ANNA UNIVERSITY : : CHENNAI – 600 025.

AFFILIATED INSTITUTIONS

REGULATIONS - 2013

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M.TECH. POLYMER SCIENCE AND ENGINEERING

SEMESTER I

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
PO7101	Polymer Chemistry	3	0	0	3
PO7102	Polymeric Materials	3	0	0	3
PO7103	Polymer Processing	3	0	0	3
	Elective I	3	0	0	3
	Elective II	3	0	0	3
PRACTICALS					
PO7111	Polymer Science Laboratory	0	0	4	2
	TOTAL	**15**	**0**	**4**	**17**

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
PO7201	Characterization and Testing of Polymers	3	0	0	3
PO7202	Polymer Composites	3	0	0	3
PO7203	Physics of Polymeric Materials	3	0	0	3
	Elective - III	3	0	0	3
	Elective – IV	3	0	0	3
PRACTICALS					
PO7211	Polymer Processing and Testing Laboratory	0	0	6	3
PO7212	Seminar	0	0	2	1
	TOTAL	**15**	**0**	**8**	**19**

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
	Elective VII	3	0	0	3
PRACTICALS					
PO7311	Industrial Training (4 weeks)	0	0	0	2
PO7312	Project work (Phase I)	0	0	12	6
	TOTAL	**9**	**0**	**12**	**17**

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICALS					
PO7411	Project Work (Phase II)	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

TOTAL NUMBER OF CREDITS : 65

LIST OF ELECTIVES

M. TECH. POLYMER SCIENCE AND ENGINEERING

ELECTIVE - I

COURSE CODE	COURSE TITLE	L	T	P	C
PO7001	Adhesive Science and Technology	3	0	0	3
PO7002	Rubber Technology	3	0	0	3
PO7003	Tyre Technology	3	0	0	3

ELECTIVE - II

COURSE CODE	COURSE TITLE	L	T	P	C
PO7004	Synthetic Resins	3	0	0	3
PO7005	Surface Coasting and Paint Technology	3	0	0	3
PO7006	Synthetic Fibers	3	0	0	3

ELECTIVE - III

COURSE CODE	COURSE TITLE	L	T	P	C
PO7007	Conducting Polymers	3	0	0	3
PO7008	Engineering Plastics	3	0	0	3
PO7009	Plastic Waste Management	3	0	0	3

ELECTIVE - IV

COURSE CODE	COURSE TITLE	L	T	P	C
PO7010	Polymer Nanocomposites	3	0	0	3
PO7011	Biopolymers and Biodegradable Polymers	3	0	0	3
PO7012	Specialty and High Performance Polymers	3	0	0	3

ELECTIVE - V

COURSE CODE	COURSE TITLE	L	T	P	C
PO7013	Die and Mould Technology	3	0	0	3
PO7014	Polymer Blends and Alloys	3	0	0	3

ELECTIVE - VI

COURSE CODE	COURSE TITLE	L	T	P	C
PO7015	Computer Aided Design	3	0	0	3
PO7016	Reaction Engineering	3	0	0	3
PO7017	Process Instrumentation	3	0	0	3
PO7018	Heat Transfer and Momentum Transfer Process	3	0	0	3

ELECTIVE - VII

COURSE CODE	COURSE TITLE	L	T	P	C
PO7019	Industrial Management	3	0	0	3
PO7020	Total Quality Management	3	0	0	3

PO7101 **POLYMER CHEMISTRY** **LT P C**
3 0 0 3

OBJECTIVE

- To make the student to acquire knowledge in fundamentals of polymers and bio-inorganic polymers
- To understand the knowledge in chain polymerization, Step growth polymerizations and copolymerization
- To provide exposure to the students about Molecular weight, solubility and fractionation of polymers .

OUTCOME

- Will be aware of preparation and properties of polymers at length.
- Will be able to methodically discuss moulding techniques
- Will develop capacity to characterize polymers and draw a parallel to their properties

UNIT I FUNDAMENTALS OF POLYMERS 9

Basics – polymer classifications based on- occurrence, types, process, structure and end uses. Polymer microstructure-chemical and geometrical structure - ladder, star and telechelic polymers – interpenetrating networks –tacticity –Polymers- crystalline-amorphous nature- crystallization.- crystallizability-effect on properties - thermal transitions–TGA,DSC ,HDT,MFI

UNIT II BIO AND INORGANIC POLYMERS 9

Naturally occurring polymers – starch, proteins, cellulose – Derivatives of cellulose polymers – rayon, cellophane, cellulose acetate, butyrate and nitrate – ethyl cellulose – carboxymethyl cellulose- preparation, properties- application organometallic polymers - co-ordination polymers - polyamides- Inorganic polymers - phosphorous and nitrogen containing polymers – silicones - hybrid polymers.

UNIT III CHAIN POLYMERIZATION 9

Kinetics and mechanism of free radical, cationic, anionic and coordination polymerization – Ziegler Natta catalysts-monometallic mechanism- stereo regular polymerization - chain transfer reaction and constant – living polymers – Alfin catalysts – iniferters.

UNIT IV STEP GROWTH POLYMERIZATIONS AND COPOLYMERIZATION 9

Polycondensation polymerization – copolymerization- kinetics – copolymer equation – composition of copolymers by NMR – monomer reactivity ratios and their significance – polymerization reactions- metathetical, electrochemical, GTP and ring opening.

UNIT V MOLECULAR WEIGHT, SOLUBILITY AND FRACTIONATION OF POLYMERS 9

Number, weight and viscosity average molecular weights – polydispersity - molecular weight distribution – determination of molecular weight by GPC and viscometry – polymer dissolution - thermodynamics of polymer dissolution - solubility parameter – fractionation of polymers - reactions of polymer molecules with specific groups OH,CHO,C=O,.COOH and – NH_2 and polymer- cross linking, cyclisation –polymer degradation-thermal, mechanical, photo and radiation.

TOTAL : 45 PERIODS

REFERENCES

1. F.W. Billmayer, Text Book of Polymer Science, 3rd edition, John Wiley and sons, New York, 2002.
2. R.J. Young, Introduction to Polymers, Chapman and Hall Ltd., London, 1999.
3. Gorge Odeon – Principles of Polymerization, 4th edition, McGraw Hill Book Company, New York.2004
4. M.S.Bhatnagar, " A Text Book of Polymers (chemistry and Technology of polymers), Vol I, II & III, 1st Edn., S.Chand and Company, New Delhi, 2007
5. PremamoyGhosh ," Polymer Science and Technology, 2nd edition,McGraw-Hill Publishing Company Limited, New Delhi,2003.

PO7102	POLYMERIC MATERIALS	LT P C
		3 0 0 3

OBJECTIVES

- The objective of this course is introduction to polymer structure, chain structure and mechanical properties.
- To impart knowledge on thermal properties and electrical properties.
- Students should be conversant with rheological properties.

OUTCOME

- Will be aware of preparation and properties of polymers at length.
- Will be able to discuss the properties of polymers.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

UNIT I INTRODUCTION 9

Polymer structure – chain structure – micro structure – crystal structure- crystallinity – determination of crystallinity, size and orientation of crystallites using x-rays-conformation and configuration.

UNIT II MECHANICAL PROPERTIES 9

Deformation of plastic materials- classification of plastic materials based on their stress – strain relationship – effect of temperature on deformation-time dependence and viscoelasticity in solid plastics – Boltzmann's superposition principle- dynamic mechanical properties – yielding of plastics–mechanical failure in plastics.

UNIT III THERMAL PROPERTIES 9

Enthalpy –melting and crystallization – importance of Tg - factors affecting Tg – determination of Tg – thermal conductivity – thermal expansion and contraction - factors affecting thermal expansion.

UNIT IV ELECTRICAL PROPERTIES 9

Electrical properties at low stress and high stress- breakdown mechanisms – electrically conductive plastics – electrical applications of plastics.

UNIT V RHEOLOGICAL PROPERTIES 9

Melt flow properties - fundamental concepts of rheology – geometry of flow – rheological and viscous behavior in simple shear - viscous properties of plastic melts in simple shear – measurement of shear properties – viscometry – types of capillary viscometer – factors affecting shear flow and elongational flow – MFI, melt elasticity.

TOTAL : 45 PERIODS

REFERENCES

1. Birley, Haworth, Batchelor, Physics of Plastics – Processing Properties and Materials Engineering, Hamer Publication, 1992.
2. N.C. McCrum et.al, Principles of Polymer Engineering, 2nd edition Oxford University Press, London, 1997.
3. J.J. Aklonis and J. McKnight, Introduction to Polymer Viscoelasticity, John Wiley and sons, New York, 1983.
4. Bever, Encyclopedia of Materials Science and Engg., Volume 7, Pergamon press, London, 1986.
5. L. H. Sperling,"Introduction to physical polymer science, 4thedn, Wiley, 2005.

PO7103 **POLYMER PROCESSING** **LT P C**
3 0 0 3

OBJECTIVES

- To impart knowledge on mixing devices, extrusion moulding.
- To know the importance of Injection moulding and special moulding Techniques.
- To understand the basic concepts in die design

OUTCOME

- Will be aware of different mixing devices, extrusion moulding.
- Will be able to methodically discuss moulding techniques.
- Will understand the basic concepts in die design

UNIT I MIXING DEVICES 9

Additives and Mixing process, different types of mixing devices - twin drum tumblers, ribbon blenders, Z-blade Mixer, High speed mixer, Ball mill, two roll mill, Banbury Mixer, internal mixing and screw mixing – twin screw compounding machines – high temperature and pressure mixing devices – antistatic agents.

