COURSES AND EVALUATION SCHEME

Syllabus

2nd, 3rd and 4th Year (Effective from Session 2014 - 2015)

B.Tech. (Plastic & Polymer Engineering)

COURSES AND EVALUATION SCHEME

B. Tech. (Plastic & Polymer Engineering) (Effective from Session 2014 -2015) YEAR II, SEMESTER –III

SI. No.	Course code	Subject	PERIODS		SESSIONAL EXAM			ESE	Subject Total	Credit	
A) T	HEORY		Т	т	D	СТ	ТА	Total			
1	TMA-301	Mathematics-III	3	1	0	30	20	50	100	150	4
2	THU-301	Engineering Economics	2	1	0	15	10	25	50	75	3
3	TME-301	Material Science	3	1	0	30	20	50	100	150	4
4	TME- 302	Engineering Thermodynamics	2	1	0	15	10	25	50	75	3
5	TCE -301	Fluid Mechanics	3	1	0	30	20	50	100	150	4
6	TPP -301	Introduction to Polymer Science	3	1	0	30	20	50	100	150	4
B) P	RACTICAL	/ TRAINING / PROJECT			•		•				
7	PME- 351	Material Science Lab	0	0	2	-	25	25	25	50	1
8	PME- 352	Machine Drawing	1	0	3	-	50	50	50	100	3
9	PCE -351	Fluid Mechanics Lab	0	0	3	-	25	25	25	50	2
10	GP-301	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-		50	-	50	-
		TOTAL	17	6	8	-		-	-	1000	28

COURSES AND EVALUATION SCHEME B.Tech (Plastic & Polymer Engineering) (Effective from Session 2014-2015) YEAR II, SEMESTER –IV

Sl. No.	Course code	Subject	PERIODS		SESSIONAL EXAM			ESE	Subject Total	Credit	
			L	Т	Р	СТ	TA	Total			
A) THEORY											
1	ECH-402	Heat Transfer	3	1	0	30	20	50	100	150	4
2	TME-403	Mechanical Measurement	3	1	0	30	20	50	100	150	4
3	TME-405	Industrial Engineering	2	1	0	15	10	25	50	75	3
4	TPP-401	Polymer Chemistry	3	1	0	30	20	50	100	150	4
5	TPP-402	Thermoplastic Materials	3	1	0	30	20	50	100	150	4
6	TPP-403	Thermoset Materials	3	1	0	30	20	50	100	150	4
B) P	RACTICAL	/ TRAINING / PROJECT									
7	PME-452	Measurement & Metrology Lab	0	0	3	-	25	25	25	50	2
8	PPP-451	Analysis & Identification of Polymers Lab	0	0	3	-	25	25	50	75	3
9	GP-401	General Proficiency (NSS/NCC/Sports/Cultural)	-	-		-	-	50	-	50	-
		TOTAL	17	6	6	-	-	-	-	1000	28

COURSES AND EVALUATION SCHEME B.Tech (Plastic & Polymer Engineering) (Effective from Session 2014-2015) YEAR III, SEMESTER –V

Sl. No.	Course code	Subject	PERIODS		SESSIONAL EXAM			ESE	Subject Total	Credit	
			L	Т	Р	СТ	TA	Total			
A) T	HEORY										
1	TPP-501	Polymer Structure & Properties Relationship	3	1	0	30	20	50	100	150	4
2	TPP-502	Polymer Rheology	3	1	0	30	20	50	100	150	4
3	TPP-503	Characterization of Polymers	3	1	0	30	20	50	100	150	4
4	TPP-504	Plastic Processing -I	3	1	0	30	20	50	100	150	4
5	TPP-505	Plastic Testing Techniques	3	1	0	30	20	50	100	150	4
6	TPP-506	Plastic Product & Mould Design	3	1	0	30	20	50	100	150	4
B) P	RACTICA	L / TRAINING / PROJEC	T								
7	PPP-551	Synthesis & Polymerization Lab	0	0	3	15	10	25	25	50	2
8	PPP-554	Plastic Processing Lab	0	0	3	15	10	25	25	50	2
		TOTAL	18	6	6	-	-	-	-	1000	28

COURSES AND EVALUATION SCHEME B.Tech (Plastic & Polymer Engineering) (Effective from Session 2014-2015) YEAR III, SEMESTER –VI

Sl. No.	Course code	Subject	PE	RIO	DS	SE	SSIO EXAI	NAL M	ESE	Subject Total	Credit
			L	Т	Р	СТ	TA	Total			
A) T	HEORY			-	-	-	-	-			
1	TPP-601	Polymeric Adhesives & Sealents	3	1	0	30	20	50	100	150	4
2	TPP-602	Polymer Blends & Composites	3	1	0	30	20	50	100	150	4
3	TPP-603	Plastics Packaging Technology	3	1	0	30	20	50	100	150	4
4	TPP-604	Additives & Compounding	3	1	0	30	20	50	100	150	4
5	TPP-605	Plastic Waste Management & Recycling	3	1	0	30	20	50	100	150	4
6	TPP-606	Plastic Processing - II	3	1	0	30	20	50	100	150	4
B) P	RACTICA	L / TRAINING / PROJECT									
7	PPP-651	Plastic Material Testing Lab	0	0	3		25	25	25	50	2
8	GP-601	General Proficiency (NSS/NCC/Sports/Cultural)	-	-		-	-	50	-	50	-
		TOTAL	18	6	3	-	-	-	-	1000	26

COURSES AND EVALUATION SCHEME B.Tech (Plastic & Polymer Engineering) (Effective from Session 2014-2015) YEAR IV, SEMESTER -VII

