamdhare	TMH
Operating systems	Deitel,Deitel,Choffnes	Pearson

# CS-6104 COMPUTER NETWORKS

L T P  
3 1 0

Credits-4

## 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
<b>Text</b>		
Computer Networks	Tanenbaum	PHI
Computer Networks and Their Protocols	Darix	DLA Labs
<b>Reference</b>		
Comp. Communication & Networks	Freer	East-West-Press
Data Communication and Networking	Forouzen	TATA McGraw Hill

# CS-6201 SOFTWARE ENGINEERING

L T P  
3 1 0

Credits-4

## 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
<b>Text</b>		
Software Engineering	Ian Somer Ville	Addison Wesley
Software Engineering	ROGER S.PRESSM	TMH
<b>Reference</b>		
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  
3 1 0

Credits-4

## 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
<b>Text</b>		
System programming	Donovan, J.J.	McGraw-Hill
System Programming	Dhamdhare	TMH.
<b>Reference</b>		
Compiler construction for digital computers	Ullman, J.D.	Wiley-Eastern

# CS-6203 ALGORITHM ANALYSIS & DESIGN

L T P  
3 2 0

Credits-5

## 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
<b>Text</b>		
Introduction to Algorithms	Coreman	PHI
Algorithm Analysis & design	Harwitz and Sahni,	Galgotia Publications
<b>Reference</b>		
The Design and Analysis of computer Algorithms,	Aho, Hopcroft, Ullman	Pearson



# CS-7101 COMPUTER GRAPHICS

L T P  
3 1 0

Credits-4

## 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
<b>Text</b> Principles of Interactive Computer Graphics	Newman, Sproul,	McGraw Hill
Computer Graphics ,	Hearn & Baker ,	PHI
<b>Reference</b> Computer Graphics – A Programming Approach	Steven Harrington	McGraw Hill

# CS-7102 ARTIFICIAL INTELLIGENCE

L T P  
3 1 0

Credits-4

## 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
<b>Text</b>		
Artificial Intelligence	Elaine Rich & Kevin, Knight	Tata McGraw – HIV edition.
Artificial Intelligence	Patrick Winston	
<b>Reference</b>		
Artificial Intelligence	Luger	

# CS-7103 THEORY OF COMPUTATION

L T P  
3 1 0

Credits-4

## 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  $\epsilon$ -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 grammars, 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, Deterministic 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, Cook-Kasami-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 , Switching circuits & FSM ,	EV Krishnamurthy, ZVI Kohavi,	East-west press TMH publications
Reference Elements of the theory of computation	H.R. Lewis	Prentice-Hall
Formal Language	A.K. Salomaa	Acad. Press

**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:**

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

# CS-7202 COMPILER DESIGN

L T P  
3 1 0

Credits-4

## UNIT-I

**Introduction:** Introduction to compilers, 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
Principles of Compiler Design	Alfred V. Aho, J.D. Ullman	Narosa Publishing
Compiler Construction	D.M. Dhamdhare	Macmillan India Ltd.
Reference		
Compiler Principles	A.V. AHO, Ravi Sethi	Addison Wcsley
Techniques Tools	J.D. Ulliman	

# EC-5101 COMMUNICATION SYSTEMS

L T P  
3 1 0

Credits:4

## Unit-I

**Review of Communication Engg.:** 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 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  
3 1 0

Credits:4

## 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 Circuitis:** 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
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# EC-5201 ANALOG ELECTRONIC CIRCUITS

L T P  
3 1 0

Credits:4

## 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 Amplifiers:** 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	Schilling and Belove	MacGraw Hill
Reference Books		
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  
3 1 0

Credits:4

## 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  
3 1 0

Credits:4

## 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

Signals and Systems

#### Title

Simon Haykin and Barry Van Veen

#### Title

John Wiley and Sons, Inc. Wiley

Communication Systems

Lathi

### Reference Books

#### Title

Signals and Systems

#### Author

Alan V. Oppenheim and Alan S. Willsky

#### Publisher

Pearson Education

# EC-6101 LINEAR ICs AND APPLICATIONS

L T P  
3 1 0

Credits:4

## 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
<b>Reference Books</b>		
Op-amp & Linear Integ. Ckts	COUGHLIN	PHI
Integrated Electronics	MILLMAN & HALKIES	Tata Mcgraw