UNIT II EXTRUSION MOULDING 10

Analysis of flow in Extruder – Drag flow, Pressure flow, Leak flow – Extruder/Die Characteristics – Basic flow patterns in extrusion die – die exit instabilities – die swell – processing methods based on extruder (Granule production, profile production, film blowing, blow moulding, extrusion stretch blow moulding) – Extrusion coating process (Sheet Coating and Wire Covering).

UNIT III INJECTION MOULDING 8

Injection moulding machines and its components - Moulds, Multi cavity Moulds, Mould clamping devices, Mould Clamping Force, Disc Moulding, Injection Blow Moulding, Reaction Injection Moulding.

UNIT IV SPECIAL MOULDING TECHNIQUES 9

Analysis of Calendaring, methods of sheet forming – Thermoforming – vacuum forming, Pressure Forming and matched mould forming – Rotation Moulding, Analysis of Compression Moulding, Transfer Moulding – Plastic finishing techniques, Powder coating, Metallizing.

UNIT V BASIC CONCEPTS IN DIE DESIGN 9

Types of moulds – ejector system – ejection techniques – mould cooling – CAD / CAM applications

TOTAL : 45 PERIODS

REFERENCES

1. D.H. Morton-Jones, Polymer Processing, Chapman and Hall, London,1989.
2. Crawford R.J. Plastics Engineering, Butterworth - Heinemann, 3rd Edition, 2005.
3. Richard G.Griskey, Polymer Process Engineering, Chapman and Hall, 1995.
4. Friedhelm Hansen, Plastics Extrusion Technology, 2nd Edition, Hanser Publishers, 1997.
5. Peter Powell, A. Jan IngenHouz, Engineering with Polymers, Stanley Thomas Publishers Ltd., 2nd Edn. 1998.

PO7111 POLYMER SCIENCE LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To make the student conversant with polymer synthesis, kinetics of polymerization
- To enable students develop their determination of reactivity ratio and molecular weight.
- To know the importance of fractionation of polymers

OUTCOME

- Will be aware of synthesis and kinetics of polymers.
- Will be able to methodically discuss fractionation of polymers.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

UNIT I **9**

Polymer synthesis – bulk, solution, emulsion, suspension and slurry polymerization - low and high temperature condensation polymerization, interfacial polycondensation, thermal and redox initiated polymerizations

UNIT II **9**

Kinetics of polymerization – dilatometry, gravimetry.

UNIT III **9**

Determination of reactivity ratio of MMA – styrene copolymer – characterization by TGA, TMA, NMR and IR. Crystallinity of polymers – X-ray diffraction study.

UNIT IV **9**

Determination Molecular weight Molecular weight determination – viscometry, end group analysis, GPC, light scattering, osmometry

UNIT V **9**

Fractionation of polymers – Fractional precipitation method – polydispersity.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Edward A. Colloind, J.Bares and F.W. Billmeyer Jr., Experiments in Polymer Science, Wiley Interscience, New York 1973.
2. Wayne R.Sorenson and T.W.Campbell, Preparative Methods of Polymer Chemistry 3rd edition, Wiley – Interscience, New York, 2001
3. E.M.McCaffery, Laboratory Preparation for Macromolecular Chemistry, McGraw Hill, Kogakush 1970.

PO7201 CHARACTERIZATION AND TESTING OF POLYMERS L T P C
3 0 0 3

OBJECTIVES

- To pass on knowledge on characterization tests, thermal and electrical properties.
- To learn mechanical properties and flammability, optical properties and analytical tests.
- To provide exposure to understand the testing of foam plastics and testing organizations.

OUTCOME

- Will be aware of characterization tests, thermal and electrical properties..
- Will be able to appreciate optical properties and analytical tests..
- Will get an idea about testing of foam plastics and testing organizations.

UNIT I CHARACTERIZATION TESTS 11

TGA, DTA, DSC, TMA, XRD, SEM, AFM, TEM, IR, NMR, GC, GPC melt index and viscosity.

UNIT II THERMAL AND ELECTRICAL PROPERTIES 9

Heat deflection temperature, Vicat softening temperature, thermal conductivity thermal expansion, brittleness temperature – dielectric strength dielectric constant, dissipation factor, resistance.

UNIT III MECHANICAL PROPERTIES AND FLAMMABILITY 9

Tensile tests, compressive properties, impact properties, deformation, brittleness abrasion resistance hardness tests – incandescence resistance, ignition properties, oxygen index, surface burning characteristics.

UNIT IV OPTICAL PROPERTIES AND ANALYTICAL TESTS 9

Refractive index, luminous transmittance, haze, density, water absorption, moisture analysis, sieve analysis, crush and burst strength.

UNIT V TESTING OF FOAM PLASTICS AND TESTING ORGANIZATIONS 7

Foam properties, rigid and flexible foam - testing methods - ASTM, ANSI, NBS, NEMA, NFPA, UL, SPI and SPE.

TOTAL : 45 PERIODS

REFERENCES

1. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.
2. B. Sivasankar, Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
3. Vishu Shah, Hand book of Plastics Testing and Failure Analysis, 3rd Edition, John-Willey &Sons, New York, 2007.
4. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., New Delhi, 2003
5. Ya. Malkin, A.A. AskaDsky, V.V. Koverica Experimental methods of polymers, Mir Publishers, Mascow, 1998.
6. Iver, Mead and Riley, Hand book of Plastic test methods, Illith Publishers, New York, 1982.

PO7202 POLYMER COMPOSITES L T P C
3 0 0 3

OBJECTIVES

- The objectives of this paper is to introduce in detail the basics of polymer composites

OUTCOME

- On completion of the paper the student should be able to demonstrate knowledge and understanding in the matrix, reinforcement and additives used in polymer composites. The student will also understand the properties of laminates, processing and applications of composites.

UNIT I INTRODUCTION AND MATRIX MATERIALS 8

Introduction - Characteristics - Advantages - Classification - Particulate, Fibrous and Laminated Composites - Hybrid Composites - Matrix Resins **-** Unsaturated Polyester - Vinyl Ester - Epoxy- Phenol Formaldehyde - Urea Formaldehyde - Melamine Formaldehyde Resin - Production - Properties and Applications

UNIT II REINFORCEMENT MATERIALS 9

Fibre Reinforcements - Glass – Types - E, S, C And D Glasses - Rovings - Yarns - CSM - Surface Mats - Performs - Woven and Non Woven Fabrics - Production - Properties and Applications - Carbon - Precursors - Pan and Pitch Based - Types - Production - Properties and Applications – Aramid Fibre - Boron Fibres - Natural Fibres – Cellulose - Jute, Sisal and Coir - Knitted and Braided Materials

UNIT III ADDITIVES AND PROCESSING OF COMPOSITES 8

Additives for Composites - Catalysts - Room Temperature and Elevated Temperature - Accelerators - Coupling Agents - Fillers - Flame Retardants - Toughening Agents - UV Stabilizers - DMC, SMC and Prepregs - Hand and Spray Layup - RTM - Bag - Autoclave - Centrifugal and Compression Molding Processes - Filament Winding - Pultrusion Sandwich Construction

UNIT IV LAMINATED COMPOSITES 10

Introduction - Stress and Strain Relationship for Anisotropic and Orthotropic Materials - Rules of Mixture - Longitudinal Tensile Loading – Transverse Tensile Loading - Longitudinal Compressive Loading – Classical Lamination Theory – Interlaminar Stresses - Failure Criteria of Orthotropic Laminates

UNIT V TESTING AND APPLICATION OF COMPOSITES 10

Testing of Composites - Fiber Volume Fraction - Determination of Gel Time - Non Destructive Evaluation Methods for Composites - Ultrasonic Methods , X-Ray Imaging, Infrared Thermal Testing & Neutron Radiography - Application of FRP Products - Auto Mobile - Marine - Aero Space - Composites in Construction

TOTAL : 45 PERIODS

REFERENCES

1. G. Lubin, “Hand Book of Composites”, 2nd edn., Van Nostrand Reinhold, New York, 1982
2. L. Holloway “Hand Book of Composites for Engineers”, Technomic, Lancaster, Pa, 1994
3. S. M. Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989
4. G. Shook, “Reinforced Plastic for Commercial Composites”, Source Book, Asm Intl., 1986
5. Kevin Potter, “An Introduction to Composites Products”, Chapman and Hall, Madras, India 1997
6. S.T.Peters, “Hand Book of Composites”, Chapman and Hall, Chennai, 1998
7. S. C. Lin and E. M. Pearce, “High Performance Thermosets”, Hanser Publishers, New York, 1993
8. Harold Belofsky, “Plastics: Product Design And Process Engineering”, Hanser Gardner Pubns., New York, 1995
9. P.K. Mallick, Fiber Reinforced composites, 3rd edn., CRC Press, US, 2007
10. T.G. Gutowski, Advanced Composites Manufacturing, John Wiley and Sons, New York, 1997

PO7203 PHYSICS OF POLYMERIC MATERIALS L T P C
3 0 0 3

OBJECTIVES

- The objectives of this paper is to introduce the physics of polymeric materials

OUTCOME

- On completion of the paper the student should be able to demonstrate knowledge and understanding in chain conformation, thermodynamics of polymer solutions, theory of gelation and polymer dynamics

UNIT I BASICS OF POLYMER PHYSICS 9

Polymer Microstructure - Fractal Nature of Polymer Conformations - Types of Polymeric Substances (Liquid, Solid and Crystal) - Molar Mass Distributions and Measurements - Molecular Sizes and Shapes and Ordered Structures - Tacticity - Crystallinity - Elasticity of Isolated Polymer Chain and of the Network - Rubber Elasticity

