



ANNA UNIVERSITY
Chennai-25.
Syllabus for

B.Tech. Polymer Technology

CM125 Chemistry I **3** **0** **0** **100**

1. CHEMICAL THERMODYNAMICS **9**

Definition of free energy and spontaneity - Maxwell relations - Gibbs-Helmholtz equation - Van't Hoff equations - Stoichiometry and energy balances in Chemical reactions.

2. DYNAMICS OF CHEMICAL PROCESSES **10**

Basic concepts - composite reactions (opposing, parallel and consecutive reactions) - Collision theory - Thermodynamic formulation of reaction rates - unimolecular reactions - Chain reactions (Stationary and non-stationary) - Enzyme Kinetics - Michaelis - Menten Equation.

3. ELECTRODICS **8**

Types of electrodes and cells - Nernst Equation - emf measurement and its applications - Principles of chemical and electrochemical corrosion - corrosion control (Sacrificial anode and impressed current methods).

4. WATER **8**

Water quality parameters - Definition and expression - Estimation of hardness (EDTA method) - Alkalinity (Titrimetry) - Water softening (zeolite) - Demineralisation (Ion-exchangers) and desalination (RO) - Domestic water treatment.

5. POLYMERS **10**

Monomer - Functionality - Degree of polymerisation - Classification based on source and applications - Addition, Condensation and copolymerisation - Mechanism of free-radical polymerisation - Thermoplastics and thermosetting plastics - Processing of plastics - Injection moulding, blow moulding and extrusion processes.

Total No of periods: 45

Text Books:

1. Alkins P.W., " *Physical Chemistry* ", ELBS, IV Edition, 1998, London.

References:

1. Balasubramanian M.R., Krishnamoorthy S. and Murugesan V., " *Engineering Chemistry* ", Allied Publisher Limited., Chennai, 1993.
2. Karunanidhi M., Ayyaswamy N., Ramachandran T and Venkatraman H., " *Applied Chemistry* ", Anuradha Agencies, Kumbakonam , 1994.
3. Sadasivam V., " *Modern Engineering Chemistry - A Simplified Approach* ", Kamakya Publications, Chennai , 1999.
4. Kuriakose, J.C. and Rajaram J., " *Chemistry in Engineering and Technology* ", Vol. I and II, Tata McGraw-Hill Publications Co.Ltd, New Delhi ,1996.
5. Jain P.C. and Monica J., " *Engineering Chemistry* ", Dhanpat Rai Publications Co.,(P) Ltd., New Delhi, 1998.

1. BASICS 5

Introduction - Units and Dimensions - Laws of Mechanics - Vectors - Vectorial representation of forces and moments - Vector operations.

2. STATICS OF PARTICLES 8

Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - single equivalent force.

3. EQUILIBRIUM OF RIGID BODIES 7

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Equilibrium of Rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions.

4. PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes - First moment of area and the centroid - second and product moments of plane area - Parallel axis theorems and perpendicular axis theorems - Polar moment of inertia - Principal moments of inertia of plane areas - Principal axes of inertia - Mass moment of inertia - relation to area moments of inertia.

5. FRICTION 4

Frictional Force - Laws of Coloumb friction - Simple Contact friction - Rolling Resistance - Belt Friction.

6. DYNAMICS OF PARTICLES 16

Displacement, Velocity and acceleration their relationship - Relative motion - Curvilinear motion - Newton's Law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

7. ELEMENTS OF RIGID BODY DYNAMICS 8

Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion - Moment of Momentum Equations - Rotation of rigid Body - Work energy equation.

Total No of periods: 60

Text Books:

1. *Beer and Johnson, " Vector Mechanics for Engineers ", Vol. 1 " Statics " and Vol. 2 " Dynamics ", McGraw Hill International Edition, 1995.*
2. *Merriam, " Engineering Mechanics ", Vol.1 " Statics " and Vol.2 " Dynamics 2/e ", Wiley International, 1988.*

References:

1. *Rajasekaran S. and Sankara Subramanian, G., " Engineering Mechanics - Statics and Dynamics ".*
2. *Irving, H., Shames, " Engineering Mechanics - Statics and Dynamics ", Thrid Edition, Prentice-Hall of India Pvt.Ltd., 1993.*
3. *Mokoshi, V.S., " Engineering Mechanics ", Vol.1 " Statics " and Vol.2 " Dynamics ", Tata McGraw Hill Books, 1996.*
4. *Timoshenko and Young, " Engineering Mechanics ", 4/e, McGraw Hill, 1995.*
5. *McLean, " Engineering Mechancis ", 3/e, SCHAUM Series, 1995.*

(Revised Syllabus For B.E. / B.Tech. Programmes - Effective From June 2002)

1. MATRICES	9
Characteristic equation - Eigen values and eigen vectors of a real matrix. Some properties of eigen values, Cayley-Hamilton theorem, Orthogonal reduction of a symmetric matrix to diagonal form - Orthogonal matrices - Reduction of quadratic form to canonical form by orthogonal transformation.	
2. THREE DIMENSIONAL ANALYTICAL GEOMETRY	9
Direction cosines and ratios - Angle between two lines - Equation of a plane - Equation of a straight line - Coplaner lines - Shortest distance between skew lines - Sphere - Tangent plane - Plane section of a sphere - orthogonal spheres.	
3. GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	9
Curvature - cartesian and polar coordinates - Circle of curvature - Involutives and Evolutes - Envelopes - properties of envelopes - Evolute as envelope of normals.	
4. FUNCTIONS OF SEVERAL VARIABLES	9
Functions of two variables - Partial derivatives - Total differential - Differentiation of implicit functions - Taylor's expansion - Maxima and Minima - Constrained Maxima and Minima by Lagrangean Multiplier method - Jacobians - differentiation under integral sign.	
5. ORDINARY DIFFERENTIAL EQUATIONS	9
Simultaneous first order linear equations with constant coefficients - Linear equations of second order with constant and variable coefficients - Homogeneous equation of Euler type - equations reducible to homogeneous form - Method of reduction of order - Method of variation of parameters.	
6. TUTORIAL	15

Total No of periods: 60

Text Books:

1. Kreyszig, E., " *Advanced Engineering Mathematics* " (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2001
2. Veerarajan, T., " *Engineering Mathematics* ", Tata McGraw Hill Publishing Co., NewDelhi, 1999.

References:

1. Grewal, B.S., " *Higher Engineering Mathematics* " (35th Edition), Khanna Publishers, Delhi , 2000.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " *Engineering Mathematics* ", Volume I (4th Revised Edition), S. Chand & Co., New Delhi, 2000.
3. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " *Advanced Mathematics for Engineering Students* ", Volume I (2nd Edition), S. Viswanathan (Printers & Publishers), 1992.
4. Venkataraman, M.K. " *Engineering Mathematics - First year* " National Publishing Company, Chennai (2nd Edition), 2000.