# EC-6102 MICROPROCESSOR AND MICRO CONTROLLER

L T P  
3 1 0

Credits:4

## 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  
3 1 0

Credits:4

## 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 criteria 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 Beaur	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  
3 1 0

Credits:4

## Unit-I

**Static Electric Field:** Force 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

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# 6201 INDUSTRIAL ELECTRONICS & APPLICATIONS

L T P  
3 1 0

Credits:4

## 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, commutation 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. Bimbira	Khanna
Power Electronics & Controls	Datta	Prentice hall

  

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

# EC-6202 MICROWAVE ENGINEERING

L T P  
3 1 0

Credits:4

## Unit I

**Introduction:** Microwave frequency spectrum, familiarization with bands and wavelength.

**Microwave Components:** Wave guides, wave guide coupling, ferrite device 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

Foundation of Microwave Engg.

#### Author

R. E. Collin

#### Publisher

McGraw-hill

### Reference Books

#### Title

Strip line like transmission for MIC

#### Author

Houl & Bhat

#### Publisher

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  
3 2 0

Credits:5

## 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, half 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, yagi 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

Antennas

#### Author

Kraus

#### Publisher

Mc Graw Hill

### Reference Books

#### Title

Electronic & Radio Engineering

#### Author

Terman

#### Publisher

Mc Graw Hill

Electronic Communication system

Kenned

Mc Graw Hill

Antennas

BALANICS

Mc Graw Hill

# EC-7101 DIGITAL SIGNAL PROCESSING

L T P  
3 1 0

Credits:4

## 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  
3 1 0

Credits:4

## 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

Wireless Digital Communication  
Digital Communication, 4th edition

#### Author

Kamilo Feher  
J.G. Proakis

#### Publisher

PHI, 2000  
McGraw Hill 2000

### Reference Books

#### Title

Mobile cellular Tele-communication 2<sup>nd</sup> edition

#### Author

William, C Y Lee

#### Publisher

McGraw Hill,  
2001

Wireless communication: Principles and practice", 3<sup>rd</sup> Indian reprint

Theodore S. Rappaport

Pearson, 2003

# EC-7103 MICROELECTRONICS

L T P  
3 1 0

Credits:4

## 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 VLSI 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  
3 1 0

Credits:4

## 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 intramodal, 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 PDFFA semiconductor amplifiers Wavelength converters, Nonlinear effects, optical solitons, Dispersion management.

(12 Hrs)

## RECOMMENDED BOOKS:

### Text Books

#### Title

Optical Fiber Communciation  
Optical Fiber Communication  
Reference Books

#### Title

Fiber Optics

#### Author

Gerd Keiser 2<sup>nd</sup> editon  
Senior

#### Author

G.P.Aggarwal

#### Publisher

McGraw Hill  
PHI

#### Publisher

Wiley

# EC-7201 COMPUTER & COMMUNICATION NETWORKS

L T P  
3 1 0

Credits:4

## Unit I

**Introduction To Computer Networks:** 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 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, Subnetting - Sub network, Subnet mark, Routing algorithm - optionality Principle, Shortest path routing, Hierarchical routing, Broadcast routing, Multicast routing, Routing for mobile host-Concatenated Virtual 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 | 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

Computer Networks,

#### Author

Tanebaum

#### Publisher

PHI

### Reference Books

Computer Networks and Their Protocols

Darix

PHI

# EC- 7202 RADAR AND NAVIGATIONAL AIDS

L T P  
3 1 0

Credits:4

## 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 its 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  
Introduction to Radar Engineering

M.I. Skolnik  
Sen & Bhattacharya

Mc Graw Hill  
PHI

### Reference Books

#### Title

#### Author

#### Publisher

Radar Systems

Peyton Z. Peebles, Jr.