UNIT II CHAIN CONFORMATIONS 9

Ideal Chains - Flexibility Mechanisms - Conformation - Chain Models - Radius of Gyration (Linear, Branched and Rod Polymer) - Distribution of End to End Vectors - Free Energy and Pair Correlations of an Ideal Chain - Measure of Size by Scattering - Real Chains - Excluded Volume and Self Avoiding Walks - Deforming Real and Ideal Chains (Polymer Under Tension and Compression, Adsorption of Single Chain) - Temperature Effects on Real Chains (Scaling Model, Flory Theory, Temperature Dependence of the Chain and Second Virial Coeffieient) - Distribution of End to End Vectors - Scattering from Dilute Solutions

UNIT III THERMODYNAMICS OF SOLUTIONS AND BLENDS 9

Thermodynamics of Mixing - Entropy and Energy of Biniary Mixing - Equilibrium and Stability - Phase Diagram - Mixtures at Low Compositions (Osmotic Pressure and Polymer Melts) - Experimental Investigations of Biniary Mixtures - Polymer Solutions - Theta and Poor Solvent - Good Solvents (Correlation Length and Chain Size and Osmotic Pressure) - Semidilute Theta Solutions (Correlation Length and Osmotic Pressure) - Alexander De Gennes Brush Theory - Multi Chain Adsorption - Measuring Semidilute Chain Conformations

UNIT IV NETWORKS AND GELATION 9

Random Branching and Gelation - Introduction - Branching without Gelation - Gelation Concepts and Definitions - Mean Field Model of Gelation (Gel Point, Sol-Gel Fractions, Number and Weight Average Molar Mass Below the Gel Point, Molar Mass Distribution, Size of Ideal Randomly Branched Polymers) - Scaling Model of Gelation (Molar Mass Distribution and Gel Fraction, Cut-off Functions, Size and Overlap of Randomly Branched Polymers) - Characterization of Branching and Gelation - Networks and Gels - Thermodynamics of Rubbers (Flory Construction) - Unentangled and Entangled Rubber Elasticity - Swelling of Polymer Gels - Networks in the Gelation Regime - Linear Visco Elasticity

UNIT V POLYMER DYNAMICS 9

Unentangled Polymer Dynamics - Intrinsic Viscosity - Relaxation Modes - Semi Dilute Unentangled Solutions - Modes of Semi Flexible Chains - Temperature Dependence of Dynamics - Dynamic Scattering - Entangled Polymer Dynamics - Entanglements in Polymer Melts - Reptation in Polymer Melts and Semi Dilute Solutions - Dynamics of Single Entangled Chain - Many Chain Effects - (Constrained Release) - Computer Simulations in Polymer Physics

TOTAL : 45 PERIODS

REFERENCES

1. M. Rubinstein and R. H. Colby, Polymer Physics, Oxford University Press, USA, 2003
2. D. I. Bower, An Introduction to Polymer Physics, Cambridge University Press, UK, 2002
3. G. Strobl, The Physics of Polymers, Springer, New York, 2007
4. Ulf W. Gedde, Polymer Physics, Kluwer Academic Publishers, Netherlands, 2001

PO7211 POLYMER PROCESSING AND TESTING LABORATORY L T P C
0 0 6 3

OBJECTIVES

- To enable students to knowthe processing of polymers and testing of plastics etc.,
- To know the importance of thermal, electrical and optical properties of the polymeric materials.
- To understand the basic concepts of Identification**,** characterization, flammability and analytical testing of polymers.

OUTCOME

- Will be able to develop methods for processing of polymers and testing of plastics etc.
- Will be able to discuss thermal, electrical and optical properties of the polymeric materials.
- Will be able to recognize the basics in analytical testing of polymers.

UNIT I PROCESSING OF POLYMERS

Processing of polymers – principles of compounding and processing for the manufacture of plastics and rubber products- injection, blow and compression moulding, extrusion, calendaring and casting processes.

UNIT II TESTING OF PLASTICS

Testing of plastics and dry rubber products – mechanical properties – tensile, Flexural, compressive, impact, hardness, abrasion and fatigue resistance tests.

UNIT III THERMAL PROPERTIES

Thermal properties – thermal conductivity, thermal expansion and brittleness temperature, heat deflection temperature.

UNIT IV ELECTRICAL PROPERTIES

Electrical properties – dielectric strength, dielectric constant and dissipation factor. Electrical resistance tests - arc resistance.

UNIT V OPTICAL PROPERTIES

Optical properties – refractive index, transmittance and haze, gloss.

UNIT VI MATERIAL CHARACTERIZATION

Material characterization tests – thermoplastics – MFI, capillary rheometer test – thermosets – apparent (bulk) density, bulk factor, pourability, viscosity (Brookfield), gel time and peak exothermic temperature.

UNIT VII FLAMMABILITY TESTS

Flammability tests – oxygen index test, ignition temperature determination.

UNIT VIII ANALYTICAL TESTS

Analytical tests – specific gravity, density, water absorption, moisture analysis.

UNIT IX ANALYSIS OF PLASTICS

Identification and analysis of plastic and dry rubber materials – chemical and thermal analysis for identification of polymers.

TOTAL : 90 PERIODS

REFERENCES

1. R.P. Brown (Ed), Handbook of Plastics Test Methods, 2nd edition, George Godwin, 1988.
2. W.E. Brown (Ed), Testing of Polymers, Vol. 4, Wiley –Interscience, New York, 1969.
3. J.V. Schmitz (Ed) Testing of Polymers, Vol. 1 –3 , Wiley – Interscience, New York, 1965, 1966, 1968.
4. G.C. Ives, J.A. Mead and M.M. Riley, Handbook of Plastics Test Methods, Illith Publishers, London, 1982,
5. J. Haslam, H.A. Willis and D. Squirrell, Identification and Analysis of Plastics. 2nd Edn.,Iliffe Book, Butterworth, London, 1983.

PO7001 ADHESIVE SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To bring a sound knowledge of theoretical and technological aspects of mechanism and characterization of adhesives.
- To understand the various types of Adhesives employed in Industries.
- To acquire knowledge of Applications of adhesives in various fields.

OUTCOME

- Will be able to attain the basic knowledge of adhesives.
- Will be able to comprehend the utility of adhesives in industry.
- Will develop capacity to apply adhesives in various fields.

UNIT I ADHESION MECHANISM 9

Definition and mechanisms of adhesion- mechanical interlocking – inter-diffusion theories – adsorption and surface reaction. Surface topography, surface features and forces, wetting and setting, thermodynamic work of adhesion – influence of constitution on adhesion – interfacial bonding – coupling agents.

UNIT II CHARACTERIZATION OF ADHESIVES 9

Principle of fracture mechanics, peel, Lap sheen and Butt tensile tests. Pull out of an extendable fibre, various testing and evaluation of adhesives, energy dissipation – plasticity – strength of elastomers.

UNIT III INDUSTRIAL ADHESIVE 9

Inorganic adhesives. Principle of compounding – role of resins – fillers – antioxidants – accelerator systems.

UNIT IV ADHESIVE TYPES 9

Adhesive from natural origin - animal glues – casein – starch – cellulosic and bio adhesives. Synthetic adhesives -phenolic resin, epoxy, polysulphide, polyurethane, polyvinyl acetate, polyvinyl alcohol, polyvinyl acetal, acrylics, high temperature silicone adhesives. Water based – pressure sensitive – hot -melt adhesives – anaerobic adhesives.

UNIT V APPLICATIONS OF ADHESIVES 9

Adhesives for building construction, medical use, automobile industry bonded and coated abrasives – fabrics, cyanoacrylate based adhesives, bonding technology for textile, metal, plastics, wood, paper and glass.

TOTAL : 45 PERIODS

REFERENCES

1. W. A. Lees, Adhesives in engineering design, Springer Verlag, Berlin, 1984.
2. D.M. Brewis and D. Briggs, Industrial adhesion problems, Wiley-Interscience Publication, New York, 1985.
3. J. Kinloch, Adhesion and Adhesive Science and Technology, Springer, 1987.
4. I Skeist, 3rd Edition, Handbook of Adhesives, Van Nostrand Reinhold, New York, 1990
5. A.V. Pocius, Adhesion and Adhesives Technology, Hanser, 2002
6. P. Ghosh, Adhesives and Coatings Technology, Tata-McGraw-Hill Publishing Company Limited, New Delhi, 2008.

PO7002 RUBBER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To acquire knowledge in the Fundamentals of Rubber and Specialty Rubbers.
- To know about the Processing of Rubber and Manufacture of tyres and Tubes.
- To impart knowledge on rubbers used in Belting, hoses and Footwear.

OUTCOME

- Will be aware of preparation and properties of rubbers.
- Will be conversant in manufacture and properties of tyres and Tubes.
- Will develop capacity to appreciate the applications of rubber.

UNIT I FUNDAMENTALS OF RUBBER 8

Criteria for a polymer to behave as a rubber – structure vsTg, chemical, mechanical and electrical properties – polymerization types and techniques involved in production of general purpose rubbers – ozone attack on rubbers– protection against oxidation - antioxidants – network bound antioxidants, vulcanization – mechanism of sulphur cure- effect of crosslink density on properties – role of accelerators, activators – non–sulphur vulcanization systems

UNIT II SPECIALTY RUBBERS 10

Heat resistant rubbers –polyisobutylene, butyl and EPDM rubbers – solvent/oil resistant rubbers –nitrile, neoprene and chloroprene rubbers, EMA,ACM, EVA – hypalon and chlorinated PE – high performance, specialty and modified rubbers – fluorine containing and silicone rubbers, polyurethanes , polyethers, polysulphide, polyalkenomers and thermoplastic elastomers – reclaim, liquid and powdered rubbers, ebonites.