1. PROPERTIES OF MATTER	9
Elasticity - stress-strain diagram-factors affecting elasticity - Twisting couple on a wire-Shafts-Torsion pendulum-Depression of a cantilever- Young's modulus by cantilever-Uniform and Non Uniform bending-I shape girders-Production and measurement of high vacuum-Rotary pump-Diffusion pump-Pirani Gauge-Penning gauge-Viscosity-Oswald Viscometer-Comparision of viscosities.	
2. ACOUSTICS	9
Acoustics of buildings-Absorption coefficient-Intensity-Loudness-Reverberation time-Sabine's formula-Noise pollution-Noise control in a machine-Ultrasonics-production-Magnetostriction and Piezoelectric methods-Applications of ultrasonics in Engineering and Medicine.	
3. HEAT AND THERMODYNAMICS	9
Thermal conductivity-Forbe's and Lee's Disc methods-Radial flow of heat-Thermal conductivity of rubber and glass-Thermal insulation in buildings-Laws of thermodynamics-Carnot's cycle as heat engine and refrigerator-Carnot's theorem-Ideal Otto and Diesel engines-Concept of entropy-Entropy Temperature diagram of carnot's cycle.	
4. OPTICS	9
Photometry-Lummer Brodhum photometer-Flicker Photometer-Antireflection coating-Air wedge-Testing of flat surfaces-Michelson's Interferometer and its applications-Photoelasticity and its applications-Sextant-Metallurgical microscope-Scanning electron microscope.	
5. LASER AND FIBRE OPTICS	9
Principle of lasers-laser characteristics-Ruby-NdYAG, He-Ne, CO ₂ and semiconductor lasers-propagation of light through optical fibers-types of optical fibre-Applications of optical fibres as optical waveguides and sensors.	

Total No of periods: 45

Text Books:

1. Arumugam.M., " Engineering Physics ", Anuradha Publications, 1998.

References:

- 1. Resnik R. and Halliday D., " Physics ", Wiley Eastern, 1986.*
- 2. Nelkon M. and Parker.P., " Advanced Level Physics ", Arnold-Heinemann, 1986.*
- 3. Vasudeva A.S., " Modern Engineering Physics ", S. Chand and Co., 1998..*
- 4. Gaur, R.K., and Gupta, S.L., " Engineering Physics ", Dhanpat Rai and Sons, 1988.*
- 5. Mathur, D.S, " Elements of properties of Matter ", S.Chand & Co., 1989.*

30

1. Preparation of standard solutions.
2. Estimation of hardness of water by EDTA method
3. Estimation of different types and amounts of alkalinity in water - Indicator method
4. Determination of dissolved oxygen - Winkler's method.
5. Estimation of iron in water - Spectrophotometric method.
6. Estimation of sodium in water - Flame Photometric method
7. Determination of molecular weight of polymers-Viscometric method.
8. Determination of total dissolved solids in water.
9. Corrosion experiments:
 - * Corrosion rate measurements
 - * Inhibition efficiency.
10. Electrochemistry experiments:
 - * Determination of emf.
 - * Single electrode potential
 - * Potentiometric and conductometric titration

Total No of periods: 30

GE133 Workshop Practice

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1. SHEET METAL 10

Tools and Equipments - Fabrication of tray, cone, etc., with sheet metal

2. WELDING 10

Tools and Equipments - Arc Welding of butt joint, Tap Joint, Tee fillet etc., Demonstration of gas welding.

3. FITTING 10

Tools and Equipments- Practice in Chipping, Filing, Drilling - making Vee joints, square and dove tail joints.

4. CARPENTRY 10

Tools and Equipments-Planning Practice-making halving joint and dove tail joint models.

5. FOUNDRY 10

Tools and Equipments Preparation of moulds of simple objects like flange, gear V- grooved pulley etc.

6. SMITHY 10

Tools and Equipments - Demonstration for making simple parts like keys, bolts etc.

Total No of periods: 60

References:

- 1. Venkatachalapathy V.S., " First Year Engineering Workshop Practice ", Raamalinga Publications, Madurai, 1999.*
- 2. Kanaiah P.and Narayana K.C., " Manual on Workshop Practice Scitech Publications ", Chennai, 1999.*

1. PRACTICALS

30

1. Young's modulus by non uniform bending.
2. Rigidity modulus and moment of inertia using Torsion Pendulum
3. Viscosity of a liquid by Poiseuille's method.
4. Wavelength determination using grating by Spectrometer.
5. Particle size determination by Laser
6. Thermal conductivity by Lees' disc.
7. Thickness of wire by Air wedge.
8. Thermo emf measurement by potentiometer.

Total No of periods: 30

1. ENVIRONMENTAL POLLUTION 8

Causes of pollution - Water pollution - Domestic, industrial and agricultural wastes - Assessment of pollution - D.O., B.O.D. and C.O.D. Treatment - Primary and secondary - sludge disposal - Air pollution - Environmental impact - Acid rain, green house effect and global warming - Ozone depletion Smog - Control measures - Soil and Noise pollution.

2. FUELS 10

Classification of fuels - Calorific value - determination - Coal - Ranking and analysis - Carbonisation of coal - Coal tar products - Metallurgical coke - Classification of Petroleum - Fractional distillation - Cracking - Reforming - Petrol - Diesel - Coal gas - Natural gas - Producer gas - LPG - Biogas.

3. BINDING MATERIALS 6

Cement and lime - Types - Composition and characteristics - Chemistry of setting and hardening - Grading and analysis - Adhesives - Types - Characteristics Epoxides, urethanes, polyvinyl alcohol and polyvinyl acetate.

4. POLYMERIC MATERIALS 10

Polytetrafluoroethylene, Polyamides (nylon 6, nylon 66, Kevlar), Polyesters (polyethylene terephthalate, polybutyleneterephthalate, aromatic polyester) polycarbonate, polyacetals, polysulphoes (applications only, manufacturing details not required) Composites: Matrix resins - Reinforcements - Applications.

5. INDUSTRIAL INORGANIC COMPOUNDS 11

Zeolites : Types - Applications - Ion exchange - Adsorbent - Separation process -Catalyst.

Pigments : Titanium dioxide - Lithophone - Zinc Oxide - Iron oxide - Ultramarine.

Bleaching agents : Reducing bleaching agents - Sulphur dioxide - Sodium hydrosulphite - Oxidizing bleaching agents - Calcium hypochlorite - Hydrogen peroxide - Chlorine dioxide.

Refractory: Silicon carbide - aluminium oxide - Ultramarine.

Lubricants : Silicone oil - Lithium grease - Graphite - Molybdenum disulphide.