Willey

# EC-7205 CONTROL SYSTEM ENGINEERING

L T P  
3 1 0

Credits:4

## 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

Control System Engg

#### Author

Nagrath Gopal

#### Publisher

Wiley Eastern

### Reference Books

#### Title

Control System Analysis

Analysis of Linear System

Automatic Control Engg

#### Author

Leon Hardl

Cheng

Kuo

#### Publisher

McGraw Hill

Mc-Graw Hill

PHI



# EE-5101/5201 BASIC ELECTRICAL & ELECTRONICS ENGINEERING

L T P  
3 1 0

Credits-4

## 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
<b>Text Books</b>		
Basic Electrical Engineering	D P Kothari & I J Nagrath	TMH
Principles of Electrical & Electronics	J.S. Dhillon, Jarnail Singh Dhillon & Diljinder Singh	Kalyani
<b>Reference Books</b>		
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

L T P  
3 2 0

Credits:5

## 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
<b>Text Books</b>		
Nagrath, Gopal	Theory of Electric Machines	TMH
B L Thareja	Electrical Machines, VOL II	S.Chand
<b>Reference Books</b>		
Fitzgerald Kingsley	Electrical Machines	McGraw Hill
I J Nagrath & D P Kothari	Electrical Machines	TMH

# EE-6101 NETWORK ANALYSIS AND SYNTHESIS

L T P  
3 2 0

Credits:5

## 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
<b>Text Books</b>		
Network Analysis	Van Valkenberg	PHI
Network Analysis and Synthesis	C L Wadhwa	New Age
<b>Reference Books</b>		
Network Analysis and Synthesis	Kuo, Franklin F.	John Wiley & Sons
Electric Circuits	J A Edminister	TMH

# EE-7101 INDUSTRIAL ELECTRONICS & APPLICATIONS

L T P  
3 1 0

Credits:4

## 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, commutation 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 inverter 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
<b>Text Books</b>		
Power Electronics	P.C Sen	McGraw Hill
Power Electronics	P.S. Bimbra	Khanna
<b>Reference Books</b>		
Power Electronics & Controls	Datta	Prentice hall
Thyristor and its application	Ramamoorthy	EW Press

# EV-6101 ENVIRONMENT SCIENCE & ENGINEERING

L T P  
3 0 0

Credits:3

## 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

CPCB

Notifications

# FT-5101 TECHNOLOGY OF FRUITS AND VEGETABLE PROCESSING

L T P  
3 2 0

Credits:5

## 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	Cruss	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  
3 1 0

Credits:4

## 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

W.C. Frazier  
H.J. Pleczar  
J. Heritage  
K.S. Bilgrami  
Casida

### Title

Food Microbiology  
Microbiology  
Introductory Microbiology  
Essentials of Microbiology  
Industrial Microbiology



# FT-5103 STATISTICAL QUALITY CONTROL

L T P  
3 1 0

Credits:4

## 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  $\bar{x}$  and R, Charts based on standard values, Interpretation of  $\bar{x}$  and R charts, The effect of non-normality on  $\bar{x}$  and R charts, Construction and operation of  $\bar{x}$  and S charts, The  $\bar{x}$  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  $\bar{x}$ , Shape of the sampling distribution of  $\bar{x}$ , Applications of the sampling distribution of  $\bar{x}$ , 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

D.C. Montgomery

P.S. Mann

Jerome D. Braverman

#### Title

Introduction to Statistical Quality Control

Introductory Statistics

Fundamentals of Statistical Quality Control

# FT-5201 FOOD CHEMISTRY

L T P  
3 0 0

Credits:3

## 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  
3 1 0

Credits:4

### 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

Sukumar De  
Walstra  
Spreer  
Eckles, Comb and Macy  
Kessler  
Farral

#### Title

Outlines of Dairy Technology  
Dairy Technology  
Milk and Dairy Product technology  
Milk and Milk Products  
Food Engineering and Dairy Technology  
Engineering of Dairy and food Products

# FT-6101 COMPUTER APPLICATION IN FOOD ENGINEERING

L T P  
3 1 0

Credits:4

## Unit I

**Introduction:** Introduction to computer hardware and operations, CPU, input and output devices, 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  
3 1 0

Credits:4

## 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 plasmids, 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:**

<b>Title</b>	<b>Author</b>	<b>Publishers</b>
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 Crueger	and Panima