UNIT III PROCESSING OF RUBBER 8

Rubber processing – mixing operations – composition, concentration, stabilization, coagulation, open mill mixing, internal and continuous mixers – forming operations – calendaring – extrusion –spreading and moulding operations.

UNIT IV MANUFACTURE OF TYRE AND TUBES 7

Rubber product manufacture – tyres – functions, requirements – basic design reinforcing systems –construction – manufacture – aero tyres – building and curing of passenger car tyre, truck tyre, four wheeler tyre - testing – Defects and remedial measures - tube manufacture– compounding for tyre and tube.

UNIT V BELTING, HOSES AND FOOTWEAR 12

Belting and hoses – conveyor, transmission (V and flat) belting. troughing moulded, braided and hand–built hoses – compounding - footwear and ports goods – hot air vulcanized – compression moulded – direct molded process for shoe bottoming – injection moulded sole and heel units – safety and antistatic foot wear – micro and macrocellular rubbers – expanding rubber by nitrogen gassing and chemical blowing agents– tennicoit rings

TOTAL : 45 PERIODS

REFERENCES

1. M.Morton, Rubber Technology, Van Nostrand Reinhold, 1987.
2. A.K. Bhowmick and H.L.Stephens, Hand Book of Elastomers, Marcel Dekker, New York, 1988.
3. J. A. Brydson, Rubbery Material and their Compound', Kluwer Academic Publishers Group, 2001.
4. C. M. Blow and C.Hepburn, "Rubber Technology and Manufacture",2rd Edn.,Butterworths, London, 1982.
5. Whelan, Injection Moulding Machine, Elsevier Publications, London, 1989.
6. Kothandaraman, Rubber Materials, Ane Books Pvt. Ltd., New Delhi, 2008.
7. J.M. Martin, W.K.Smith, Handbook of Rubber Technology, Vol. 1 & 2, CBS Publishers & Distributors, 2004.

PO7003	TYRE TECHNOLOGY	L T P C 3 0 0 3

OBJECTIVES

To learn about types of tyres, design and fabrication of tyre

OUTCOME

Understanding of the various components used and their functions in tyres, designing and suitable compounding formulation for various tyre components and quality control in tyres

UNIT I HISTORY AND TYPES OF TYRES 9

A Historical Introduction on the Design and Development of Tyres- Current Status of Tyre Industry in India and Its Future Prospectus- Tyre Sizing and Marking on the Tyres - Various Kinds and Types - Bias - Bias Belted Radial - Tube Type and Tubeless Tyres - Basic Features and Performance Comparison

UNIT II BASICS 9

Tyre Terminology **-** Different Components of Tyre - Geometry - Basic Functions - Functions of a Pneumatic Tyre - Load Carrying - Vibration and Noise Reduction - Tyre Function as a Spring - Contribution to Driving Control and Road Adhesion - Tyre Friction Contribution to Driving Control - Steering Control and Self Aligning Torque

UNIT III MANUFACTURING OF TYRES 9

Manufacturing Techniques of Various Tyres like Two Wheeler and Car Tyres - Truck Tyres - OTR - Farm Tyres - Aircraft Tyres - Principles of Designing - Formulations for Various Rubber Components - Tyre Reinforcement Materials (Textile, Steel, Glass Etc.) - Criteria of Selection - Different Styles and Construction - Textile Treatment - Tyre Mould Design - Green Tyre Design Principles - Methods of Building Green Tyres for Bias - Bias Belted - Radial and Tube Less Tyres - Green Tyre Treatments

UNIT IV QUALITY CONTROL, TUBES AND MACHINERIES 9

Tyre Curing Methods - Post Cure Inflation - Quality Control Tests - Tyre Related Products - Design and Manufacturing Techniques - Tubes - Valves - Flaps and Bladders - Different Types - Feature and Operation of Tyre Building Machines - Bead Winding Machine - Wire/Glass Processing Machines - Bias Cutters - Curing Presses

UNIT V TESTING AND STANDARDS OF TYRES 9

Measurement of Tyre Properties - Dimension and Size-Static and Loaded - Tyre Construction Analysis - Endurance Test Wheel and Plunger Tests - Traction - Noise Measurements - Cornering Coefficient Aligning Torque Coefficient - Load Sensitivity and Load Transfer Sensitivity - Rolling Resistance - Foot Print Pressure Distribution - BIS Standards For Tyres - Tubes and Flaps

TOTAL : 45 PERIODS

REFERENCES

1. Samuel K. Clark, Mechanics of pneumatic Tyres, National Bureau of standards, Monograph, US Govt. printing office, 1971
2. Tom French, Tyre Technology, Adam Hilger, New York, 1989
3. F.J. Kovac, Tyre Technology, 4th edn., Good year Tyre and Rubber Company, Akron, 1978.

PO7004 **SYNTHETIC RESINS** **L T P C**
3 0 0 3

OBJECTIVES

- To acquire knowledge on the classification of natural, synthetic polymers and its commercial applications**.**
- To understand the basic concepts of water soluble polymers and its applications in various fields.
- To understand the concepts of thermoplastics and thermosetting resins, the importance of rubbers, fibers and plastics and their engineering applications.

OUTCOME

- Will be aware of classification of polymers
- Will develop capacity to appreciate the applications of natural and synthetic polymers.

UNIT I CLASSIFICATION OF POLYMERS 10

Introduction – Classification of natural, modified and synthetic polymers – effect of structure on properties of polymers –– Salient features of plastics-water soluble polymers– classification- functions and properties – starch - dextrinization – modified starches – cellulose and its derivatives- commercial Applications.

UNIT II WATER SOLUBLE POLYMERS 10

Synthetic water soluble polymers, preparation, properties and applications of polyvinyl alcohol – polyvinylpyrrolidone – polyacrylic acid and its homolog's – polyacrylamide – polyethylene oxide – polyethylene mine. Application of water soluble polymers in pharmaceuticals – cosmetics – textiles – paper – detergents and soaps – paint – flocculation – beverages – polyelectrolyte's.

UNIT III THERMOPLASTIC RESINS 10

Thermoplastic resins – polyolefins – vinyl polymers – poly vinyl chloride-polystyrene – PMMA – SAN – PAN - Teflon – polyamides – polycarbonates and their applications.

UNIT IV THERMOSETTING RESINS 10

Thermosetting resins – phenolic resins – aminoplast – UF- MF - polyesters – alkyd resins – epoxies – bisphenol-A and cycloaliphatic based epoxy resins - polyurethanes and polyureas – silicone resins.

UNIT V RUBBERS, FIBERS AND PLASTICS 5

Elastomers – natural rubber – vulcanization - synthetic rubbers - butyl- SBR neoprene. Application of synthetic resins as fiber – commodity plastics – sheets and film – foam – packaging – biodegradable and engineering applications.

TOTAL : 45 PERIODS

REFERENCES

1. J.A. Brydson, Plastics Materials, Newness - Butterworths, Seventh Edn, London, 1999.
2. R.L.Davidson and S. Marshall, Water Soluble Resins, Van-Nostrand Reinhold, New York, 1988.
3. R.B. Seymour and C.E.Carraher, Jr., Polymer Chemistry – An Introduction, Marcel Dekker Inc., New york, 2006.
4. Maurice Morton, Rubber Technology, Van Nostrand Reinhold, New York, 2002**.**

PO7005 **SURFACE COATINGS AND PAINT TECHNOLOGY** **L T P C**

OBJECTIVES:
To learn about the coating materials and their applications

OUTCOME:
Familiarization of the formulations of various types of coating materials and evaluation of properties of surface coatings and paints

UNIT I INTRODUCTION 10

Introduction to Surface Coatings - Components of Paints - Pigments - Pigment Properties - Different Types - Extenders - Solvents - Oils - Driers - Diluents - Lacquers - Varnishes - Paint Preparation - Formulation - Factors Affecting Pigment Dispersion - Preparation Of Pigment Dispersion

UNIT II PAINT FORMULATION AND PROPERTIES 10

Essential Concepts of Paint Formulation and Paint Properties - Paint Preparation (Pigment Dispersion) - Surface Preparation and Paint Application - Paint Properties and Their Evaluation - Mechanism of Film Formation - Factors Affecting Coating Properties - Methods Used for Film Preparation and Their Properties- Mechanism of Film Formation - Barrier Properties and Corrosion - Mechanical Properties - Aging Properties - Rheological Properties - Adhesion Properties and Other Related Properties

UNIT III CLASSIFICATION AND APPLICATIONS 10

Different Types of Paints - Classification Based on Polymeric Resin - Emulsion - Oil and Alkyd Paints - Acrylic Paints - Epoxy Coatings - Polyurethane - Silicones - Chlorinated Rubbers - Fluoropolymers - Vinyl Resins - Classification Based on Application - Appliance Furnishes - Automotive Finishes - Coil Coatings - Can Coatings - Marine Coatings - Aircraft Coatings

UNIT IV MATHEMATICS OF PAINT FORMULATION 10

Mathematics of Paint Formulation - Formulations of Coatings as Finishes (Automotive Appliances, Coil, Can, Marine, Aircraft Etc) and for Various Substrates (Steel, Timber, Masonry, Plastics Etc.) - State of the Art Technologies - Specialty Coatings (Radiation Curable, Nonpolluting, Powder, High Solids Etc.)