Course code	Subject	PERIODS		SESSIONAL EXAM			ESE	Subject Total	Credit	
		L	Т	Р	СТ	TA	Total			
HEORY		I.				I				
TPP-701	Industrial Safety & Hazard Management	3	1	0	30	20	50	100	150	4
TME-701	CAD/CAM	3	1	0	30	20	50	100	150	4
TPP-702	Nylon Technology	3	1	0	30	20	50	100	150	4
TPP-703	Fibre Manufacturing Technology	3	1	0	30	20	50	100	150	4
TOE-	Open Elective*	3	1	0	30	20	50	100	150	4
B) PRACTICAL / TRAINING / PROJECT										
PPP-701	Polymer Characterization Lab	0	0	3	-	50	50	50	100	3
PPP-702	Minor Project	0	0	2	-	50	50		50	2
PPP-703	Industrial Training Report presentation	0	0	2	-	50	50		50	
GP-301	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-		50	-	50	-
	TOTAL	15	5	7	-	-	-	-	1000	27
 * Details of open elective (Select any one elective subject. Syllab TOE – 01Non Conventional Energy Resources TOE – 02Reliability Engineering TOE – 03Environment & Ecology TOE – 04Geographic Inf. System Tech. & its application TOE – 05Entrepreneurship Development Programme TOE – 06Ancient Indian Culture TOE – 06Ancient Indian Culture TOE – 07Human Values TOE – 08Quality System & Management TOE – 09Condition Monitoring & Diagnostics TOE – 10Value Engineering TOE – 11Nanotechnology TOE – 12Solar Energy 		TC TC TC TC TC TC TC TC TC TC TC TC TC	$ \frac{1}{1} 1$	to UT 4Adva 5Indu 6Biod 7Func 8Cons 9Artif 0Hum 1IT in 2Artif 3Heal 4Intro 5Mod	U, Dehi ance Ma strial In Imedica lamenta sumer E ficial ne nan Con a Busine ficial In th, Hos oduction lern Cor	radun) aterial S strumer l Engine ls of Cc Clectroni ural net uputer In ess telligence pital and to Med ntrol Sys	cience ntation eering oding Theo ics work & Fu nteraction ce in Manu d Equipme lical Physic stem	ry izzy logic facturing nt Manag cs	ement	
	Course code	Course codeSubjectCourse codeSubjectHEORYIndustrial Safety & Hazard ManagementTPP-701Industrial Safety & Hazard ManagementTME-701CAD/CAMTPP-702Nylon TechnologyTPP-703Fibre Manufacturing TechnologyTOE-Open Elective*RACTICAL / TRAINING / PROJECTPPP-701Polymer Characterization LabPPP-702Minor ProjectPPP-703General Proficiency (NSS/NCC/Sports/Cultural)GP-301General Proficiency (NSS/NCC/Sports/Cultural)Utalis of open elective (Select any one elective subject. Syllabit = 01Non Conventional Energy Resources = 02Reliability Engineering = 03Environment & Ecology-04Geographic Inf. System Tech. & its application = 05Entrepreneurship Development Programme = 06Ancient Indian Culture = 07Human Values-08Quality System & Management = 09Condition Monitoring & Diagnostics = 11Nanotechnology-13Huma Resource Management-09Condition Monitoring & Diagnostics = 13Huma Resource Management	Course codeSubjectPEICourse codeIndustrial Safety & Hazard ManagementITPP-701Industrial Safety & Hazard Management3TME-701CAD/CAM3TPP-702Nylon Technology3TPP-703Fibre Manufacturing Technology3TPP-703Fibre Manufacturing Technology3TOE-Open Elective*3RACTICAL / TRAINING / PROJECT0PPP-701Polymer Characterization Lab0PPP-702Minor Project0PPP-703General Proficiency (NSS/NCC/Sports/Cultural)-Italis of open elective (Select any one elective subject. Syllabus accol - 01Non Conventional Energy ResourcesTC- 02Reliability EngineeringTCTC- 03Environment & EcologyTCTC- 04Geographic Inf. System Tech. & its applicationTC- 05Entrepreneurship Development ProgrammeTC- 06Ancient Indian CultureTC- 07Human ValuesTC- 09Condition Monitoring & DiagnosticsTC- 13Human Resource ManagementTC- 13Huma Resource ManagementTC- 13Huma Resource ManagementTC	Course codeSubjectPERIONCourse codeIITImageImageImageImageTPP-701Industrial Safety & Hazard Management31TME-701CAD/CAM31TPP-702Nylon Technology31TPP-703Fibre Manufacturing Technology31TOE-Open Elective*31RACTICAL / TRAINING / PROJECT00PPP-701Polymer Characterization Lab00PPP-702Minor Project00PPP-703General Proficiency (NSS/NCC/Sports/Cultural)Image: Colore of the subject subject subject subject subject of the subject subject of the	Course codeSubject $PERIOES$ Image: Course codeImage: Course sector of the sector of	Course codeSubject $PERIODS$ SE Image: SubjectLTPCTImage: SubjectLTPCTHEORYImage: State	Course codeSubject $PERIODS$ $SESSIOEXAMINEImage: SubjectLTPCTTAHEORYIndustrial Safety & HazardManagement3103020TPP-701Industrial Safety & HazardManagement3103020TPP-702Nylon Technology3103020TPP-703Fibre ManufacturingTechnology3103020TOE-Open Elective*3103020TOE-Open Elective*3103020PPP-702Minor Project002-50PPP-703Industrial Training Reportpresentation002-50PPP-703Industrial Training Reportpresentation002-50GP-301General Proficiency(NSS/NCC/Sports/Cultural)TOTAL1557IoBustrial Training Reportpresentation002-50GP-301(NSS/NCC/Sports/Cultural)$	Course codeSubjectPERIODSSESSIONAL EXAMLTPCTTATotalHEORYIndustrial Safety & Hazard Management310302050TME-701CAD/CAM310302050TPP-702Nylon Technology310302050TPP-703Fibre Manufacturing Technology310302050TOE-Open Elective*310302050FOE-Open Elective*310302050PPP-701Polymer Characterization Lab003-5050PPP-702Minor Project002-5050PPP-703Industrial Training Report presentation002-5050PPP-703General Proficiency (NSS/NCC/Sports/Cultural) UNon Conventional Energy Resources - 02Reliability EngineeringTOE - 15Hodustrial InstrumentationTOE - 16Hodustrial InstrumentationTOE - 16Hodustrial InstrumentationTOE - 16Hodustrial Instrumentation- 03Roadity System & Management - 10Naute EngineeringTOE - 22Artificial Intelligence in Mana TOE - 22Artificial Intelligence in Mana TOE - 22Artificial Intelligence in Mana TOE - 23Headth, Hospital and Equipment TOE - 24Introduction to Medical Physite TOE - 24Introduction to Medical Physite TOE - 24Introduction to Medical Physite TOE - 24Introduct	Course codeSubjectPERIODSSESSIONAL EXAMESEImage: Course codeImage: Course Amage: CourseImage: Course Image: CourseImage: Course <td>Course codeSubjectPERIDESESSIONAL EXAMESESubjectImage: SubjectImage: SubjectImage: SubjectSESSIONAL FileESESubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectTPP-701Industrial Safety & Hazard Management3Image: SubjectImage: SubjectImage: SubjectTPP-701Industrial Safety & Hazard Management3Image: SubjectImage: SubjectImage: SubjectTPP-702Nylon Technology3Image: SubjectImage: SubjectImage: SubjectImage: SubjectTPP-703Fibre Manufacturing Technology3Image: SubjectImage: SubjectImage: SubjectTOE-Open Elective*3Image: SubjectImage: SubjectImage: SubjectImage: SubjectPPP-701Polymer Characterization Lab003-5050Image: SubjectPPP-702Minor Project002-5050Image: SubjectSubjectPPP-703Industrial Training Report presentation002-5050Image: SubjectImage: Subject Subje</td>	Course codeSubjectPERIDESESSIONAL EXAMESESubjectImage: SubjectImage: SubjectImage: SubjectSESSIONAL FileESESubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectImage: SubjectTPP-701Industrial Safety & Hazard Management3Image: SubjectImage: SubjectImage: SubjectTPP-701Industrial Safety & Hazard Management3Image: SubjectImage: SubjectImage: SubjectTPP-702Nylon Technology3Image: SubjectImage: SubjectImage: SubjectImage: SubjectTPP-703Fibre Manufacturing Technology3Image: SubjectImage: SubjectImage: SubjectTOE-Open Elective*3Image: SubjectImage: SubjectImage: SubjectImage: SubjectPPP-701Polymer Characterization Lab003-5050Image: SubjectPPP-702Minor Project002-5050Image: SubjectSubjectPPP-703Industrial Training Report presentation002-5050Image: SubjectImage: Subject Subje