6. PRACTICALS 30

Phenol water system - Kinetics of Ester Hydrolysis - Distribution Coefficient - Pigment analysis: Lead and Titanium - Melting point and Molecular weight Determination - Estimation of percentage composition of Glycerol (Viscometric method)

Total No of periods: 75

References:

1. *Kuriacose J.C., & Rajaram, J., " Chemistry in Engineering and Technology ", Volume 1 & 2, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1989.*
2. *Jain, P.C., " Engineering Chemistry ", Revised and Enlarged Edition, Dhanpat Rai and Sons., New Delhi, 1990.*
3. *Puri P.C. and Sharma L.R., " Principles of Physical Chemistry ", Shoban Lal Naginchand and Company, Delhi, 1994.*
4. *Raymond B.Seymour, " Engineering Polymer source Book ", McGraw Hill Publishing Co., New York, 1990.*
5. *Miles D.C. and Briston J.H., " Polymer Technology ", Chemcial Publishing Co., Inc.,*
6. *Gopalan R., Venkappayya D. and Nagarajan S., " Engineering Chemistry ", Vikas Publishing House Pvt.Ltd., New Delhi, 1999.*

1. SEMICONDUCTORS AND RECTIFIERS	9
Classification of solids based on energy band theory - Intrinsic semiconductors - Extrinsic semiconductors - P type and N type - P-N junction - VI characteristic of PN junction diode - Zener effect - Zener diode - Zener diode characteristic - Half wave and full wave rectifiers - Voltage regulation.	
2. TRANSISTORS AND AMPLIFIERS	9
Bipolar Junction Transistor - CB, CE, CC - Configurations and characteristics - Biasing circuits - Elementary treatment of voltage amplifier - Class A, B and C power amplifiers - principles of Tuned amplifiers.	
3. POWER AND CONTROL ELECTRONIC DEVICES	9
Field Effect Transistor - Configurations and characteristics - FET amplifier - SCR, Diac, Triac, UJI - Characteristics and simple applications - switching transistors - concept of feed back - negative feed back - application in temperature and motor speed control.	
4. SIGNAL GENERATORS AND LINEAR IC'S	9
Sinusoidal oscillators - positive feed back - RC phase shift, Hartley, Colpitt's, Wien bridge Oscillators - multivibrators - operational amplifier - adder, multiplier, integrator and differentiators - Integrated circuits.	
5. DIGITAL ELECTRONICS	9
Binary number system - AND, OR, NOT, NAND, NOR circuits - Boolean algebra - Exclusive or gate - Half and full adders - flip flops - registers and counters - A/D, D/A conversion - Digital computer principle.	
6. TUTORIAL	15

Total No of periods: 60

Text Books:

1. *Milman and Halkias, " Integrated Electronics ", McGraw Hill, 1979.*

References:

1. *Mehta,V.K., " Principles of Electronics ", S.Chand and Company Ltd., 1994.*
2. *Malvino & Leach, " Digital Principles and Applications ", McGraw Hill, 1986.*

1. ELECTRICAL CIRCUITS 9

Ohms Law - Kirchoff's Laws - steady state solution of DC circuits - Introduction to AC circuits - Waveforms and RMS value - power and power factor, single phase and 3 phase balanced circuits.

2. ELECTRICAL MACHINES 15

Principles of operation and characteristics of DC machines, Transformers (single phase and three phase) - Synchronous Machines - 3 Phase and single phase Induction motors - (op. principles).

3. ELECTRICAL MEASUREMENTS 6

Moving coil and moving iron instruments (Ammeter and Voltmeter) Dynamometer type watt meters and energy meters (op. principles).

4. PRACTICAL 30**Total No of periods: 60***Text Books:*

1. Mittle, V.N., " Basic Electrical Engineering ", TMH Edition, New Delhi, 1990.
2. Del Toro, " Electrical Engineering Fundamentals ", Prentice Hall of India Pvt.Ltd., New Delhi, Second Edition.

References:

1. Jimmie J.Cathey and Nasar, S.A., " Basic Electrical Engineering ", Schaurn outline series in Engineering, McGraw Hill Book Co.1987.
2. Deshpande, N.V., " Electrical Machines " A.A.Wheeler and Co. Ltd., New Delhi, 1994.

(Revised Syllabus For B.E. / B.Tech. Programmes - Effective From June 2002)

- 1. MULTIPLE INTEGRALS 9**
 Double integration in Cartesian and polar coordinates - Change of order of integration - Area as a double integral - Triple integration in Cartesian coordinates - Change of variables - Gamma and Beta functions.
- 2. VECTOR CALCULUS 9**
 Curvilinear coordinates - Gradient, Divergence, Curl - Line, surface & volume integrals - Statements of Green's, Gauss divergence and Stokes' theorems - Verification and applications.
- 3. ANALYTIC FUNCTIONS 9**
 Cauchy Riemann equations - Properties of analytic functions - Determination of harmonic conjugate - Milne-Thomson's method - Conformal mappings : Mappings $w = z + a$, az , $1/z$, z^2 and bilinear transformation.
- 4. COMPLEX INTEGRATION 9**
 Cauchy's theorem - Statement and application of Cauchy's integral formulae - Taylor's and Laurent's expansions - Singularities - Classification - Residues - Cauchy's residue theorem - Contour integration - Circular and semi Circular contours (excluding poles on real axis).
- 5. STATISTICS 9**
 Moments - Coefficient of correlation - Lines of regression - Tests based on Normal and t distributions, for means and difference of means - Chi Square test for goodness of fit.

Total No of periods: 45

Text Books:

1. Kreyszig, E., " *Advanced Engineering Mathematics* " (8th Edition), John Wiley and Sons, (Asia) Pte Ltd., Singapore, 2000.
2. Grewal, B.S., " *Higher Engineering Mathematics* " (36th Edition), Khanna Publishers, Delhi 2001

References:

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " *Engineering Mathematics* ", Volumes I & II (4th Revised Edition), S. Chand & Co., New Delhi, 2001.
2. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " *Advanced Mathematics for Engineering Students* ", Volumes I & II (2nd Edition), S. Viswanathan (Printers & Publishers, Pvt, Ltd.), 1992.
3. Venkataraman, M.K. " *Engineering Mathematics III - A* ", National Publishing Company, Chennai, (13th Edition), 1998.

1. ELECTROSTATICS AND ELECTROMAGNETISM 9

Electric field and potential - Gauss theorem - Applications - dielectrics - capacitance - energy stored in a dielectric medium - types of capacitors - Loss of energy due to sharing of charges by the capacitors - electrical conductivity in conductors - Carey Foster's bridge - Maxwell's equations - Free space wave equation - Characteristic impedance.