UNIT V WATER BORNE COATINGS 5

Water - Borne Coatings - Fundamental Constituent of Water-Borne Coatings - Types of Aqueous Coatings Systems - Binders in Water-Borne Coatings - Additives in Water-Borne Coatings - Pigments and Fillers - Action of Amines and Auxiliary Solvents - Manufacture of Water-Borne Coatings

TOTAL : 45 PERIODS

REFERENCES

1. W.M. Morgans, Outline of Paint Technology, 3rd edn., John Wiley and Sons, New York, 1990
2. Dieter Stoye, Werner Freitag, Editors, Paints, Coatings and Solvents, 2nd edn., Wiley VCH, New York, 2001
3. R. Woodbridge, Editor, Principles of Paint Formulation, Blackie, 1991
4. K. Doren, W. Freitag, D. Stoye, Water-Borne Coatings: The Environmentally-Friendly Alternative, Hanser Publications, Munich, 1994

3 0 0 3

OBJECTIVES

- To introduce the textile process and also teach about Manufacture of fibre forming polymers.
- To make the student conversant with the Manufacture of filament fibre and Manufacture of Staple fibre.
- To teach Texturization.

OUTCOME

- Will be up to date with the preliminary preparation of fibers.
- Will have clear understanding of the concept of dyeing.
- Will be familiar the machinery and stages involved in textile processing.

UNIT I INTRODUCTION TO TEXTILE PROCESS 5

Classification of fibres, yarn manufacture, fabric manufacture, wet processing of textile, testing of textile materials.

UNIT II MANUFACTURE OF FIBRE FORMING POLYMERS 15

Polymer production - fibre forming polymers – properties, characterization - production of polyethylene terephthalate (PET), polyester, nylon, polyacrylonitrile and polypropylene.

UNIT III MANUFACTURE OF FILAMENT FIBRE 15

Filament fibre manufacture - melt, wet and dry spinning of polymers- spin finishes – functions, constitution and application - post spinning operations – drawing and winding.

UNIT IV MANUFACTURE OF STAPLE FIBRE 5

Staple fibre manufacture - production of staple fibres – drawing of tow, heat setting, crimping and cutting - tow to top converters – advantages, principles and working of machines.

UNIT V TEXTURIZATION 5

Texturization - introduction, methods, false twist texturing, air jet texturing, comparison.

TOTAL : 45 PERIODS

REFERENCES

1. A.A.Vaidya, Production of Synthetic Fibres, Prentice Hall of India Pvt. Ltd., New Delhi 1988.
2. V.B.Gupta and K.K.Kothari (Ed), Man-made Fibres Production, Processing Structure, Properties and Applications, Vol. I and II, Dept. of Textile Technology, IIT, New Delhi 1988.
3. H.F. Mark,S.M.Atlas and E.Cernia (Ed), Man-made Fibres -Science and Technology, Vol . I to III, Interscience publishers, New York, 1987.
4. V.Usenko, Processing of Man-made Fibres, MIR publishers, Moscow, 1985.
5. MenachemLewin and Eli M.Pearce, (Ed), Hand book of Fibre Science and Technology, Vol IV Fibre chemistry, Marcel Dekker Inc., New York, 1985.
6. T.Nakajima, Advanced Fibre Spinning Technology, Wood head, S.B. Leed, 1994.
7. S.B. Warner, Fibre science, Prentice Hall, 1995.

PO7007 CONDUCTING POLYMERS L T P C

3 0 0 3

OBJECTIVES

- To acquire a knowledge of chemistry on conducting polymers and its conductivity.
- To understand the basic concepts of synthesis, processing and applications of conducting polymers.
- To impart knowledge on spectral, morphological,thermal, mechanical and electrochemical characterization of conductive polymers.

OUTCOME

- Will get a basic idea about conducting polymers.
- Will be able to synthesise conducting polymers.
- Will be able to characterize and analyse the properties of conducting polymers.

UNIT I ELECTROCHEMISTRY OF CONDUCTING POLYMER 9

Electrochemistry of electronically conducting polymers-source of electronic conduction in polymers – solitons, polarons and bipolarons – Doping – measurement of conductivity – van der Pauw technique – factors affecting conductivity.

UNIT II SYNTHESIS, PROCESSING AND APPLICATIONS OF CONDUCTING POLYMERS 12

Synthesis of conducting polymers – chemical, electrochemical and enzymatic methods – Synthesis, processing methods and applications of polyacetylene, polyaniline, polypyrrole, polythiophene and poly-paraphenylene based conducting polymers.

UNIT III ELECTROCHEMICAL CHARACTERIZATION OF CONDUCTING POLYMERS 7

Electro-analytical techniques – cyclic voltammetry, chronoamperometry and chrono-coulometry

UNIT IV SPECTRAL AND MORPHOLOGICAL CHARACTERIZATION OF CONDUCTING POLYMERS 9

FTIR, UV-vis, Raman, XRD, SEM, TEM and NMR

UNIT V MECHANICAL AND THERMAL CHARACTERIZATION OF CONDUCTING POLYMERS 8

UTM, Dilatometry, TGA, DTA, DSC and DMA

TOTAL : 45 PERIODS

REFERENCES

1. T.A. Skotheim, R.L. Elsenbaumer and J.R. Reynolds, Hand book of Conducting Polymers – 2nd Edn, Revised and enlarged, Marcel Dekker
2. Inc., New York, 2007.
3. J.M. Margolis (Ed.), Conducting Polymers and Plastics, Chapman and Hall, London, 1989.
4. R.B. Seymour, edr.,Conductive Polymers", Plenum Press, New York, 1981.
5. B. Wessling, Electronic Properties of Conjugated Polymers, Vol.3, Springer, Berlin, 1989.
6. H.G. Kiess (Edr.), Conjugated Conducting Polymers, Springer, Berlin, 1992.
7. D.S.Soane and Z. Martynenko (Eds.), Polymers in Microelectronics, Elsevier, Amsterdam, 1989.

PO7008 ENGINEERING PLASTICS L T P C
3 0 0 3

OBJECTIVES

- To acquire knowledge of polymers meant forelectrical, electronics and high temperature applications.
- To impart basic knowledge on polymer blends, alloys and liquid crystals.
- To gain knowledge of polymers in lithography, water treatment and biomedical applications

OUTCOME

- Will be able to apply polymers to electrical, electronics and high temperature fields.
- Will understand polymer blends, alloys and liquid crystals.
- Will appreciate the application of polymers in a variety of fields.

UNIT I POLYMERS FOR ELECTRICAL AND ELECTRONICS APPLICATIONS 10

Engineering plastics – polymers in electrical and electronics industry – electro conducting polymers – polymer batteries – electrets - polymers with piezoelectric, pyroelectric and ferroelectric properties-photo conducting polymers.

UNIT II POLYMERS FOR HIGH TEMPERATURE APPLICATIONS 10

Polymers for high temperature resistance– fluoro polymers – aromatic polymers– heterocyclic polymers – polymers as building materials – ultrahigh fibres – aramids – technora – carbon fibres.

UNIT III POLYMER BLENDS, ALLOYS AND LIQUID CRYSTALS 10

Polymer blends and alloys – reinforced plastics – ionic polymers –interpenetrating networks – sequential – simultaneous – full and semi IPN – thermoplastic IPN – liquid crystalline polymers (LCP) – lyotropic and thermotropic liquid crystals – main chain and side chain liquid crystalline polymers–processing of LCP's- applications –ablative plastics.

UNIT IV POLYMERS IN LITHOGRAPHY AND WATER TREATMENT 10

Polymers in lithography – photoresist – positive resists – negative resists – solution inhibition resists – image reversal process – Ion exchange resins – polymer membrane – polymer complexes for water treatment.

UNIT V POLYMERS FOR BIOMEDICAL APPLICATIONS 5

Polymer for biomedical applications – polymers in dentistry – tissue adhesives – dialysis membrane – blood oxygenators – bone cement – prostheses – biodegradable sutures – control drug delivery systems.

TOTAL : 45 PERIODS

REFERENCES

1. H.F. Mark (Ed), Encyclopedia of Polymer Science and Engineering, Wiley – Interscience, New York, 1991
2. L.L. Chapoy (Ed), Recent Advances in Liquid Crystalline Polymers, Chapman and Hall, London, 1985.
3. R.W. Dyson, Specialty Polymers, Blackie Academic & Professional, London, (second edition) 1998.
4. C.P.Wong, Polymers for Electronic and Photonic Applications, Academic Press, New York, 1993.

PO7009 **PLASTIC WASTE MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

- To make the student familiar with the polymer wastes and primary and secondary recycling.
- To acquaint the student with tertiary and quaternary recycling, recycling of plastics.
- To introduce to students with recycling of plastics.

OUTCOME

- Will be aware of plastics waste management.
- Will develop techniques for recycling of plastics.
- Will develop concern for environment and develop skills to address the same

UNIT I POLYMER WASTES 9

Sources of plastics waste – definitions - generation of industrial plastic waste - plastic in solid waste; Separation of components in municipal refuse - separation process specific to plastics- legal aspects.

UNIT II PRIMARY AND SECONDARY RECYCLING 9

Primary recycling – degradation of plastics – industrial practice; Secondary recycling – approaches to secondary recycling – mechanical reworking of plastic waste – chemical modification of mixed plastic waste – co-extrusion and co-injection moulding – waste plastics as fillers.