TOE – 27SCADA & Energy Management System

COURSES AND EVALUATION SCHEME B.Tech (Plastic & Polymer Engineering) (Effective from Session 2014-2015) YEAR IV, SEMESTER –VIII

Sl. No.	Course code	Subject	PERIODS		SESSIONAL EXAM			ESE	Subject Total	Credit	
			L	Τ	P	СТ	TA	Total			
A) T	HEORY			1	T						
1	TME-020	Total Quality Management	3	1	0	30	20	50	100	150	4
2	TPP-801	Surface Coating Technology	3	1	0	30	20	50	100	150	4
3	TPP-803	Polyurethane Technology	3	1	0	30	20	50	100	150	4
4	TPP-804	Technology of Elastomers	3	1	0	30	20	50	100	150	4
B) P	RACTICA	L / TRAINING / PROJECT		<u>.</u>	·					·	
5	PPP-801	Project Lab	0	0	3	-	100	100	200	300	4
6	PPP-802	Seminar	0	0	2	-	50	50		50	2
7	GP-301	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-		50	-	50	-
		TOTAL	12	4	5	-	-	-	-	1000	22

Unit – I: Function of Complex variable

TMA-301

Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem,

Evaluation of real integrals of the type $\int_{0}^{2\pi} f(\cos\theta, \sin\theta) d\theta$ and $\int_{-\pi}^{+\pi} f(x) dx$ 10

Unit – II: Statistical Techniques - I

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non – linear and multiple regression analysis, Probability theory. **08**

Unit – III: Statistical Techniques - II

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc.

Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, X, R, p, np, and c charts. **08**

Unit – IV: Numerical Techniques – I

Zeroes of transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, difference tables, Newton's forward and backward

interpolation, Lagrange's and Newton's divided difference formula for unequal intervals.

Unit – V: Numerical Techniques –II

Solution of system of linear equations, Gauss-Seidal method, Crout method. Numerical differentiation, Numerical integration, Trapezoidal, Simpson's one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and forth-order Runge- Kutta methods. **08**

Reference Books :-

- 1. T. Veerajan & T. Ramchandran, Theory & Problems in Numerical Methods, TMH, New Delhi, (2004).
- 2. Devore, Probability and Statistics, Thomson(Cengage) Learning, (2007).
- 3. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, (2003).
- 4. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, (2007).

LTP 310

08

THU-301

ENGINEERING ECONOMICS

LTP 210

(8)

(8)

Unit-I

Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison. (8)

Unit-II

Use and situations for equivalent annual worth comparison, Comparison of assets of equal and unequal life. Rate of return, Internal rate of return, comparison of IIR with other methods, IRR misconceptions.

Unit-III

Analysis of public Projects: Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost –effectiveness analysis. (9)

Unit-IV

Depreciation, computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models.

Product and Process Costing, Standard Costing, cost estimation, Relevant Cost for decision making, Cost control and Cost reduction techniques.

Reference Books :

- 1. Horn green, C.T., Cost Accounting, Prentice Hall of India, (1962).
- 2. Riggs, J.L., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, (1996)

MATERIAL SCIENCE

LTP 310

Unit-I

Introduction : Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings. (4)

Crystallography and Imperfections : Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids. (3)

Unit-II

Mechanical properties and Testing : Stress strain diagram, Ductile & brittle material, Stress vs. strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength testings, Hardness testing, Impact tastings, Fatigue testing Creep testing, Non-destructive testing (NDT) (4)

Micro structural Exam : Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. (2)

Phase Diagram and Equilibrium Diagram : Uniary and Binary diagrams, Phase rules.Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-
carbon equilibrium diagram.(4)

Unit-III

Ferrous materials : Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses. (3)

Heat Treatment : Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys : Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys. (3)

Unit-IV

Magnetic properties : Concept of magnetism - Dia, para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. (2)

Electric properties : Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Diffusion of Solid. Super conductivity and its applications. Messier effect. Type I & II superconductors. High Tc superconductors. (2)

Unit-V

Ceramics : Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics. (2)

Plastics : Various types of polymers/plastics and its applications. Mechanical behavior and processing of plastics. Future of plastics.