2. QUANTUM PHYSICS 9

Development of quantum theory - Dual nature of matter and radiation - Compton effect - Pair production - Uncertainty principle - Equivalence of mass and energy Schrodinger's wave equation - Particle in a box - Electrons in a metal.

3. ATOMIC AND NUCLEAR PHYSICS 9

Characteristics of atomic spectra - molecular spectra - vector atom model - Stern and Gerlach experiment - Raman Effect and its applications - Liquid drop model - Explanation for Nuclear fusion - Shell model - Chain reaction - Criticality - Four factor formula - Q value - Power reactors - Laser induced Nuclear fusion.

4. ELEMENTARY CRYSTALLOGRAPHY 9

Crystalline and non-crystalline materials - Bravais lattices - Crystal systems - Symmetry elements - Simple crystal structures - Packing factor for sc, bcc, fcc, hcp structures - Miller Indices - Imperfections in crystals - Bragg's law and x-ray diffraction methods to study crystal structures.

5. NON DESTRUCTIVE TESTING 9

Liquid penetrant, Magnetic particle and eddy current methods - X-ray radiography - Fluoroscopy - Gamma ray radiography - Ultrasonic scanning methods - Ultrasonic flaw detector - Thermography.

6. PRACTICALS 30

1. Meter Bridge - Temp. Coefficient
2. Field along the axis of coil - Determination of H
3. Carey Foster's Bridge - Resistivity
4. X-ray diffraction - calculation of cell parameters
5. Newton's rings - Wavelength measurement
6. Spectrometer - Dispersive power of a prism
7. Rigidity modulus - static torsion
8. Ammeter & voltmeter calibration using potentiometer

Total No of periods: 75

Text Books:

1. Arumugam, M., " *Engineering Physics* ", Anuradha Publications, 1998.

References:

1. Beiser, A., " *Perspective of Modern Physics* ", John Wiley, 1985
2. Tayal, D.S., " *Nuclear Physics* ", Himalayan Publishers, 1998
3. Vasudeva, D.N., " *Fundamentals of Electricity and Magnetism* ", S.Chand & Co., 1985.
4. Hull, B. and John V., " *Nondestructive Testing* ", McMillan Education Ltd, London, 1988

1. PRINCIPLES OF GRAPHICS 16

Two dimensional geometrical construction - Conic sections, involutes and cycloids - Representation of three dimensional objects - Principles of projections - standard codes of principles.

2. ORTHOGRAPHIC PROJECTIONS 28

Projections of points, straight line and planes - ' Auxiliary projections ' - Projection and sectioning of solids - Intersection of surfaces - Development of surfaces.

3. PICTORIAL PROJECTIONS 8

Isometric projections - ' Perspectives ' - Free hand sketching.

4. COMPUTER GRAPHICS 8

Hardware - Display technology - Software - Introduction to drafting software.

Total No of periods: 60

Text Books:

1. Narayanan, K.L., and Kannaiah, P., " Engineering Graphics ", Tata McGraw-Hill Publishers Co., Ltd., 1992.

References:

1. William M. Neumann and Robert F. Sproul, " Principles of Computer Graphics ", McGraw Hill, 1989.
2. Warren J. Luzzadder and John M. Duff, " Fundamentals of Engineering Drawing ", Prentice-Hall of India Private Ltd., Eastern Economy Edition, 1995.
3. Natarajan K.V., " A Text Book of Engineering Drawing ", Private Publication, Madras, 1990.
4. Mathur, M.L. and Vaishwanar, R.S., " Engineering Drawing and Graphics ", Jain Brothers, New Delhi, 1993.

1. MULTIUSER OPERATING SYSTEM	4
Unix: Introduction - Basic Commands - Vi editor - filters - Input/output redirection - piping - transfer of data between devices - shell scripts.	
2. FUNDAMENTALS OF NETWORKING	3
Working on a networked environment - Accessing different machines from one node - concept of E-mail - Uses of Internet.	
3. HIGH LEVEL LANGUAGE PROGRAMMING	8
C Language: Introduction - Operator - Expressions - Variables - Input/output statements - control statements - function arrays - pointer - structures - unions - file handling - case studies.	
4. TUTORIAL	45

Total No of periods: 60

Text Books and References:

1. *Stephan J. Kochen & Patrick H. Wood, "Exploring the UNIX System", Techmedia, 1999.*
2. *Maurice J. Bach, "The design of UNIX Operating Systems", Prentice Hall of India, 1999.*
3. *Ramos, "Computer Networking Concepts", Prentice Hall International, 1999.*
4. *Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, 1999.*
5. *Kernighan and Ritchie, "The C Programming Language", Prentice Hall of India, 1999.*
6. *Gottfried, "Programming with C", Tata McGraw Hill, 1999.*
7. *Kutti, "C and UNIX Programming: A Conceptual Perspective", Tata McGraw Hill, 1999.*
8. *Eric Nagler, "Learning C++", M/s. Jaico Publishing Co., 1998-99.*

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- 1. PARTIAL DIFFERENTIAL EQUATIONS 9**
 Formation - Solutions of standard types of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.
- 2. FOURIER SERIES 8**
 Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series - Parseval's identity - Harmonic Analysis.
- 3. BOUNDARY VALUE PROBLEMS 9**
 Classification of second order linear partial differential equations - Solutions of one - dimensional wave equation, one-dimensional heat equation - Steady state solution of two-dimensional heat equation - Fourier series solutions in Cartesian coordinates.
- 4. LAPLACE TRANSFORMS 9**
 Transforms of simple functions - Basic operational properties - Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem - Periodic functions - Applications of Laplace transforms for solving linear ordinary differential equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.
- 5. FOURIER TRANSFORMS 10**
 Statement of Fourier integral theorem - Fourier transform pairs - Fourier Sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

Total No of periods: 45

Text Books:

1. Kreyszig, E., " *Advanced Engineering Mathematics* " (8th Edition), John Wiley and Sons, (Asia) Pte Ltd., Singapore, 2000.
2. Grewal, B.S., " *Higher Engineering Mathematics* " (35th Edition), Khanna Publishers, Delhi 2000.

References:

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " *Engineering Mathematics* ", Volumes II & III (4th Revised Edition), S. Chand & Co., New Delhi, 2001.
2. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " *Advanced Mathematics for Engineering Students* ", Volumes II & III (2nd Edition), S. Viswanathan (Printers & Publishers, Pvt, Ltd.) 1992.
3. Venkataraman, M.K. " *Engineering Mathematics* " Volumes III - A & B, 13th Edition National Publishing Company, Chennai, 1998.
4. Shanmugam, T.N. : <http://www.annauniv.edu/shan/trans.htm>

1. UNIT I 12

Potential energy and conformational energy of molecules - Staggered and eclipsed states - conformations and configurations, isomeric states and isomerism in polymers - Tacticity, stereoisomerism, geometric isomerism - Unperturbed and Gaussian chains - Random coils and average end to end distance - Freely jointed and freely rotating chain models - Random flight analysis.