# FT-6103 FOOD BIOCHEMISTRY AND NUTRITION

L T P  
3 1 0

Credits:4

## 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  
3 1 0

Credits:4

## 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 Bessel 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  
3 1 0

Credits:4

## 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

**Bioreactor 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 Ollis, D.F.	McGraw Hill, NY
Biochemical Engineering Principles of Fermentation Technology	James M. Lee Stanbury, P.F Whitaker, W and Hall, S.J	Prentice Hall, NJ Reed Elsevier Pvt Ltd, New Delhi



# FT-6202 FOOD ANALYSIS AND QUALITY CONTROL

L T P  
3 1 0

Credits:4

## 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 synchroelectric 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  
3 2 0

Credits:5

## 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, psychrometric chart, Humidification and dehumidification operations, Application of psychrometry 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  
3 1 0

Credits:4

## 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, cellulose, 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

**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:**

<b>Author</b>	<b>Title</b>	<b>Publisher</b>
Hall, C.W.	Handling and storage of food grains in tropical and subtropical 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

**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**

Chrysam, Erickson and others

Fennema

Meyer

Lawson

Maran

Oilseeds and Oil Milling in India

**Title**Bailey's Industrial Oil and Fat Products  
Volume-3

Food Chemistry

Food Chemistry

Food oils and fats

Fats in food products

A cultural and History Survey

**FT-7104**

**TECHNOLOGY OF CEREAL AND PULSE  
PROCESSING**

**L T P  
3 0 0**

**Credits:3**

**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 cereals 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:**

<b>Authors</b>	<b>Title</b>	<b>Publishers</b>
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

**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**

<b>Authors</b>	<b>Title</b>	<b>Publisher</b>
Varnam and Sutherland	Beverages- Technology, Chemistry and Microbiology	ASPEN

**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, - Dietetic 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:**

<b>Title</b>	<b>Author</b>	<b>Publishers</b>
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



**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 ingredients, methods for incorporation of cure ingredients, chemistry of cured color, comminution, blending and emulsification, Technology of sausages.

(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, composite 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 processing industry.

(08 Hrs)

**Recommended Books:**

<b>Title</b>	<b>Author</b>	<b>Publishers</b>
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

**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:**

<b>Authors</b>	<b>Title</b>	<b>Publishers</b>
SB Arora	Hand Book of Bakery Products	SIRI
Matz	Bakery Technology and Engineering	AVI
Dendy & Dobraszczyk	Cereal and Cereal Products.	Aspen.
Hosney 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**  
**3 1 0**

**Credits:4**

**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:**

<b>Author</b>	<b>Title</b>
O.P.Khanna	Production Engg. and Industrial Management
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

**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:** Definition, 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 natural food 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  
3 0 0**

**Credits:3**

**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:**

<b>Author</b>	<b>Title</b>	<b>Publisher</b>
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  
3 0 0

Credits:3

### 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**  
**3 0 0**

**Credits-3**

## **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)

### **Recommended Books:**

<b>AUTHOR</b>	<b>TITLE</b>	<b>PUBLICATIONS</b>
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

# IE-5101 FUNDAMENTALS OF MEASUREMENT & INSTRUMENTATION

L T P  
3 1 0

Credits:4

## 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, relationship 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:

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

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 1091c, 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, A/D converter using voltage to frequency conversion, A/D converter using voltage to time conversion, countertype A/D 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
<b>Text Books</b>		
Digital Electronics	R. P. Jain	TMH
Digital Circuits and Logic Design	Katre	Techmax
<b>Reference Books</b>		
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

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, hysteresis 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
<b>Text Books</b>		
Electronic Instrumentation and Measurement Techniques	W D Cooper	PHI
Electrical and Electronics Measurements and Instrumentation	A K Sawhney	Dhanpat Rai
<b>Reference Books</b>		
Electronic Instrumentation and Measurements	Bell David A	PHI
Electrical Measurements Fundamentals, Concepts, Applications	Reissland Martin V	Wiley Eastern

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 filters, Regulators, Line regulation and load regulation, Zener diode as voltage regulator, Working of Switched Mode Power Supply (SMPS).