(2)

Other materials : Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nanomaterials and their potential applications (3)

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control. (2)

Reference Books :

- 1. W.D. Callister, Jr, Material Science & Engineering Addition-Wesley Publication, (2007)
- 2. Van Vlash Elements of Material Science & Engineering John Wiley & Sons, (1996)
- 3. V. Raghvan Material Science, Prentice Hall, (2006)

ENGINEERING THERMODYNAMICS

L T P 2 1 0

(7)

UNIT I: INTRODUCTION

Review of fundamental concepts and definitions. Review of first and second law of thermodynamics, entropy, properties of substances. (5)

UNIT II:

AVAILABLE ENERGY, EXERGY AND IRREVERSIBILITY

Available energy, available energy referred to a cycle, quality of energy, maximum work in a reversible process, reversible work by an open system exchanging heat only with surroundings, useful work, dead state, availability, availability in a chemical reaction, irreversibility and Gouy-Stodala Theorem, availability or energy balance, second law efficiency, comments on energy,

Helmholtz and Gibb's function.

UNIT III:

THERMODYNAMIC RELATIONS, EQUILIBRIUM AND THIRD LAW

Mathematical conditions for exact differential, Maxwell's equation, Tds equation, difference in heat capacities, ratio of heat capacities, energy equation, Joule -Kelvin effect, Clausius-Clapeyron equation, evaluation of thermodynamic properties from an equation of state, general thermodynamic considerations on an equation of state, mixtures of variable composition, conditions of equilibrium of a heterogeneous system, Gibbs phase rule, types of equilibrium, local equilibrium conditions, conditions of stability, Joule-Thompson coefficient and Inversion curve, coefficient of volume expansion, adiabatic and isothermal compressibility. (8)

UNIT IV: GAS POWER CYCLES AND GAS COMPRESSORS

Gas power cycles:

Carnot cycle, Stirling cycle, Ericsson cycle, Air standard cycles, Otto cycle, Diesel cycle, Limited pressure cycle or Dual cycle, comparison of Otto, Diesel and Dual cycles, Brayton cycle, Aircraft propulsion, Brayton-Rankine combined cycle. (4)

Gas compressors

Compression processes, work of compression, single stage reciprocating air compressor, volumetric efficiency, multi stage compression, air motors, rotary compressors, blowers and fans. (3)

Reference Books:

- 1. Engineering thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
- 2. Fundamentals of thermodynamics by Sonntag, Wiley India Pvt. Ltd, (2010)
- 3. Fundamentals of Classical Thermodynamics by Van Wylen, John Wiley and Sons, (1978)
- 4. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man Ltd.

FLUID MECHANICS

LTP 310

Unit-I:

Introduction : Fluid and continuum, Physical properties of fluids, Rheology of fluids.

Kinematics of Fluid flow : Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body.

Unit-II:

Fluid Statics:

Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

Dynamics of Fluid Flow: Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, Hot-wire anemometer and LDA, notches and weirs, momentum equation and its application to pipe bends.

Unit-III: Dimensional Analysis and Hydraulic Similitude:

Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

Unit-IV:

Laminar and Turbulent Flow:

Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

Unit-V:

Boundary Layer Analysis:

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub layer, separation and its control, Drag and lift, dragon a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

Reference Books :

- 1. S. Narasimhan: First Course in Fluid Mechanics, University Press, (2006)
- 2. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, (2000) 2nd edition.
- 3. M MDas: Fluid Mechanics & Turbomachines, Oxford University Press
- 4. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. (1946)
- 5. Vijay Gupta and S.K.Gupta, "Fluid Mechanics and its Applications", Wiley Eastern Ltd, (1984).

TPP- 301INTRODUCTION TO POLYMER SCIENCEL T P

3 1 0

UNIT -I

Basic Concepts of Polymers

Introduction – Monomer, oligomer, Polymer and Polymerisation, Functionality, Repeating units Nomenclature of polymers, classification of polymers (Natural vs Synthetic), Polymer structure (a)Linear, Branched and Cross-linked (b) Amorphous or crystalline (c) Homopolymer or Copolymer (d) Fibres, Plastics or Elastomers,

UNIT-II

Molecular Weight And Molecular Weight Distribution

Average Molecular Weight, Number Avg. Molecular Weight, Weight Avg. Molecular Weight, Viscosity Avg. Molecular Weight, Degree of Polymerisation and molecular weight, Poly dispersity and Molecular Weight Distribution in polymers.

UNIT-III

Crystallinity

Crystalline and amorphous structure of polymers, Degree of Crystallinity, Polymer crystallization, Effect of Crystallinity on Polymer property

Glass Transition Temperature (Tg)

Tg and its associative properties, Factors affecting Tg, Relation between Tg and Melting Temperature Tm, Importance of Tg, Tg and polymer properties relationship

UNIT-4

Polymer Degradation and Stability

Introduction, Types of Degradation – Thermal Degradation, Mechanical Degradation, Oxidative Degradation, Photo Degradation, Chemical degradation

UNIT - 5

Polymer Solution:

The process of polymer solution, nature of polymer molecules in solutions, size and shape of macro molecules in solution.

Reference Books:

1. Plastics Materials by J. A. Brydson, Butterworth Heinemann (1999).

- 2. Textbook of Polymer Science by Fred W. Billmeyer, Wiley, India (2007).
- 3. Polymer Crystillization, by Schultz, American Chemical Society (2001).
- 4. Polymer Chemistry, by Seymour R. B. and Carraher, Marcel Dekker (2000).
- 5. Principles of Polymerization, by G.Odian, Wiley- Interscience (2004).

Suggested Reading:

(Ref. 1 for Chap.1), (Ref. 2 for Chap. 3 & 4), (Ref. 3 for Chap. 2), (Ref.4 for Chap. 5), (Ref. 5 for Chap. 6)

PME-351

MATERIAL SCIENCE LAB

Material Science Lab Experiments:

- 1. Making a plastic mould for small metallic specimen.
- 2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
- 3. Grain size determination of a given specimen.
- 4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
- 5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
- 6. Material identification of, say, 50 common items kept in a box.
- 7. Faradays law of electrolysis experiment.
- 8. Study of corrosion and its effects.
- 9. Study of microstructure of welded component and HAZ. Macro and Micro Examination.
- 10. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

PME – 352 MACHINE DRAWING LAB

L T P 103

LTP 002

Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz., couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.; IS/ISO codes;

Limits, tolerances and Fits, Surface finish; Symbols for weldments, process flow, electrical and instrumentation units.

Introduction to solid modellers. A drawing project on reverse engineering.