2. UNIT II 12

Thermodynamics - First and second law of Thermodynamics, Carnot cycle - Entropy and enthalpy - Energy driven and entropy driven elasticity - Thermoelasticity - Thermodynamic treatment of rubbers - entropic and energetic contributions to the elastic force in rubbers - Statistical mechanical theory.

3. UNIT III 12

Amorphous State - Transition temperatures - Glass transition temperature - Free volume, kinetic and thermodynamic views of glass transition - Factors influencing glass transition temperature.

Crystalline State - Crystal systems, unit cells, primitive cell, Bravais lattices, polymorphism - Polymer single crystals, lamellae, spherulites, supermolecular structures, fringed micelle model - Degree of crystallinity, factors affecting crystallinity - X-ray diffraction.

4. UNIT IV 12

Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers - Uniaxial and biaxial orientation practical significance - Orientation processes - fibre spinning, blown film extrusion, solid state extrusion, profile extrusion - Properties of oriented polymers - Birefringence.

5. UNIT V 12

Polymer solutions - Terms and definitions, types of solutions - Hilderbrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - Concentration regimes in polymer solutions - theta conditions.

Total No of periods: 60

References:

1. *S. Glasstone and D. Lewis, Elements of Physical Chemistry, Macmillan India Press, Madras, 1995.*
2. *Paul C. Painter and Michael M. Coleman, Fundamentals of Polymer Science, Technomic Publishing Co. Inc., Lancaster, USA, 1994.*
3. *Ulf W. Gedde, Polymer Physics, Chapman & Hall, 1995.*

1. UNIT I 12

Structure reactivity and mechanism : Classification and IUPAC Nomenclature of organic compounds. Bonding in organic molecules ; Methane, ethylene, acetylene, and butadiene. Polarity of bonds (electron displacement effect) ; Inductive ; Electromeric ; Conjugative - mesomeric and Resonance effects. Types of bond breakage- homolysis and heterolysis with examples, Stereochemistry: General idea of optical and stereoisomerisms, geometrical isomerism.

2. UNIT II 12

Types of reagents- Electrophiles and Nucleophiles, types of reactions ; addition ($>C=C<$, $>C=O$) substitution ; Electrophilic and Nucleophilic substitution - elimination and rearrangement reactions ; Inter and Intra molecular rearrangement General conditions and mechanism of each of the above.

3. UNIT III 12

Natural gas ; Synthesis gas ; Petroleum and petroleum products ; Coal and coal products ; Cellulose and cellulose products.

Preparation, properties and uses of Ethylene - Propylene - Butadiene - Vinyl chloride ; Vinylidene chloride ; Vinyl fluoride - Vinylidene fluoride ; Vinyl acetate.

4. UNIT IV 12

Preparation, properties and uses of ; Formaldehyde ; Epichlorohydrin - Ethylene oxide - Propylene oxide ; Ethylene glycol, Propylene glycol ; Phenol - Bisphenol-A, Phthalic acid - Adipic acid - Maleic acid - Maleic anhydride - Phthalic anhydride.

5. UNIT V 12

Preparation, Properties and uses of Styrene ; Hexa Methylene Diamine ; Urea ; Acrylic acid - Methacrylic acid - Acrylonitrile - Methyl methacrylate ; Tolylenediisocyanate (TDI)- Hexamethylene di-isocyanate (MDI)- Diphenyl methane di-isocyanate.

Total No of periods: 60

References:

1. *Morrison & Boyd, Organic Chemistry, Prentice Hall. New Delhi, 6th edition, 1992*
2. *B.S.Bahl and Arun Bhal, Advanced Organic Chemistry, S. Chand & Co. Ltd., New Delhi, 15th edition, 1998*
3. *I.L.Finar, Text Books of Organic Chemistry, ELBS, 5th edition, 1996*
4. *Jerry March, Advanced Organic Chemistry, John Wiley & Sons, New york, 1992*
5. *J.A.Brydson, Plastics materials, Butterworth - Heinemann , Oxford, 1995*
6. *K.J. Saunders, Organic Polymer Chemistry , Chapman and Hall Publishers*

1. UNIT I 12

Basic concepts of macromolecules ; Monomers- Functionality ; Classification and nomenclature of polymers. Step growth polymerization ; Mechanism ; Kinetics ; Bi-functional systems ; Poly functional systems.

2. UNIT II 12

Addition polymerization Mechanism and kinetics of free radical- Cationic ; Anionic polymerisation ; Initiator systems ; Chain length and degree of Polymerisation ; Control of molecular weight ; Chain transfer ; Inhibition Coordination polymerisation ; Mechanism ; Kinetics- Ring opening polymerization ; Diene polymerization.

3. UNIT III 12

Copolymerization ; Mechanism and Kinetics of free radical ; Ionic copolymerization Types of copolymers- Copolymer composition ; Determination of Monomer reactivity ratios. Polymerization techniques ; Bulk polymerization ; Solution polymerization ; Suspension polymerization ; Emulsion polymerization ; Interfacial condensation.

4. UNIT IV 12

Molecular weight ; Molecular weight averages ; Molecular weight distribution ; Unidispersity, Polydispersity, degree of polymerization ; Molecular weight determination ; Basic concepts of end group analysis, colligative properties, osmometry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions, size of the polymer molecules.

5. UNIT V 12

Chemical reactions of polymers ; Hydrolysis ; Acidolysis ; Aminolysis- Hydrogenation ; Addition and substitution reactions ; cross linking reactions. Polymer degradation ; Mechanical degradation ; Mechano-chemical degradation ; Oxidative degradation ; Hydrolytic degradation ; Photo degradation. (12hrs.)

Total No of periods: 60

References:

1. *F.W. Billmeyer, Text Books: of Polymer Science, Wiley international publishers, 1984.*
2. *Joel R. Fried, Polymer science and Technology, Prentice Hall , NJ, 1995*
3. *JM.G. Cowie, Polymers: Chemistry and Physics of Modern Materials, Blackie, London, 1991.*
4. *R.J. Young and P.Lovell, Introduction to Polymers, 2nd Ed., Chapman & Hall, 1991.*
5. *Premamoy Ghosh, Polymer Science and Technology of Plastics and Rubbers, Tata McGraw - Hill, New Delhi, 1990.*

1. UNIT I 12

Mechanical Behavior of materials ; Stress ; Strain curve, Elastic deformation- Characteristics of elastic deformations, atomic mechanism of elastic deformation, Inelastic deformation, Strain-Time curves, Damping capacity, Viscous deformation, Plastic deformation, Mechanism of plastic deformation- slip & twinning, Schmidt's law, critical resolved shear stress.