UNIT III TERTIARY AND QUATERNARY RECYCLING 9

Tertiary recycling – chemicals from plastics waste – pyrolysis chemical decomposition of plastic waste; Quaternary recycling energy from plastics waste – incinerator – effect of plastics on the incineration process – plastics as land refill- blending of plastics waste with asphalt.

UNIT IV RECYCLING OF PLASTICS 9

Recycling of plastics – surface refurbishing; Plastics aging – environmental aging – thermal aging – weathering – chemical degradation – ionizing radiation – wear and erosion; Biodegradation – biodegradable plastics – photodegradable plastics.

UNIT V RECYCLING PROCESSES 9

Specific recycling processes –PET reprocessing – polyolefines – polystyrene – PVC – acrylics; Thermosets – PURS – phenolics – polyesters – epoxy resins – melamine and urea resins – recycling technologies

TOTAL : 45 PERIODS

REFERENCES

1. Nabil Mustafa, Plastics Waste Management: Disposal, Recyling and Reuse, Marcel Dekker Inc., New York, 1993.
2. R. J. Ehrig, Plastic recycling: Products and Processes, Hanser Publishers, New York, 1992.
3. Jacob Leidner, Plastic waste: Recovery of Economic Value, Marcel Dekker Inc., New York, 1982.
4. John Scheirs, Plastics Recycling, John Wiley and Sons, New York, 1998.
5. Ann Christine, Albertsson and Samuel J. Huang, Degradable Polymers: Recycling of Plastics, Marcel Dekker Inc., New York, 1995.

PO7010 POLYMER NANOCOMPOSITES L T P C

3 0 0 3

OBJECTIVES

- To learn about the basic concepts in synthesis, processing and applications of polymer nanocomposites

OUTCOME

- On completion of the paper the student should be able to demonstrate knowledge and understanding in the basics, properties, rheology, processing and structural aspects of polymer nanocomposites

UNIT I BASIC AND PREPARATION OF NANOCOMPOSITES 10

Morphology of Polymer Layered Silicate Nanocomposites - Structure of Layered Silicates - Organically Modified Clay - Formation of Polymer Nanocomposites - Effect of Cation Exchange Capacity on Organo Clay - Effect of Organic Cation Structure Organo Clay - Preparation and Synthesis - Solution Dispersion - In-Situ Polymerization - Melt Intercalation - Effect of Mixing

UNIT II PROPERTIES OF NANOCOMPOSITES 10

Thermodynamics and Interactions - Multi Component Systems - Surface Free Energy - Types of Interfacial Interactions - Models of Nanocomposites at Equilibrium - Mixing in Nanocomposite Synthesis - Mechanics of Particle Separation and Agglomerate Dispersion - Crystallization of Polymers in Nanocomposites

UNIT III RHEOLOGY OF NANOCOMPOSITE 10

Rheology of Multi Phase Systems and Polymer / Clay Nanocomposites - Steady Shear Rheology - Dynamic Rheology - Non Linear Viscoelastic Properties - Extensional Rheology - Extensional Rheology

UNIT IV PROCESSING OF NANOCOMPOSITES 10

Extrusion - Dispersion of Clay - Effect of Extruder Types - Effect of Processing Conditions - Injection Molding - Blow Molding - Foaming - Rotational Molding

UNIT V STRUCTURE AND PROPERTIES CHARACTERIZATION 5

Ultra Violet Spectroscopy - Fourier Transform Infrared Spectroscopy - Nuclear Magnetic Resonance Spectroscopy - X-ray Scattering Studies - Electron Microscopy Studies - Chromatography - Dynamic Mechanical Analysis - Differential Scanning Calorimetry - Thermogravimetric Analysis - Heat Distortion Temperature - Cone Calorimetry

TOTAL : 45 PERIODS

REFERENCES

1. S. N. Bhattacharya, M. R. Kamal, R. K. Gupta, Polymeric nanocomposites: theory and practice, Hanser Publications, Munich, 2008
2. R. K. Gupta, E. Kennel, K. Kim, Polymer Nanocomposites Handbook, CRC Press, New York, 2010
3. J. Koo, Polymer Nanocomposites, McGraw Hill Professional, 2010

PO7011 BIOPOLYMERS AND BIODEGRADABLE POLYMERS L T P C
3 0 0 3

OBJECTIVES

- To acquire knowledge on synthetic biodegradable polymers and its applications.
- To gain knowledge on principles of biodegradation and disposal of municipal waste.
- To study about the biopolymers and their structures.

OUTCOME

- Will be concerned for environment by synthesizing synthetic biodegradable polymers.
- Will be able to methodically discuss importance of waste management.
- Will develop capacity to comprehend biopolymers and their application.

UNIT I SYNTHETIC BIODEGRADABLE POLYMERS 11

Biodegradable polymers - polyε-caprolactone- modified poly ε-caprolactone copolymer with ester, amide and urethane linkages, polyglycolate, polymandelic acid. Copolymer of 1,4-butanediol with adipic acid and sebacic acid, polyalkylene tartrate cellulose block copolymers -biodegradable polyamides –copolymers of α- amino acid (glycine, serine), ε-aminocaproic acid. Benzyl substituted urethane – polyester urea – polyamide urethane - synthesis and properties. γ -polyglutamic acid, bacterial polyesters. Applications – agriculture, medicine, packaging.

UNIT II PRINCIPLES OF BIODEGRADATION 9

Biodegradation -introduction – modes of biological degradation –enzymatic degradation of biopolymers (poly saccharides, proteins, nucleic acids) and synthetic polymers - microbial degradation of synthetic polymers.

UNIT III DISPOSAL OF MUNICIPAL WASTE 8

Disposal of solid municipal waste by biodegradation – composting (bioreactors) deposition in landfills – microbial decomposition processes in anaerobic rubbish dumps. Ideal bioreactors – stirred tank reactor – Batch and continuous operations – Fed - Batch operation - plug flow reactor.

UNIT IV BIOPOLYMERS 8

Biopolymers - introduction – functions – cotton, wool, paper, rubber, collagen hyaluroran-melanin for UV protection –Applications.

UNIT V STRUCTURE OF BIOPOLYMERS 8

Proteins, nucleic acids and polysaccharides – the macromolecular structure and biological functions of polymers- primary, secondary, tertiary and quaternary structure of polymers – structure maintenance and transmission of the biological information- structure and enzymatic activity – mechano structural function of biopolymers- viruses and phages – living macromolecules.

TOTAL : 45 PERIODS

REFERENCES

1. J.Guillet, Polymers and Ecological problems, Plenum Press, New York, 1973.
2. W.Schnabel, Polymer Degradation – Principles and Practical Applications, Hanser International, 1982.
3. L.L.Hench, E.C. Ethridge, Biomaterials – An Interfacial Approach, Biophysics and Biotechnology Series, Vol 4, Academic Press, New York, 1982.
4. Jens Nielsen, John Villadsen and Gunnar liden, Bioreaction Engineering Principles, 3rded, Springer. 2011.
5. Charles Gebelein, Biotechnological Polymers: Medical, pharmaceutical and industrial applications, CRC press,1993

PO7012 SPECIALITY AND HIGH PERFORMANCE POLYMERS L T P C
3 0 0 3

OBJECTIVES

- To learn about the synthesis, properties and applications of specialty polymers

OUTCOME

- Understanding of the synthesis, manufacture, properties and special applications of silicones, high performance polymers, dendrimers and template polymerization will be the outcome after studying this paper

UNIT I SILICONE POLYMERS 9

Synthesis and Manufacture - Chlorosilanes - Silsesquioxanes - Hydrogen Silsesquioxanes - Alkoxy Siloxanes - Epoxy modified Siloxanes - Silaferrocenophanes - Chemical Modifications - Curing by Condensation - Condensation Crosslinking - Peroxides - Hydrosilylation Crosslinking - Silicone Rubber - Properties - Thermal - Electrical - Surface Tension - Antioxidants - Gas Permeability - Weathering - Applications and Uses

UNIT II TEMPLATE POLYMERIZATION 9

Mechanism of Template Polymerization - Template Polycondensation - Chain Template Polymerization - Template Copolymerization - Polyacids, Polyimines, Polyamines, Poly(ethylene oxide), Poly(vinyl pyrrolidone), Poly(methyl methacrylate), Poly(vinylopyridines) as Templates - Ring Opening Template Copolymerization - Radical Template Copolymerization

UNIT III HIGH PERFORMANCE POLYMERS - I 9

Carbazole Polymers - N-Vinylcarbazole - Polymerization and Fabrication - Properties and Applications - Poly(p-xylylene)s - Monomers - Polymerization and Fabrication - Properties and Applications - Poly(arylene vinylene)s - Monomers - Polymerization and Fabrication - Properties and Applications

UNIT IV HIGH PERFORMANCE POLYMERS - II 9

Poly(arylene ether nitrile)s - Halogenated Benzonitriles - Aromatic Hydroxy Compounds - Polymerization and Fabrication - Electrophilic and Nucleophilic Route - Properties and Applications - Triazole Polymers - Polymerization and Fabrication - Properties and Applications - Poly(oxadiazole)s - Monomers - Polycondensation - Anionic Polymerization - Sulfonation - Properties and Applications

UNIT V DENDRIMERS 9

Dendritic Branching Concepts - Historical Overview - Dendritic Polymers - Random Hyperbranched Polymers - Dendrigraft (Arborescent) Polymers - Synthesis - Divergent and Convergent Methods - Dendrimer Features - Dendrimer Shape Changes - De Gennes Dense Packing - Comparison of Traditional and Dendritic Polymer Properties - Monodispersity - Unimolecular Container/Scaffolding Properties - Amplification of Terminal Surface Groups - Persistent Nanoscale Dimensions and Shapes – Megamers