Reference Books:

- 1. N.D. Bhatt, Machine Drawing, Charotar Book Stall, Anand, (1996).
- 2. N. Sidheswar, P. Kanniah and V.V.S. Sastry, Machine Drawing, Tata McGraw Hill, (1983).
- 3. SP 46: 1988 Engineering Drawing Practice for School & Colleges. Bureau of Indian Standards, (1998)

PCE-351 FLUID MECHANICS LAB

L	Т	P
0	0	2

- 1. To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
- 2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
- 3. To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
- 4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
- 5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
- 6. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
- 7. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

ECH-402

HEAT TRANSFER

L T P 310

Unit I

Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation. Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields and one dimensional conduction without heat generation, e.g., through plane walls, cylindrical and spherical surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness. Extended surfaces, fins and their practical applications. Introduction to unsteady state heat transfer. (7)

Unit II

Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes, Dimensional analysis, determination of individual and overall heat transfer coefficients and their temperature dependence, heat transfer in molten metals. (9)

Unit III

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation. (4)

Unit IV

Heat Transfer with Phase Change: Condensation of pure and mixed vapors, film wise and drop wise condensation, loading in condensers and basic calculation on condensers, heat transfer in boiling liquids, boiling heat transfer coefficients. Evaporation: Elementary principles, types of evaporators. Single and multiple effect evaporators and their calculation, thermocompression. (10)

Unit V

Heat Transfer Equipment: Classification, principles and design criteria, types of exchangers, viz., double pipe, shell and tube, plate type, extended surface, Furnaces and their classification and application. (10)

Books Recommended

Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).

Reference Books

- 1. Coulson, J.M. & Richardson, J.F. "Chemical Engineering :Vol-1",6th ed. Butterworth-Heinemann(1999)
- 2. McAdams W.H. "Heat Transmission", 3rd ed., McGraw-Hill, (1954)
- 3. Kern D.Q. "Process Heat Transfer" McGraw Hill Book (1950)
- 4. Badger W.L. & Bancharo J.T.,"Introduction to chemical engineering" Tata McGraw Hill, (1995)

MECHANICAL MEASUREMENTS

Unit-I:

Mechanical Measurements:

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. (4)Sensors and Transducers: Types of sensors, types of transducers and their characteristics (2) Signal transmission and processing: Devices and systems. Signal Display & Recording Devices (3) Unit-II: **Time related measurements:** Counters, stroboscope, frequency measurement by direct comparison. Measurement of displacement (2)Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. (1)Strain measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. (2)Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. (2)Temperature measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers. (2) Vibration: Seismic instruments, vibration pick-ups and decibel meters, vibrometers accelerometers. (2)**Unit-III:** Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. (2)Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Mikrokator. (2)Limit gauges classification, Taylor's Principle of Gauge Design. (1) **Unit-IV:** Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile project autocollimator. Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement. (6)**Unit-V: Concept of Automatic Controls-** Open loop & closed loop systems. Servomechanism. Block Diagrams (4) Brief introduction to Pneumatic, Hydraulic and Electric controllers. (2) **Reference Books:**

- 1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi, (1989)
- 2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, (1990)
- 3. Raven, Automatic Cotrol Theory, Mc-Graw Hill Publisher, (1992)
- 4. Nagrath and Gopal, Control System Engineering, New Age Publications, (2006)

TME – 405 INDUSTRIAL ENGINEERING

L T P 2 1 0

Unit-I

Productivity: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System. 2

Work study : Meaning and benefits of work study, time & motion study. Micromotion study P.M.T.S. man machine Diagram flow chart. Motion economy, Method study, workmeasurement, work sampling, standard time.

Unit-II

Plant layout and materials Handling : Plant location, type of layout, principles of
facility layout principles of material handling, Material Handling eqpts.3Replacement Analysis : Depreciation causes, obsolescence, service life of assets,
Replacement of items.2Mointenance Management : Maintenance Planning & Control Maintenance Structure3

Maintenance Management : Maintenance Planning & Control, Maintenance Strategy2

Unit-III

Inventory Control : Inventory, function, cost, deterministic models, Introduction to MRP, supply chain Management 4

Quality Control : Introduction, process control, SQC control Charts, Single double & sequential sampling, Introduction to TQM & bench marking.

Unit-IV

Industrial Ownership: Proprietorship, partnership, Joint stock & co-operative stores2 Manpower Planning: Resources, Human relationship. 2

Organization: Principles of organization, Development of Organizational charts like line, staff, line and staff & Functional types. 2

Job Evaluation & Merit Rating: Job analysis, Job description job simplification and job evaluation methods & description, merit rating, wage incentive plans.

Reference Books:

- 1. Principles of management. An analysis of management functions-H. Koontz & C.O. Donnel. Tata Mc-Graw-Hall Co.
- 2. Manufacturing Management-J Moore Prentice Hall Englewood Cliffs: New Jersey.
- 3. Modern production operations Management-Buffa, E.S. WileyEastern.
- 4. Industrial Engineering & Management, O.P. Khanna.
- 5. Industrial Engineering by Ravi Shanker.
- 6. Industrial Engineering by Mahajan.

POLYMER CHEMISTRY

LTP 310

UNIT- I

TPP - 401

Criteria for polymer synthesis. Classification of polymerization processes. Basic methods of polymerization and their mechanism: Addition, condensation, mass (bulk), suspension, emulsion and solution processes.

UNIT- II

General characteristics of condensation polymerization, kinetics and mechanism, Molecular weight control and development of cross-linked structures. Step polymerization and its utility. General theory of chain-growth polymerization. Free radical polymerization, initiators, kinetics of free radical polymerization.

UNIT-III

Autoacceleration. Factors affecting molecular weight and molecular weight distribution. Chaintransfer reactions, retardars, inhibitors, Effect of temperature on polymerization, kinetics & mechanism.

UNIT-IV

Copolymerization reactions and its utility. Kinetics and copolymerization behavior. Block and graft copolymers.

UNIT – V

Stereo-chemistry of polymerization. Ring-opening polymerization.Different advanced catalyst systems: Ziegglar Natta catalyst & metallocene catylysts & their role in polyolefins.

Reference Books:

1. Principles of Polymerization, by G.Odian, Wiley – Interscience (2004).

- 2. Plastics Materials by J. A. Brydson, Butterworth-Heinemann (1999).
- 3. Principles of Polymer Chemistry by P.J. Flory, Asian Books Private Limited (2006).
- 4. A Text book of Polymer Science by F.W. Billmeyer, John-Wiley and Sons (2011).
- 5. Polymer Chemistry by R. B. Seymour and C.E. Carraher, Marcel Dekker (2003).