2. UNIT II 12

Mechanical testing and fracture of materials ; tensile test, stress-strain curves for ductile and brittle materials ; mild steel, copper, proof stress, yield point phenomena, Luder's bands, compression test, hardness test ; various hardness tests. Impact test ; ductile-brittle transitions. Fatigue- Stress cycles for fatigue testing, endurance limit, fatigue limit, S-N curve, Creep-curve, primary creep, secondary creep, tertiary creep. Fracture ; ideal fracture stress, brittle fracture- Griffith's theory- fracture toughness, ductile failure, cup & cone type fracture, fatigue failure.

3. UNIT III 12

Phase diagram ; solid solutions, inter metallic compound, cooling curves, non-equilibrium cooling, phase rule, equilibrium diagrams ; Isomorphous diagrams, Eutectic, Peritectic and eutectoid reactions with examples. Ferrous and non-ferrous alloys ; Fe-C diagram, Effect of alloying elements on properties of steel, tool steel, heat resisting and die steel. Alloys of copper, aluminium, magnesium, nickel and zinc ; compositions and their uses, bearing materials, brazing and soldering alloys. Polymeric and composite materials, metal matrix composites, ceramic, shape memory materials.

4. UNIT IV 12

Special diffusion process ; Aluminizing, Siliconising, Boriding ; Laser hardening, Electroplating-hard chrome & nickel plating - Hard dip coating, Cladding - Physical and chemical vapor deposition - Metal spraying ; Plastics and rubber coating ; Conversion coating ; Coating of tools ; TiC, TiN, Alumina and diamond coating of tools ; Selection of coating of tools ; Selection of coating for wear and corrosion resistance ; Elastic materials ; Applications.

5. UNIT V 12

Heat treatment of steel ; Critical temperature and heating - Annealing- Spheroidizing- normalizing ; hardening - Isothermal transformations ; TTT diagram - tempering - austempering - martempering and ausforming. Hardenability and its testing. Selection of the steel ; Case-hardening steel ; Nitriding steels ; Quenched and tempered steels ; Fully-hardening steels ; Corrosion-resistance steels ; Maraging steels ; Hard material alloys ; Heat treatment of steels ; Proper design for proper heat treatment ; Stress-relief annealing ; Preheating to the treatment temperature ; Types of structure and their specific volume ; Heat treatment of case-hardening steels ; Heat treatment of nitriding steels ; Heat treatment of quenched and tempered steels ; Heat treatment of fully-hardening steels ; Heat treatment of corrosion - resistance steels ; Heat treatment of maraging steels.

Total No of periods: 60

References: BOOKS

1. *M. Arumugham, Material Science, Anuradha Agencies, 1st Ed., 1987.*
2. *G. E. Dieter, Mechanical metallurgy, McGraw Hill, 2000.*
3. *Klaus Stoeckhert, Mold making handbook for the Plastic engineers, Hanser Pub.*
4. *Data book on Plastics ; CIPET , Chennai.*
5. *J. C. Anderson, K. D. Leaver, R. D.Rawlings , J. M. Alexander, Material Science,*
6. *Donald S. Clark and Wilbur R Warney , Physical metallurgy, Affltd. East west press.*
7. *C. W. Richards, Engineering material Science, Prentice Hall Of India.*

1. UNIT I 12

Introduction ; specific mass ; specific volume ; specific weight ; specific gravity ; pressure ; dynamic viscosity ; kinematic viscosity ; Newtonian and Non Newtonian fluids ; surface tension ; capillarity ; compressibility ; vapor pressure ; real and ideal fluids ; concept of gauge and absolute pressure ; measurement of pressure using manometers of different types- definitions and explanations of steady, unsteady, uniform, non-uniform, laminar and turbulent flows ; rotational and irrotational flows ; path line ; streak line ; stream line ; continuity equation in three dimensional Cartesian co-ordinates ; continuity equation for one dimensional flow ; stream function ; potential function.

2. UNIT II 12

Euler's equations of motion ; Derivation of Bernoulli's equation ; applications of Bernoulli's Energy theorem ; Venturi meter ; orifice meter ; nozzle pitot tubes.
Laminar flow through pipes ; shear stress, pressure gradient ; Hagen-Poiseuille's equation ; laminar flow between parallel plates ; Couette flow ; plane Poiseuille's flow.

3. UNIT III 12

Turbulent flow through pipes ; friction loss calculation ; Darcy ; Weisbach equation ; minor losses ; use of moody chart ; dimensional analysis and model testing ; Reynold's and Froude's number and their use in model testing.

4. UNIT IV 12

Pumps & Motors: Introduction to Fluid Power Control ; Pumps ; Gear Pumps, Vane Pumps, Radial and Axial Piston Pumps. Motors ; Fixed and variable displacement motors. Cylinders and power packs. Different types of cylinders - Construction.

5. UNIT V 12

Valves ; construction and operation ; Directional control valves ; method of actuation. Different types of center position. Pressure control valves. ; Relief valves, Sequence valves, Pressure reducing valves, unloading valves, counter ; balancing valves, Brake valves. Proportional valves ; Flow control and pressure control valves ; Servo valves.

Total No of periods: 60

References: BOOKS:

1. *R.K .Bansal, Fluid Mechanics and Hydraulic Machines, Lakshmi Publications, 1993*
2. *C.P. Kothandaraman, and R. Rudramoorthy, Basic Fluid Mechanics, New age international, 1998.*
3. *Anthony Esposito, Fluid Power with applications, Prentice Hall India. 1997*
4. *V.I .Streeter, Fluid Mechanics, McGraw Hill Company Ltd., 1985.*
5. *K.L .Kumar, Engineering Fluid Mechanics, Eurasia Publishing House, 1995.*
6. *Mathur, Sharma and purohit, Fluid Mechanics & Fluid Machines, Satya Prakashan Pub. 1984.*
7. *Herbert E. Marrit, Hydraulic Control systems, John Wiley., 1967*
8. *Industrial Hydraulics Manual, Vicker's International, Edition 2, 1989*

1. PART A: IDENTIFICATION OF ORGANIC COMPOUNDS OF THE FOLLOWING TYPES: 20

1. Alcohols
2. Aldehydes
3. ketones
4. Carboxylic acids
5. Esters
6. Amines
7. Amides
8. Carbohydrates
9. Halogen compounds
10. Phenols

2. PART B: SINGLE STEP PREPARATION OF ORGANIC COMPOUNDS BY THE FOLLOWING METHODS 25

1. Nitration
2. Acetylation
3. Bromination
4. Oxidation
5. Hydrolysis

II. Quantitative Estimation of

1. Phenol
2. Acetone
3. Urea
4. Formaldehyde
5. Methyl Methacrylate
6. Acrylonitrile

Total No of periods: 45

References: BOOKS:

1. A.I. Vogel, Organic Qualitative and Quantitative Analysis.

1. UNIT I : 12
PROBABILTY AND RANDOM VARIABLES.

Probability concepts, Random variables, Moments, Moment Generating function, Binomial, Poisson, Geometric, Negative Binomial, Exponential, Gamma, Weibull Distributions, Functions of Random Variable, Chebycnev inequality.