TOTAL : 45 PERIODS

REFERENCES

1. J. K. Fink, Reactive Polymers Fundamentals and Applications, William Andrew Publishing, New York, 2005
2. S. Polowinski, Template Polymerization, ChemTec Publishing, Canada, 1997
3. J. K. Fink, High Performance Polymers, William Andrew Publishing, New York, 2008
4. J. M. J. Frechet, D. A. Tomalia, Editors, Dendrimers and Other Dendritic Polymers, John Wiley and Sons Ltd., UK, 2001

PO7013 **DIE AND MOULD TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

- To learn about die and mold parts and their design

OUTCOME

- Understanding the basic principle of product design, classification of the dies and selection of suitable materials for dies will be the outcome

UNIT I PRODUCT DESIGN 9

Orthographic Projection - Projection of Solids - Vertical and Horizontal Surfaces - Inclined Surfaces - Curved Surfaces - Sectional Views and Assembly Drawing - Basic Principles - Shrinkage - Flash Lines - Undercuts - Suggested Wall Thickness - Draft - Tolerance - Moulded Holes - Threads -Radius - Moulded Hinges - Integral Hinge - Snap Fits - Product Design Thumb Rules - Case Studies and Product Design

UNIT II SCREW DESIGN 9

Extrusion Die Design - Construction Features of an Extruder - Process - Characteristics of Polymer Melt - Die Geometry - Die Head Pressure - Characteristics of Land Length to Profile Thickness - Extrudate Die Swell - Die Materials - Classification of Dies - Dies for Solid Section - Dies for Hollow Profiles - Blown Film Dies - Flat Film Dies - Parison Dies - Wire and Cable Coating Dies - Spiral Mandrel Die - Fish Tail Die - Adjustable Core Die

UNIT III MOULD DESIGN 9

Parting Line - Construction of Core and Cavity - Types of Gate - Types of Ejection - Mould Temperature Control - Cooling - Mould Alignment Mould Anciliary Parts - Types of Moulds - Two Plate - Three Plate - Split Moulds - Machine Selection - Principles of Shrinkage Allowances - Materials for Mould Parts - Life of Mould - Mould Maintenance - Case Studies on Mould Design -Injection Moulds for Threaded Components - Automatic Unscrewing - Various Unscrewing Methods

UNIT IV MOULD MAKING 9

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) - Die Sinking (Copy Milling) - Pentograph - Profile Grinding - Electrical Discharge Machining - Characteristics - Physical Processes - Special Technological Features - Types of EDM - Design Consideration and Functions and Technological Planning - Applications of Wire Cut EDM in Mold Making

UNIT V ELECTROFORMING FOR MOLD MANUFACTURING 9

Materials for Electroforming - Design and Materials for Models - Machining for Electroformed Blanks - Mold Cavities - Economy and Service Life - Hobbing Process for Mold Making - Advantages - Elements of Hobbing - Materials Used for Cavity - Lubrication - Depth of Hobbing - Hobbing Presses - Operations - Polishing Technology in Mold Making - Definition of Surface Roughness - Basis of Polishing Technology - Types of Polishing Tools - Methods of Polishing - Surface Texturing - Process Description - Patterns and Mold Shapes - Mold Preparation - Limitations of Chemical Texturing

TOTAL : 45 PERIODS

REFERENCES:

1. R.G.W. Pye, Injection Mould Design for Thermoplastics, Published for The Plastics Institute [by] Iliffe, 1968
2. J. B. Dym, Injection Molds and Molding: A Practical Manual, 1987
3. H. Gastrow, Injection Moulds - 102 Proven Design, Hanser, 1983
4. G. Mennig, K. Stoeckert Klus Stokhert, Editors, Mold making handbook, Hanser Publications, New York,1998

PO7014 POLYMER BLENDS AND ALLOYS L T P C

3 0 0 3

OBJECTIVES:

To learn about the polymer miscibility and polymer interaction in various types of polymer blends and alloys

OUTCOME:

On completion of the paper the student should be able to demonstrate knowledge and understanding in the blends of various polymers, its solubility parameter, compatibility and phase separation

UNIT I INTRODUCTION 9

Definition for Blends - Alloys and Copolymers - Reason for Blending - Classification of Polymer Blends - Methods of Blending - Selection Criteria of Blending - Design of Polymer Blends - Polymer Miscibility **-** Introduction - Miscible Blends and Immiscible Blends - Difference Between Miscible and Immiscible Blends - Properties of Miscible and Immiscible Blends - Phase Equilibria Calculation - Huggins - Flory Theory

UNIT II DETERMINATION OF POLYMER/POLYMER MISCIBILITY 9

Phase Equilibria Methods - Measurement of Polymer/Polymer Interaction Parameter - Indirect Methods - Methods of Measurements - Refractive Index - Ultrasonic Velocity - Thermal and Optical Methods - Factors Affects on Miscibility of Polymer Blends - Compatibility - Solubility Parameter - Interaction Parameter - Composition - Molecular Weight - Transition Temperature

UNIT III THERMODYNAMICS, CRYSTALLIZATION AND MELTING OF POLYMER BLENDS 9

Introduction - Thermodynamic Principles - Thermodynamics of a Single Component Systems - Polymeric Liquid Mixtures - Theory of Liquid Mixtures - Phase Separation - Methods of Measurements - Crystallization, Morphological and Melting Behavior of Miscible and Immiscible Polymer Blends

UNIT IV COMPATIBILIZED BLENDS AND METHODS OF TOUGHENING 9

Introduction - Types and Role of Compatibilizer - Compatibilization Methods - Mechanism and Properties of Compatibilized Blends - Mechanism and Theory of Toughing - Toughening of Thermoplastics and Thermosets - Thermoplastic Elastomers - Introduction - Properties and Uses with Examples

UNIT V RHEOLOGY AND APPLICATIONS OF POLYMER BLENDS AND ALLOYS 9

Introduction - Rheological Models for Miscible and Immiscible Blends - Rheology of Miscible and Immiscible Blends - Applications - Automotive - Electrical and Electronics - Medical - Building and Construction - Business Machines and Communications – Packaging

TOTAL : 45 PERIODS

REFERENCES

1. L. A. Utracki, Polymer blends and alloys, Hanser Publishers, New York, 1979
2. L. M. Robeson, Polymer blends Hanser publications, USA, 2007
3. M. J. Folkes, P. S. Hope, Polymer blends and alloys, Springer, London, 2012
4. L. A. Utracki, Polymer Blends Hand book, Kluwer academic publichers, UK, 2002

PO7015 COMPUTER AIDED DESIGN L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on Computer graphics fundamentals and Interactive computer programming.
- The students should be conversant with Computer animation and Mechanical assembly.
- To introduce Proto typing, process planning and CAD CAM integration**.**

OUTCOME

- Will be able to appreciate incorporation of computers in chemistry.
- Will be able to use computers as a tool in solving chemistry related problems.
- Will be able to create programs for direct use in problem solving.

UNIT I COMPUTER GRAPHICS FUNDAMENTALS 10

Graphic primitives – transformations – graphic standards – representation of curves – surface and solid modeling.

UNIT II INTERACTIVE COMPUTER PROGRAMMING 10

Requirements of interactive programming – types of interactive programming- objective oriented programming – development of interactive programme in languages like Auto LISP etc. – applications.

UNIT III COMPUTER ANIMATION 10

Conventional animation – computer animation – animation requirements – animation types – animation techniques – design application

UNIT IV MECHANICAL ASSEMBLY 5

Assembly modeling – mating conditions – representation schemes – assembling sequences – assembly analysis.

UNIT V PROTOTYPING, PROCESS PLANNING AND CAD CAM INTEGRATION 10

Basics of prototyping - principles and planning –basics of process planning and CAD CAM integration.

TOTAL : 45 PERIODS

REFERENCES

1. Donald Hearn and M. Pauline Baker, Computer Graphics, Prentice Hall, Inc.1997.
2. Ibrahim Zeid, CAD / CAM – Theory and Practice, McGraw Hill, International Edition, 1998.
3. Mikell, P. Grooves and Emory W.Zimmers Jr., CAD / CAM Computer – Aided Design and Manufacturing, Prentice Hall Inc., 1995.

PO7016 REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- To train students in reaction kinetics and evaluation of reaction rate and reactors.
- To make the student conversant with the heat effects in reactors and reactor stability.
- To familiarize chemical equilibria and equilibrium constant to students.

OUTCOME

- Will understand reaction kinetics.
- Will be able to comprehend heat effects in reactors and reactor stability.
- Will be aware of different reactors.
- Can grasp the idea of chemical equilibria and equilibrium constant.

UNIT I REACTION KINETICS AND EVALUATION OF REACTION RATE 12

Reaction kinetics – rate equation – elementary, non-elementary reactions – mechanism – temperature dependence of reaction rates – analysis of experimental reactor data – evaluation of reaction rate – integral and differential analysis for constant and variable volume system.

UNIT II REACTORS 12

Ideal reactors – homogeneous reaction systems – batch, stirred tank and tubular flow reactor – design for multiple reactions – choice, yield, conversion, selectivity, reactivity – consecutive, parallel and mixed reactions.