Suggested Reading

(Ref. 1 for Chap.1), (Ref. 2 & 5 for Chap. 4), (Ref. 3 for Chap. 2), (Ref.4 for Chap. 3)

TPP - 402

THERMOPLASTIC MATERIALS

L	Т	Р
3	1	0

Unit-I:

Brief introduction to preparation, structure, properties and application of following thermoplastic materials: Polyethylene; modified polyethylene, Polypropylene and copolymer of PP, modified Polyolefins like cross linked & filled polyolefins

Unit-II:

Brief introduction to preparation, structure, properties and application of following thermoplastic materials: Engineering Polymers Polyesters such as PET, PBT, PTT, Polycarbonates, Polyacetals.

Unit-III:

Brief introduction to preparation, structure, properties and application of following thermoplastic materials: Styrenic polymers - Polystyrene, HIPS, SAN, ABS, important copolymers of styrene maleic anhydride and styrene acrylics copolymers, toughening mechanism of impact modified plastics

Unit-IV:

Brief introduction to preparation, structure, properties and application of following thermoplastic materials: Polymamides- Nylon 6, Nylon 6, Nylon 11, aromatic polyamide such as Kevlar Acrylic polymers & copolymers, Polyacrylamide, PMMA, Polyacrylonitrile.

Unit-V:

Brief introduction to preparation, structure, properties and application of following thermoplastic materials: Polyvinyl chloride & its copolymers, Poly vinyl acetate, Polyvinyl alcohol Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals.

Reference Books

- 1. Text book of Polymer Science by Billmeyer, John Wiley ans Sons, (1984).
- 2. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc (1988).
- 3. Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, (1990)
- 4. Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley Interscience Publication, (1977)
- 5. Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, (1996)

THERMOSET MATERIALS

L T P 3 1 0

UNIT – I

Epoxy Resins:

Basic raw materials used, resin preparation, types of epoxy resins, Ratios of reaction component and their effect on properties of reaction product and molecular weight. Curing of resin: curing agentsamines, acids and anhydrides. Role of diluents and plasticizers in epoxy resin compositions. Application of epoxy resins.

UNIT – II

Polyester Resins:

Raw materials: polybasic acids, polyfunctional glycols. Resin preparation – saturated and unsaturated polyester resins, Curing of unsaturated polyester resin – curing system, catalyst and accelerators. Role of diluents and plasticizers in unsaturated polyester resin compositions. Applications of unsaturated polyester resins in moulding compositions such as Sheet Moulding Compounds and Dough Moulding Compounds.

UNIT - III

Phenolic Resins:

Basic raw materials – phenol and formaldehyde. Resin preparation – Resol and Novolac type. Effect of the ratio of phenol to aldehyde on the nature and the property of polymer. Eeffect of pH on the reaction mechanism and the reaction products. Curing of phenolics. Phenolic moulding compounds, ingredients, compounding and applications.

UNIT-IV

Silicone Resins:

Silicones: Thermoplastic and Thermoset: Preparation of intermediates, Grignard's method, direct method, olefin addition method, sodium condensation method, rearrangement of organochlorosilanes. Nature and effect of Si-H, Si-O, Si-Si, and Si-C bond. Effect of different functional groups on properties, Silicone fluids, resins, elastomers, RTV silicones. Their compounding, processing , applications and properties.

UNIT- V

Thermosetting acrylics:

Synthesis of acrylic polymers and co-polymers, application of thermosetting acrylics, like anaerobic adhesives.

Alkyd resins: Basic components like polyfunctional alcohols, poly-basic acids, vegetable oils/fatty acids. Different types of drying oils: drying, semi-drying and non-drying with examples. Influence of all these components in the synthesis and properties of the final alkyds obtained modification of alkyds: modification with rosin, maleic anhydride, acrylics, vinyls.

Reference Books;

- 1. Composite Polymeric Material, R. P. Sheldon, Applied Science Publishers, (1982).
- 2. Composite Material Handbook, M. M. Schwartz, McGraw-Hill company, (1984).
- 3. Polymer chemistry, Seymour and Carraher, Marcel Dekker, (2003).
- 4. Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D.Van Nostrand Company Inc, (1959).
- 5. Organic Coating: Science and Technology by Z. Wicks.Wiley Interscience, (2007).

PME 452 MEASUREMENT & METROLOGY LAB

L T P 003

Experiments: Minimum 8 out of following (or similar experiments)

- 1. Study & working of simple measuring instruments- Vernier calipers, Micrometer, Tachometer.
- 2. Measurement of effective diameter of a screw thread using 3 wire methods.
- 3. Measurement of angle using Sine bar & slip gauges.
- 4. Study of limit gauges.
- 5. Study & angular measurement using level protector
- 6. Adjustment of spark plug gap using feeler gauges.
- 7. Study of dial indicator & its constructional details.
- 8. Use of dial indicator to check a shape run use.
- 9. Study and understanding of limits, fits & tolerances
- 10. Study of Pressure & Temperature measuring equipment.
- 11. Strain gauge measurement.
- 12. Speed measurement using stroboscope.
- 13. Flow measurement experiment
- 14. Vibration/work measuring experiment.
- 15. Experiment on Dynamometers.

PPP-451 ANALYSIS AND IDENTIFICATION OF POLYMERS LAB

L	Т	P
0	0	3

Minimum 8 Experiments

- 1. Identification of unknown polymer using heating, burning, solubility.
- 2. Confirmatory chemical tests for Identification of unknown polymer.
- 3. Quantitative estimation of the purity of phenol used in the manufacture of phenol formaldehyde resins.
- 4. Quantitative estimation of the aldehyde contents in formaldehyde used in the manufacture of phenol formaldehyde resins.
- 5. Determination of water soluble matter in given pigment.
- 6. Determination of boiling point of a given solvent.
- 7. Determination of melting point of a given solid resin by capillary method.
- 8. Determination of refractive index of a liquid resin.
- 9. Determination of specific gravity of given resin by pycnometer.
- 10. Determination of solubility of a given polymer in different solvents.
- 11. Determination of viscosity of a resin by Ford Cup or Brook field viscometer.
- 12. Determination of gel time of a thermoset materials at a given temperatre.