2. UNIT II 12
LINEAR PROGRAMMING.

Formulation of linear programming problem, Graphical solution, simplex algorithm, artificial variable and the M-method, degeneracy, alternative optima and unbounded solution.

3. UNIT III 12
FURTHER TOPICS IN LINEAR PROGRAMMING.

Duality, primal dual computations, transportation model and algorithm, Assignment model and Hungarian technique of solution, imbalance, cost maximization alternative optima in transportation and assignment method.

4. UNIT IV 12
IMPROPER INTEGRALS AND SERIES SOLUTIONS

Improper integrals ζ Gamma and Beta functions, Series solutions ζ Ordinary point, regular singular point of second order linear ordinary differential equation, series solution to second order linear differential equation about an ordinary point and a regular singular point.

5. UNIT V 12
DIFFERENTIAL EQUATIONS AND Z TRANSFORMS

Linear difference equation with constant coefficients, elementary properties of z ζ Transform, applications of z transform, applications of z ζ Transform to difference equation.

Total No of periods: 60

References: BOOKS:

1. Miller, and J.E. Freund, *Probability and statistics for Engineers*, Prentice hall of India, New Delhi, 1977.
2. T.A .Taha, *Operations research, An introduction*, Mc Millan Newyork 1976.
3. Kanti Swarup, P.K.Guptha, and Manmohan, *Operations Research*, Sultan chand & sons New Delhi 1982.
4. L.A. Andrews, *Special functions for scientists and Engrs.*,Mcgraw Hill,1992.
5. L.C. Andrews, and B.K. Shivamoggi, *Integral Transforms for Engineers and applied mathematicians*. Macmillan, New York, 1988.
6. S.Narayanan, Manicavachagam Pillay & *Advanced Mathematics for Engg. Students Vol II* ; S.Viswanathan Printers, Madras.
7. B.S.Grewal, *Higher Engg Mathematics*, Khanna Publishers.
8. J.N .Kapur, and H.C .Saxena, *Mathematical statistics*, S.Chand & Co.

1. UNIT I 12

Elasticity: Stress and strain, compressive, tensile, shear and bearing stress - Stress - strain diagram, Hooks law, modulus of elasticity, modulus of rigidity, bulk modulus of rigidity, bulk modulus, Poisson's ration. Relationship between elastic constraints and temperature stresses, composite bars, dead, live and shock loads.

2. UNIT II 12

Properties of section, calculation of areas, centroid, neutral axis, moment of inertia, modulus of section, radius of gyration with reference to structural shapes.

3. UNIT III 12

Theory of simple bending - relationship between load shearing force and bending moment. Bending moment and shear force diagram for cantilever, simple supported and over hanging beams - bending stresses.

Deflection - deflection of beams in simple cases. Principal stresses and stains.

Torsion in solid and hollow shafts - combined bending and torsion.

4. UNIT IV 12

Thin and thick cylinders and shells subjected to internal and external pressures.

5. UNIT V 12

Column and struts - long and short columns - axial and eccentric loading - effect of end conditions - equivalent length and slenderness ratio - Euler and Rankine formulae.

Total No of periods: 60

References: BOOKS:

- 1. R.S. Khurmi, Applied Mechanics and Strength of Materials
S.Chand & Co., (6th ed), New Delhi, 1987.*
- 2. P.N. Singh and I.K.Jha, Elementary Mechanics and Solids, Wiley Eastern, New Delhi.*

1. UNIT I	12
Mold Making: Introduction of mold parts, Mechanism of metal cutting, types of tools, influence of tool angles, Cutting fluids, Tool materials used including coated tools. Studies of various machining operations: Turning, Shaping, Planning, Drilling, Grinding (Surface, Cylindrical, Tool & Cutter, Rotary Grinding), Milling (Horizontal / Copy Milling / Vertical / Ram / Tool Milling).	
2. UNIT II	12
Die sinking (copy milling), Pentagraph, Profile grinding, Electrical discharge machining - Characteristics, physical processes, special technological features, types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making.	
3. UNIT III	12
Electroforming for mold manufacturing - discussion of the process, materials for electroforming, design & materials for models, machining for electroformed blanks, mold cavities, economy & service life. Hobbing for mold making - Discussion of the hobbing process & its advantages, elements of hobbing like hobbing punch, shape of the hob, materials used for cavity, lubrication, and depth of hobbing, Hobbing presses, Hobbing operations & its economy with examples	
4. UNIT IV	12
Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, Effect of mold materials on polishability, Types of polishing tools, Methods of polishing - Basic information on Electro sonic polishing - Principles of Electro deposition in damaged molding surfaces. Surface Texturing of molds - Process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.	
5. UNIT V	12
Metrology and inspection: Scope of inspection, Procedures, Choices of basic measuring instruments, Vernier, Micrometer, Surface Plates, Angle plates, Squares, Vernier height gauges, Depth gauges, Slip gauges, Dial gauges, Surface roughness measurement, Hardness testing, Comparators, Optical profiles projectors, Tool makers microscope, Optical flats - types and uses.	
	Total No of periods: 60

References: BOOKS:

1. *Klus Stokhert (Ed.), Mold making handbook for Plastic Engineers, Hanser Publishers, NY, 1983*
2. *HMT Production Technology, TMH (India), 1992*
3. *Bhattacharya, A New Technology, IB Publishers, 1984*
4. *P.C.Pandey & H. S. Shah, Modern Machining Processes, TMH, 1990*
5. *R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.*
6. *Stoekhert & Menning, Mold making handbook, 2nd edition, Hanser Publishers, Munich.*
7. *W.A.J Chapman, Workshop Technology, Vol I & II, ELBS.*
8. *Herbert Rees, Mold Engineering, Hanser Publishers, NY.*
9. *George Menges & Paul Mohren, How To Make Injection Molds, Hanser Publishers.*

1. UNIT I 12

Methods of manufacturing - Properties and applications of polyethylene - LDPE - HDPE- LLDPE, HMWHDPE- UHMWHDPE- Crosslinked polyethylene- Chlorinated polyethylene - Polypropylene - Homopolymers - Copolymers.

2. UNIT II 12

Methods of manufacturing - Properties and applications of poly(vinyl chloride)- Poly(vinylidene chloride)- Poly(vinyl alcohol) - Poly(vinyl acetate)- Chlorinated poly(vinyl chloride)- Plasticsols.