(12 Hrs)

**RECOMMENDED BOOKS:**

<b>Title</b>	<b>Author</b>	<b>Publisher</b>
<b>Text Books</b>		
Basic Electronics and Linear Circuits	Bhargava and Kulshreshtha	TMH
Electronics Devices and Circuits	Katre and Goyal	Techmax
<b>Reference Books</b>		
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  
3 2 0

Credits:5

## 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
<b>Text Books</b>		
Modern Control Engineering	K. Ogata	Pearson
Control System Engineering	Nagrath & Gopal	New Age
<b>Reference Books</b>		
Control Systems- Principles & Design	M Gopal	TMH
Modern Control Engineering	Choudhury, Roy	PHI

# IE-6102 MICROPROCESSOR APPLICATIONS

L T P  
3 1 0

Credits:4

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

# IE-6103 INDUSTRIAL INSTRUMENTATION & SAFETY

L T P  
3 2 0

Credits:5

## 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
<b>Text Books</b>		
Process Control Instrument	Jhonson	PHI
Instrumentation Handbook	Kallan	Mc Graw Hill
<b>Reference Books</b>		
Instrument Measurement & Analysis	Nakara	PHI
Measurement Systems Applications	E O Deoblin	Mc Graw Hill

# IE-6201 SENSOR & SIGNAL PROCESSING

L T P  
3 2 0

Credits:5

## Unit I

**Introduction:** General Concept of Measurement: Basic block diagram stages of generalized measurement system state characteristics; accuracy, precision, resolution, reproducibility, 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
<b>Text Books</b>		
Instrumentation -Devices and Systems	Rangam, Sarma & Mani	TMH
A Course in Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney	Dhanpat Rai
<b>Reference Books</b>		
Measurement Systems	E.O. Doebelin	McGraw Hill
Instrument Measurement & Analysis	Nakra	PHI



## IE-6202 PROCESS DYNAMICS & CONTROL

L T P  
3 1 0

Credits:4

### 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, Linearizing 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
<b>Text Books</b>		
Process Control Instrumentation Technology	Johnson Curtin	PHI
Principles of Process Control	D. Patranabis	TMH
<b>Reference Books</b>		
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  
3 2 0

Credits:5

## Unit-I

**State space analysis & design:** Invariance of eigen values, Diagonalisation 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
<b>Text Books</b>		
Modern Control Engineering	Katsuhiko Ogata	Prentice Hall of India Pvt Ltd
Digital Control Systems	Benjamin C. Kuo	Pearson Education
<b>Reference Books</b>		
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  
3 1 0

Credits:4

## 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
<b>Text Books</b>		
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
<b>Reference Books</b>		
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  
3 1 0

Credits:4

## 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
<b>Text Books</b>		
Telemetry Principles	D Patranabis	TMH
A Course in Electrical & Electronics Measurement & Instrumentation	A K Sawhney	Dhanpat Rai
<b>Reference Books</b>		
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  
3 1 0

Credits:4

## 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
<b>Text Books</b>		
Digital Signal Processing	Oppenheim & Schafer	PHI
Digital Signal Processing: Principles, algorithms and Applications	Proakis & Manolakis	PHI
<b>Reference Books</b>		
Theory and Application of DSP	Rabiner & Gold	PHI
Understanding Digital Signal Processing	R. G. Lyons	Pearson Education

# IE-7104 VIRTUAL INSTRUMENTATION

L T P  
3 1 0

Credits:4

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

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<sub>2</sub>, 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, gases.

(12 Hrs)

Unit IV

**Spectro-chemical Analysis:** Classification of techniques, Principles and components, emission spectrometry:- 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 spectrometry.