UNIT III HEAT EFFECTS IN REACTORS 12

Heat effects in reactors – isothermal and non-isothermal homogeneous systems adiabatic reactors – rates of heat exchange for different reactors –design for constant rate heat input and constant heat transfer coefficient operation – batch and continuous reactors.

UNIT IV REACTOR STABILITY 4

Reactor stability – criteria for stability of reactors, limit cycles and oscillating reactions

UNIT V CHEMICAL EQUILIBRIA AND EQUILIBRIUM CONSTANT 5

Reaction equilibria – equilibrium in chemically reactive system – evaluation of equilibrium constant – effects of temperature on equilibrium – equilibrium composition evaluation.

TOTAL : 45 PERIODS

REFERENCES

1. Octave Levenspiel, Chemical Reaction Engineering (3rd Edition), , John Wiley & Sons, 1998
2. J. M. Smith, Chemical Engineering Kinetics, McGraw Hill Inc.,3rd edition, New Delhi, 1981
3. Nauman E. Bruce, Chemical Reactor Design, John Wiley & Sons, New York, 1987.
4. H. Scott Fogler**, "**Elements of Chemical Reaction Engineering", (4th Edition) Prentice Hall,

PO7017 PROCESS INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES

- To learn abouttemperature measurement and pressure, level and flow measurement.
- To acquaint the student physical property measurement in and process chemical analyzer.
- To know the importance of Indicating and recording instruments.

OUTCOME

- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Knows the importance of in physical property measurement the industrial operations.
- Can associate the reactions that he has already learnt with the actual process in the industry

UNIT I TEMPERATURE MEASUREMENT 9

Differential expansion and fluid expansion types - resistance thermometers- thermoelectric pyrometers - radiation pyrometers - optical pyrometers- pyrometric cones- ultrasonic thin wire thermometer- location of temperature measuring devices in equipment.

UNIT II PRESSURE, LEVEL AND FLOW MEASUREMENT 9

Liquid types and spring balanced type pressure measuring devices- manometer and sealed belt types of pressure measuring equipment- pressure transmitters - various types of level measuring equipment - volumetric, variable head meters for flow measurement- variable area meters - velocity and current meters- ultrasonic flow meters - mass meters.

UNIT III PHYSICAL PROPERTY MEASUREMENT 9

Density and specific gravity - viscosity and consistency - refractive index analysers - boiling point and flash point analyzers - thermal conductivity measurement - moisture measurement.

UNIT IV PROCESS CHEMICAL ANALYZER 9

Chromatographic analyzers, infrared analyzers, ultraviolet and visible radiation analyzers, mass spectrometers, electro analytical instruments.

UNIT V INDICATING AND RECORDING INSTRUMENTS 9

Measurement to indicator transducers, analog and digital indicating and recording instruments, variables of importance to various industries and their measurement.

TOTAL : 45 PERIODS

REFERENCES

1. Eckman, D.P. – Industrial Instrumentation, CBS publishers 2004(Reprint).
2. Rebert , H. Perry –Chemical Engineering Hand Book, 8th Edn.,McGraw Hill
3. Co.,Inc. New York, 2007.
4. A.E. Fribance – Industrial Instrumentation Fundamentals, McGraw Hill Co.
5. New York, 1983.
6. William Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGraw Hill Professional, 2005

PO7018 HEAT TRANSFER AND MOMENTUM TRANSFER PROCESS L T P C
3 0 0 3

OBJECTIVES

- To acquire knowledge on momentum transport process and solution to equations of motion.
- To understand the basic concepts of heat transfer by conduction process and convective heat transfer process.
- To know the importance of mass transfer.

OUTCOME

- Will be aware of momentum transport process and solution to equations of motion..
- Will be able to methodically discuss heat transfer process.
- Will understand the importance of mass transfer.

UNIT I MOMENTUM TRANSPORT PROCESS 10

Momentum transport –fluid behavior – overall mass, energy and momentum balances – differential mass, energy and momentum balance-polymeric liquids.

UNIT II SOLUTION TO EQUATIONS OF MOTION 9

Solution to equations of motion - flow measurement - boundary layer flow – turbulent flow – dimensional analysis applied to momentum transport – design equation for incompressible fluid- flow through packed column–fluidization.

UNIT III HEAT TRANSFER BY CONDUCTION PROCESS 8

Heat transfer – steady state conduction – unsteady state conduction – numerical and graphical methods in analysis of heat conduction.

UNIT IV CONVECTIVE HEAT TRANSFER PROCESS 8

Convective heat transfer – heat transfer in laminar and turbulent flow- boiling and condensation – design equations for convective heat transfer – heat exchangers.

UNIT V MASS TRANSFER 10

Mass transfer – molecular diffusion – binary systems – convective mass transfer coefficients – mass transfer in laminar and turbulent flow –design equations for convective mass transfer – analysis between momentum, heat and mass transfer.

TOTAL : 45 PERIODS

REFERENCES

1. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot, Transport Phenomena, (Second Edition) John Willey & Sons, 2006.
2. C.J.Geankoplis, Transport Processes and Unit Operation, (Third Edition) Prentice Hall, 1993.
3. J.R.Welty, C.E. Wicks, G. L. Rorrer and R.E.Wilson, Fundamentals of Momentum, Heat and Mass transfer, John – Wiley & Sons, New York, 2007.(Fifth Edition).
4. C.J. Geankoplis, Transport Processes – Momentum, Heat and Mass(Allyn and
5. Bacon Inc), Boston, USA 1983.

PO7019 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To acquire knowledge on man power planning, motivation and productivity.
- To learn the Industrial relations, public policies, leadership and management in the trade union.
- To understand the basic concepts of dynamics of conflict and collaboration and also on Workers participation and management**.**

OUTCOME

- Will be able to manage industrial issues effectively.
- Will be concerned about labour laws and policies.

UNIT I MAN POWER PLANNING 12

Need – objectives – planning for future – manpower planning process- projecting manpower supply and demand at organizational level – developing manpower strategy - recruitment selection and induction – process of recruitment – selection tests – placement induction – orientation – training and development – training – management development – retraining – evaluation of training programme.

UNIT II MOTIVATION AND PRODUCTIVITY 12

Issues in managing people – Maslow's need hierarchy – social needs and productivity – hygiene and motivators – motivational climate – demotivation – cases – performance appraisal – job performance and performance measurement – validity and reliability – methods – problems in Indian context – career planning – responsibility – process of career planning and development – advantages and limitations.

UNIT III UNION MANAGEMENT PERSPECTIVE 7

Approaches to industrial relations – public policies – major events in international issues – perspectives for India – trade with development and functions – growth of trade unions – development – functions – structure – leadership and management in the trade union.

UNIT IV DYNAMICS OF CONFLICT AND COLLABORATION 7

Process of conflict – types of conflict – interpersonal conflict – managing inter group relations and conflict – industrial conflict resolution – consultation- collective bargaining – types of bargaining – new collective bargaining –negotiation skills – trends in collective bargaining.

UNIT V WORKERS PARTICIPATION AND MANAGEMENT 7

Concept, strategies and practices –models in workers participation management – design and dynamics of anticipative forms – case studies– case study analysis – synthesis

TOTAL : 45 PERIODS

REFERENCES

1. C.B. Memoria, Personnel Management, Himalaya Publishing Co., Bombay, 1985.
2. Robbins, The Management of Human Resource, Prentics, Hall, New Jersey, 1982
3. C.B. Memoria and S.Memoria, Dynamics of Industrial Relations in India, Himalaya Publishing co., Bombay, 1985
4. H.C. Lucas Jr., Information System Concepts for Management, McGraw Hill, Kogakusha, 1978.

PO7020 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on the theory of quality control**,** quality capability study.
- To introduce knowledge on quality assurance and acceptance, sampling plans and tables.
- To acquaint the students about quality engineering, reliability and maintainability in enterprises management.

OUTCOME

- Will develop management skills.
- Will build up concern for quality and its maintenance.

UNIT I 9

Introduction to quality control theory - elements of quality, fundamentals of statistics and probability in quality control –measures of central tendency on-normal distribution – significance tests – difference between means. binomial, Poisson distributions – Thorndike chart – hyper geometric distribution.

UNIT II 9

Control of process quality – principles of control – quality capability analysis – quality capability study – average range method for determining process capability – control of variable quality – characteristics – theory of control charts –control limits- types of control charts – control chart for variables –X and R control charts – control charts for attributes – P. Chart, C. Charts.

UNIT III 9

Quality assurance and acceptance – acceptance sampling-operating characteristics curve – development of single sampling plan, concept of AQL, LTPD producers and consumers risk – average outgoing quality (AOQ) curve. Other acceptance sampling plans – sampling tables.

UNIT IV 9

Quality engineering – planning for quality and reliability – quality standards – specification of inspection methods, setting of standard quality levels – introduction to ISO-9000 –design of quality experiments using statistics –analysis of variance.

UNIT V 9

Reliability and maintainability – definition of reliability, factors affecting reliability – MTTF – MTBF – evaluation of reliability, quality management – organising for quality – economy of quality- techniques of ABC analysis- quality management education – zero defects concept – quality circles concept- applying total quality management in enterprises.

TOTAL : 45 PERIODS

REFERENCES

1. A.J. Ducan, Quality Control and Industrial Statistics, Homewood, Illinois, 1959.
2. A.V.Feigenbaum, Total Quality Control, McGraw Hill Co. New York, 1961
3. B.L. Hansen, Quality Control: Theory and Applications, Prentice-Hall, New Jersey, 1966.
4. H. Lal, Total Quality Management –A Practical Approach, 2nd ed,Wiley Eastern, New York, 1990