3. UNIT III 12

Methods of manufacturing - Properties and applications of polystyrene - High impact polystyrene- expanded polystyrene- Copolymers - Copolymer of acrylonitrile, butadiene and styrene - Copolymer of styrene and acrylonitrile.

4. UNIT IV 12

Methods of manufacturing - properties and applications of Acrylates - Poly (methyl methacrylate)- Polyacrylonitrile. Aliphatic polyamides -Aromatic polyamides - Polyethylene terephthalate - Polybutylene terephthalate - Polyacetals and copolymers - Polycarbonates.

5. UNIT V 12

Methods of manufacturing - Properties and applications of Fluoro polymers - Polytetrafluoroethylene, Polychlorofluoroethylene, Thermoplastic polyurethanes, Cellulose nitrate - Cellulose acetate- ethyl cellulose- Cellulose esters.

Total No of periods: 60

References: BOOKS:

1. *J.A.Brydson, Plastics materials, Butterworth- Heinemann - Oxford, 6th Ed., 1995.*
2. *Olagoke Olabisi, Hand book of thermoplastics, Marcel Decker, inc., 1997*
3. *K.J. Saunders, Organic Polymer chemistry, Chapman & Hall, NY, 1988.*
4. *Irvin.I. Rubin, Hand Book of Plastic Materials and Technology, Wiley Interscience, NY, 1990.*
5. *Feldman.D and Barbalata.A, Synthetic polymers, Chapman Hall, 1996.*

1. UNIT I 12

Structure of polymers - Linear, branched, crosslinked, and network polymers - Homochain and hetero atomic chain polymers - Copolymers - Linear and cyclic arrangement - Prediction of polymer properties, group contribution techniques, topological techniques- Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.

2. UNIT II 12

Mechanical properties - Stress-strain properties of polymers - Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness - Craze in glassy polymers - Ductile brittle transition. Effect of additives on mechanical properties of polymers - Creep, stress relaxation, and fatigue.

3. UNIT III 12

Thermodynamic and transition properties - Transition temperature in polymers, glass transition (T_g), melt transition (T_m), relationship between T_g and T_m - other transitions like β -transitions, upper and lower glass transition temperatures - Prediction of T_g and T_m of polymers by group contributions. Calorimetric properties - Heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy - Calculation of heat capacities of polymers.

4. UNIT IV 12

Electrical and optical properties - Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor - effect of frequency of voltage and temperature on dielectric properties - Prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers. Optical properties - Effect of polymer structure on optical properties - clarity, transparency, haze, transmittance, reflectance, and gloss - Prediction of refractive indices of polymers by group contributions.

5. UNIT V 12

Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers - Prediction of solubility parameter -Effect of polymer structure on solubility in solvents and oils - Influence of structure in prediction of flame retardancy, water repellency - Chemical resistance of polymers - Polymer toxicity.

Total No of periods: 60

References: BOOKS:

1. D.W. Van Krevelen And P.J. Hoftyzen, "Properties Of Polymer , 3rd Edition Elsevier Scientific Publishing Company Amsterdam - Oxford - Newyork. 1990.
2. J.E. Mark Ed.AIP, *Physical Properties Of Polymers Hand Book*, Williston, Vt, 1996.
3. D.A.Seanor, ed., *Electrical properties of polymers*, Academic press, Newyork, 1982.
4. Jozef.Bicerano, *Prediction Of Polymer Properties, Second Edition*, Marcel Dekker Inc. Newyork,1995.
5. J.M.Margolis (Ed.),*Engineering Thermoplastics Properties & Applications* ,Marcel Dekker , New York 1985.
6. R.J.Samuels, *Structured Polymer Properties*, John Wiley & Sons ,New York,1974.
7. I.M.Ward & D.W.Hadley , *An Introduction to the Mechanical Properties of Solid Polymers* , John Wiley & Sons , Chichester , England , 1993.
8. C.C.Ku & R.Liepins , *Electrical Properties of Polymers* , Hanser Publications, Munich,1987.
9. F. Bueche, *Physical properties of polymers*, Wiley, New york, 1962.
- 10.J.Mort & G.Pfister, eds., *Electronic properties of polymers*, Wiley interscience, Newyork, 1982.

1. UNIT I 12

Classification of Unit Operations

Heat transfer-Modes of HT, Fourier's law of heat conduction, steady state conduction across composite walls, cylinder and hollow sphere. Insulated bodies. Film concept and convective heat transfer coefficient. Convection - Heat transfer by natural & forced convection. Heat transfer in laminar & turbulent flow, Counter current, parallel and cross flows. Individual and overall heat transfer coefficients. LMTD

2. UNIT II 12

Heat exchange equipments - double pipe and shell and tube heat exchangers, condensers (Equipment description & solution to simple problems)

Mass Transfer - Principles of diffusion, theory of diffusion, Mass transfer coefficients and film theory Penetration theory.

Distillation - Vapour liquid equilibria, Simple distillation, Steam distillation, Continuous binary distillation. Industrial equipments for distillation.

3. UNIT III 12

Agitation of liquids - Types of impellers. Selection criteria. Power consumption calculations for agitated vessels.

Absorption - Principle and equipment (packed towers and plate columns).

Adsorption - Principle and equipment for adsorption.

4. UNIT IV 12

Drying - Principles and definitions. Rate of batch drying. Equipments for drying.

Humidification - Humidity and saturation, dry bulb and wet bulb temperatures, percentage saturation, dew point, humid volume, humid heat, enthalpy. Equipment - Water - cooling towers, spray chambers.

5. UNIT V 12

Membrane Separation Processes - Separation of gases and liquids, Dialysis, Membrane liquid-liquid extraction, pervaporation and reverse osmosis.

Size reduction Laws of crushing, Equipment-classification, Crushers and grinders.

Mechanical separations-Screening and screening equipments, Filtration- principle and filtration equipment (filter press, shell and leaf filter, rotary drum filter, centrifugal filter, centrifuges), filter media, filter aids. Gravity settlers. Cyclones and hydro cyclones.

(Basic principles and equipment description only. Mathematical consideration not required for Size Reduction & Mechanical Separation)

Total No of periods: 60

References: BOOKS:

1. *W.L. McCabe, J.C. Smith, Unit Operations of Chemical Engineering -., Mc. Graw Hill, 1993.*
2. *W.L. Badger, J.T. Banchero. Introduction to Chemical Engineering, Mc. Graw Hill, UK, 1997.*
3. *Richardson and Coulson, Chemical Engineering. Vol. 1 & Vol. 2, Asian Books Pvt. Ltd., India, 1996.*
4. *Chemical Engineer's handbook - Perry and Chilton.*
5. *Principles of Unit Operations - Foust A.S., Walzel.L.A. , John Wiley.*