TPP-501 Polymer Structure and Property Relationship

L	Т	P
3	1	0

Unit-I

Structure of polymers. Linear, branched, cross linked, 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.

Unit-II

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 . Crazing in glassy polymers. Ductile brittle transition. Effect of additives on mechanical properties of polymers. Creep, stress relaxation, and fatigue.

Unit-III

Thermodynamic and transition properties: Transition temperature in polymers, glass transition (Tg), melt transition (Tm), relationship between Tg and Tm. Other transitions like β-transitions, upper and lower glass transition temperatures. Prediction of Tg and Tm 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.

Unit -IV

Electrical 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

Unit -V

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.

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. A Text book of Polymer Science by F.W. Billmeyer, John-Wiley and Sons (2011).

4. Polymer Chemistry by R. B. Seymour and C.E. Carraher, Marcel Dekker (2003).

TPP-502POLYMER RHEOLOGY

L T P 3 1 0

Unit –I :

Viscosity and polymer processing, other rheological properties of fluids, shear stresses in polymer systems, non-Newtonian flow, practical melt viscosities, flow in channels, simple shear flow, melt-flow index.

Unit –II :

Types of fluids and rheological models, techniques for rheological measurements by capillary, parallel plate and cone & plate viscometers. Simple elongational flow and its significance. Dynamic flow behavior, time dependent fluid responses.

Unit –III :

The elastic and viscoelastic state of polymers. Viscoelasticity - relationships of various approaches taken in describing the viscous and elastic properties, Maxwell model and Voigt model, Boltzmann superposition principles, dynamic mechanical testing.

Unit –IV :

Mixing: Types of mixing, concept and importance of master batches. Mixing of additives with the polymers, melt compounding and calendaring.

Unit –V :

Types of mixers: High speed mixer, two roll mill, internal batch mixers (Banbury, Haake), single screw & twin screw extruders, flow mechanism, analysis of flow (drag, pressure and leak flow).

Reference Books:

- 1. Introduction to Polymer Viscoelasticity by J. Aklonis and W. J. Macknight, John Wiley & Sons(2005).
- 2. Polymer Science and Technology of Plastic and Rubber by P. Ghosh, Tata McGraw Hill (2010).
- 3. Fundamental Principles of Polymeric Materials by S.L. Rosen, Wiley-Interscience (2012).
- 4. Melt Rheology and Its Role in Plastic Processing by J. M. Dealy and K.F. Wissbrum, Springer(1999).
- 5. Applied Rheology in Polymer Processing by B. R. Gupta, Asian Books (2004).

Suggested Reading:

(Ref. 1 for Chap. 1), (Ref. 2 for Chap. 2), (Ref. 3 for Chap. 3), (Ref.4 for Chap. 4), (Ref.5 for Chap. 5)

TPP-503CHARACTERIZATION OF POLYMERS

L	Т	Р
3	1	0

Unit-I

Basic principles of spectroscopy, molecular and atomic spectra, Lambert-Bear law, Frank- condon principal, electromagnetic radiation, properties of electromagnetic radiation, interaction of radiation with matter: A classical picture, uncertainty and the question of time scale.

Unit-II

Applications of spectroscopy: IR, FTIR, UV, NMR and mass spectroscopy of polymers.

Unit-III

Chromatography: Thin layer chromatography, high performance liquid chromatography, gel permeation chromatography (GPC), gas chromatography in the area of polymeric materials.

Unit-IV

Applications of optical microscope, SEM, TEM and XRD in polymers.

Unit - V

Determination of molecular weight by viscometry, end group analysis, colligative property, osmometry, light scattering technique, gel permeation chromatography.

Reference Books

- 1. Instrumental method of analysis, by H. H. Willard, Wadsworth Publishing Co. Inc. (1988).
- 2. Principle of Instrumental Analysis, by D. A. Skoog, F. J. Holler, S. R. Crouch, Harcourt College (1997).
- 3. Handbook of Plastic Testing & Technology by V. Shah, Wiley-Interscience (2007).
- 4. Experimental Methods in Polymer Sciences by T. Tanaka, Academic Press (1999).
- 5. Spectrometric identification of organic compounds. Silverstein, Robert M John Wiley (2005).
- 6. A complete introduction to NMR spectroscopy by R. S. Macomber, Wiley-Interscience (2008).

Suggested Reading

(Ref. 1 & 2 for Chap.1), (Ref. 3 & 4 for Chap. 2), (Ref. 5 for Chap. 3 & 4), (Ref.6 for Chap. 2)

PLASTIC PROCESSING-I

LTP 310

Unit – I

Processability of polymers and the role of rheology in polymer processing

Unit – II

General description of extrusion processes, type of extruders, screw and their output in terms of drag, leakage and pressure flow, influence of screw dimensions and output, die and screw characteristics. Design of barrel and screw for commodity, heat sensitive and engineering polymers. Barrier Screws.

Unit – III

Individual extrusion systems, Dies, Sizing and Downstream equipments, Faults, Causes and Remedies for film, pipe, lamination, profiles, cables, sheet, Box Strapping.

Unit – IV

Twin-screw extrusion and Co Extrusion systems. Casting of films. Multi layer systems for Films and Pipe . Faults , Causes & Remedies.

Unit – V

General description of Compression and Transfer moulding and its application in processing of thermosetting materials. Faults , Causes & Remedies

Recommended Books :

- 1. Berins, "Plastics Engineering Hand book" Society of the Plastics Industry, (1991)
- Allen , W.S & Baker , P.N. "Hand book of Plastics Technology, Hanser Publication, (2006)
- 3. Chris Rauwendaal, "Polymer Extrusion" Hanser Publication, (2001)
- 4. lsayev, A.I "Compression molding" Marcel Dekker Inc, (1989)

TPP-505PLASTICS TESTING TECHNIQUES

L T P 3 1 0

Unit-I

Principles and methods of standardization, statistical method of analysis. Standards: BIS standards – BIS standards of few polymers. ASTM standards – ASTM standards of few polymers. Evaluation of errors in polymer testing.

Unit-II

Mechanical properties: Thermal and mechanical analysis of polymers

- (a) Short term strengths: Tensile, Flexural, Impact, Tear resistance, Abrasion resistance.
- (b) Long term strengths: Creep and fatigue properties.
- (c) Thermal properties: Thermal conductivity, thermal diffusivity, specific heat

capacity, linear thermal expansion, heat distortion temperature, vicat softening point, low temperature flexibility etc.