(12 Hrs)

## RECOMMENDED BOOKS:

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

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 impedance, 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, PCO<sub>2</sub>, PO<sub>2</sub> 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
<b>Text Books</b>		
Biomedical Instrumentation	Cromwell Pratt	Prentice Hall
Handbook of Biomedical Instrumentation	R S Khandpur	TMH
<b>Reference Books</b>		
Medical Instrumentation, Applications & Design	John G Webster	John Wiley
Baker Principles of Applied Biomedical Instrumentation	Geddes	John Wiley



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, Furnaces 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:**

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

**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; Equipotential 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:**

<b>Title</b>	<b>Author</b>	<b>Publisher</b>
<b>Text Books</b>		
Electromagnetic	John D. Kraus	TMH
Engineering Electromagnetic	W. Hayt	TMH
<b>Reference Books</b>		
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  
3 1 0

Credits-4

## 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<sup>s</sup>, 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
<b>Text</b>		
Fundamental of Computers	V. Raja Raman	PHI
Fundamentals of Computer	Yadav	BPB
<b>Reference</b>		
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  
3 1 0

Credits-4

## 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
<b>Text</b> An engineering approach to Digital design	William I. Fletcher	Prentice-Hall
Digital design: principles and practice package	J. F. Wakerly	Pearson Edu
<b>Reference</b> Digital Design	M. Morris Mano	PHI
Digital Principles & Applications	Malvino & Leech	TMH

# IT-5201 DATA STRUCTURES

L T P  
3 1 0

Credits-4

## 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
<b>Text</b>		
Data Structures using C and C++	A.M. Tanenbaum	PHI
Data Structures	Lipschutz	TMH
<b>Reference</b>		
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  
3 1 0

Credits-4

## 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
<b>Text</b> Microprocessor Architecture Programming and Applications with the 8085/8080A	R. S. Goankar	Wiley Eastern Ltd
Microprocessor, interfacing, programming & Hardware.	D.V. Hall	PHI
<b>Reference</b> Introduction to Microprocessors Microprocessor systems 8086 & 8080 family	A.P. Mathur Liu & Gibsion	Tata McGraw Hill. 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  
3 0 0

Credits-3

## 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
<b>Text</b>		
Mastering Java	John Zukowski	BPB
The Complete Reference	Patrick Naughton	TMH
<b>Reference</b>		
Java Programming	Balagurusamy	
Java 2 Programming Bible	Aaron Walsh & Daniel Steinberg	IDG Books

# IT-6101 OPERATING SYSTEM CONCEPTS

L T P  
3 1 0

Credits-4

## 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
<b>Text</b> Operating System Concepts An Introduction to Operating System	Silber Schatz & Galvin Deitel H.M.	Jonh Wiley Addison Wesley
<b>Reference</b> Operating System Operating Systems	Mandinck S.E. Dhamdhare	McGraw Hill TMH



# IT-6102 DATA COMMUNICATION SYSTEMS

L T P  
3 2 0

Credits-5

## 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
<b>Text</b>		
Data Communications Networking	Behrouz A Forouzan	PHI
Data and Computer Communication	William Stalling	Pearson Education
<b>Reference</b>		
Data Communication	Prakash C-Gupta	PHI
Computer Networks	A. S. Tanenbaum	PHI

# IT-6103 INTERACTIVE COMPUTER GRAPHICS

L T P  
3 2 0

Credits-5

## 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
Computer Graphics	Hearn. D & MP Baker	Prentice Hall
Principle of Interactive Computer Graphics	Newman W.M	McGraw Hill
<b>Reference</b>		
Computer Graphics - A Programming Approach	Harrington. S.	McGraw Hill
Fundamentals of Computer Graphics	Foley J.D et al.	Addison Wesley

# IT-6104 COMPUTER ARCHITECTURE AND ORGANIZATION

L T P  
3 1 0

Credits-4

## 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
<b>Text</b> Computer System organization and Architecture	J.D. Carpinelli	Pearson Edu.
Computer System Architecture	Morris Mano	PHI
<b>Reference</b> 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  
3 2 0

Credits-5

## 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
<b>Text</b>		
Database system concepts	Korth & Silberchatz,	McGraw Hill
Introduction to Database system	Date, C.J.	Addison Wesley
<b>Reference</b>		
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  
3 2 0

Credits-5

## 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, Subnetting – 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
<b>Text</b>		
Computer Networks	Tanenbaum	PHI
Data communication and networking B. A.	Forouzan	Tata Mcgraw-Hill.
<b>Reference</b>		
Computer Networks and Their Protocols	Darix	DLA Labs
Computer Communication & Networks	Freer	East-West-Press

# IT-6203 MULTIMEDIA TECHNOLOGY

L T P  
3 2 0

Credits-5

## 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
<b>Text</b>		
Multimedia Systems Design	P.K. Andleigh and K. Thakrar	Prentice Hall PTR
Multimedia Computing, Communications and Applications,	Ralf Steinmetz	Prentice Hall
<b>Reference</b>		
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  
3 1 0

Credits-4

## 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
<b>Text</b>		
Software Project Management	Bob Hughes and Mike Cotterell	TMH
Software Project Management	Pankaj Jalote	Pearson Edu.
<b>Reference</b>		
Software Project Management	Walker Royce	Addison Wesley.

# IT-7102 WEB APPLICATION ENGINEERING

L T P  
3 1 0

Credits-4

## 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, Gopher, 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, ASPs, COMs , DCOMSs.

(13 Hrs)

### Recommended books:

Title Text	Author(s)	Publisher
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  
3 1 0

Credits-4

## 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
Enterprise Resource Planning Text	Alexis Leon	TMH.

# IT-7201 INTELLIGENT INFORMATION SYSTEMS

L T P  
3 1 0

Credits-4

## 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
<b>Text</b>		
Artificial Intelligence	Elaine Rich and Kevin Knight 2 <sup>nd</sup> Ed.	TMH IVth Ed.
Artificial Intelligence	Patrick Winston	
<b>Reference</b>		
Artificial Intelligence	Luger	
MIS	A.K. Gupta	S. Chand

# IT-7202 CYBER LAWS AND IPR

L T P  
3 1 0

Credits-4

## 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
<b>Text</b> A Guide to Cyber Laws & IT Act 2000 with Rules & Notification Cyber Cops, Cyber Criminals & Internet	Nandan Kamath. Keith Merill & Deepti Chopra	
<b>References</b> Information Technology Law Handbook of Cyber Laws	Diane Row Land Vakul Sharma	Mc Millian

# ME-5101 MECHANICS OF SOLIDS

L T P  
3 1 0

Credits:4

## 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*

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 1 0

Credits:4

## 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  
3 0 0

Credits:3

## 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 Riser:** 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*

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Manufacturing Science	Malik & Ghosh	EWP
Foundry Engineering	Taylor	John Wiley & Sons
Principles of Metal Casting	Rosenthal	Mc Graw Hill
Foundry Technology	O.P. Khanna	S. Chand
Foundry Technology	Beeley	Butterworth Scientific

# ME-5201 FLUID MECHANICS AND MACHINERY

L T P  
3 1 0

Credits:4

## 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  $\pi$ -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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 0 0

Credits:3

## 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, spheroidising, 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*

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 1 0

Credits:4

## 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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 1 0

Credits:4

## 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<sub>2</sub> 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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 2 0

Credits:5

## 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, Coriolis 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  
3 2 0

Credits:5

## 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  
3 2 0

Credits:5

## 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, absorptivity, 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  
3 2 0

Credits:5

### 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  
3 2 0

Credits:5

### 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, Ibrahim	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

**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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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



**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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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

**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  
3 0 0

Credits:3

## 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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 0 0

Credits:3

## 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. Industrial Engineering	Dalela & Sharma	Standard
Indl. Engg. & Organization Management	M. Mahajan S. K. Sharma	Dhanpat Rai Kataria
Motion and Time study	Barnes	John Wiley

**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<sub>2</sub>, 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

**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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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

**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

**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



**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. Design for 'X', Design for Manufacturing, Reverse Engineering. Agile Manufacturing, Lean Manufacturing, Rapid Prototyping (RP).

(12 Hrs)

**Recommended Books:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Mastering CAD/CAM	Zeid, Ibrahim	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

**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 and 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**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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

**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:***

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Welding Engineering & Technology	R. S. Parmar	Khanna
Metallurgy of Welding	J. F. Lancaster	Allen & Unvin
The Metallurgy of Welding	D. Seferian	Chapman and Hall

**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:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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  
3 0 0

Credits:3

## 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 magnetostriction, 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

Raghvan  
Srinivasan & Srivastava  
Callister JR  
Askeland & Phule

#### Title

Materials Science  
Science of Engineering Materials  
Materials Science and Engg.: An Introduction  
The Science and Engineering of Material