Unit-III

Flammability properties: Oxygen index, critical temperature index, smoke density, flammability tests .

Unit-IV

Optical properties: Gloss, haze, refractive index, degree of yellowness etc.

Unit-V

Permeability: Definition, permeability to gases, standard methods of measuring, permeability of gases, other methods of measuring permeability. Environment resistance – cause of deterioration of polymer by weathering, assessment of deterioration, natural weathering, artificial weathering. Chemical resistance.

Reference Books

- 1. Handbook of Plastic Testing & Technology by V. Shah, Wiley-Interscience (2007).
- 2. Rubber Technology Handbook by Martin and Smith, Smithers Rapra Technology (2009).
- 3. SPI Plastic Engineering Handbook by M.L. Berins. Springer-Verlag (1991).
- 4. Blythe A R, Electrical Properties of Polymers, Cambridge University Press, Cambridge, (1979)

Suggested Reading

(Ref. 1 for Chap.1 & 2), (Ref. 2 for Chap.3), (Ref. 3 for Chap. 4 & 5), (Ref.4 for Chap. 6)

TPP 506PLASTIC PRODUCT & MOULD DESIGN

L T P 3 1 0

Unit -I

Design of polymeric product. Design criteria based upon product functions and geometry. Material selection by property assessment. Selection of appropriate forming processes. Moulding considerations: Draft, radii, dimensional tolerances, wall thicknesses, ribs and bosses, inserts, sink marks, undercuts, feeding system, gate location, flow pattern, shrinkage and post moulding shrinkage.

Unit-II

Design of Plastic under static load; Design of Plastic under Dynamic load – Gear Bearing. Metal insert, hinge, fastners.

Unit-III

Injection mould design: Single, multicavity, semi automatic and automatic moulds. Types of injection mould, their application, detailed structure and working. Feed system, Temperature control system, Ejection System, Standard Mould base.

Unit – IV

Split Mould and types of mechanism, Unscrewing mechanism, Introduction to Hot Runner mould. Design concepts for compression moulds, transfer moulds and blow moulds.

Unit -V

Extrusion Dies - Types of extrusion dies and design characteristics. Die Design for Pipe and sheets.

Reference Books :

- 1. David H Morton Jons John W ellis "Polymer product design materials and processing" Hanser Publication
- 2. Rao NS "Design data for plastics engineers" (2000)
- 3 Bebb,R.H., "Plastics Mould Design," Vol.1, Compression and Transfer Moulds, (2006)
- 4. Pye R.G.W., "Injection MOULD Design for Thermoplastics" (1968)

PPP-551

Minimum 8 Experiments

LTP

0 0 3

- 1. Suspension polymerisation of Styrene/MMA.
- 2. Preparation and testing of UF/PF/MF resins.
- 3. Preparation and testing of Diglycidyl ether of bis phenol-A (DGEBA).
- 4. Bulk and solution polymerisation of Methyl Methacrylate/Styrene.
- 5. Emulsion polymerisation of Styrene/ Methyl Methacrylate.
- 6. Copolymerization of styrene & MMA and determination of reactivity ratios.
- 7. Preparation of Poly(vinyl butyral).
- 8. Preparation of unsaturated polyester resin & determination of its acid value .
- 9. Preparation of saturated polyester resin and determination of its acid value.
- 10. Synthesis of copolymers based on any common monomers like styrene, acrylates,

PPP-554

PLASTING PROCESSING LAB

L T P 0 0 3

Minimum 8 Experiments

- 1. Auto Injection Moulding Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 2. Micro-Processor Controlled Injection Moulding Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 3. Extrusion Process Free sketch of Machine, Study of Parts & their function. Practice on Die setting, Cycle time analysis, Start up and shut down Procedure.
- 4. Compression Moulding or Transfer Moulding Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 5. Blow moulding Process Free sketch of Machine, Study of Parts & their function, Parison die. Practice on Die centering, Cycle time analysis, Start up and shut down Procedure.
- 6. Thermoforming (Vacuum forming) Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 7. Rotational Moulding Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 8. Plastics coating Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 9. Plastics Sealing Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 10. Plastics welding Process Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
- 11. Screen-Printing on Plastics
- 12. Hand lay Process for FRP Study of resin and other components. Making of a product.

TPP -601 POLYMERIC ADHESIVES AND SEALENTS

L T P 3 1 0

Unit-I

Introduction to polymeric foams and adhesive, adhesion and adhesive joints, Advantages and Disadvantages of adhesive bonding over conventional joining techniques, theory and mechanism of adhesion.

Unit-II

Surface characterization, surface preparation and surface treatments for various substrates. Techniques for evaluation of adhesives.

Unit-III

Principle of adhesives formulation and production techniques, Adhesives formulation for various industries viz. construction, packaging, textiles, automotive, consumer, abrasives and friction material shoes, electrical, aerospace, etc. types of polymeric foams, viz. expanded polystyrene, polyurethanes, polypropylene, etc.

Unit-IV

Hot melt, polymerizing, solution, solvent-activated anaerobic and pressure sensitive adhesives, etc. Bonding of polymeric materials to various substrates

Unit-V

Sealants, caulks, Mastics, Type of sealants, curing of sealants, properties and formulation relevant to different application.

Reference Books

- 1. Hand Book of Adhesives, by Skiest, I, Springer, (1989)
- 2. Industrial Cold Adhesive, by Roger Dulac, Charlles Griffin & Co, (2007)
- 3. Handbook of Adhesives Raw material, by Ernest W. Flick, Noyel Publication, (1982)
- 4. Sealants & Adhesives, by H.A. Perry, Elsevier Butterworth Heinemann, (2004)

TPP-602 POLYMER BLENDS AND COMPOSITES

L T P 3 1 0

Unit-I

Introduction of Polymer Blends, Methods of blending, Phase Behaviour, The incompatibility problem, methods of compatibilization. Properties of blends (mechanical, morphological, rheology and thermal),

Unit-II

Different types of polymer blends (TPE, elastomeric blends and plastic blends).Characterization of blends by various techniques.

Unit-III

Introduction and classification of composites, selection criteria for polymer matrices for composites.

Unit-IV

Fabrication Processes: hand-lay up process, spray-up technique, pultrusion, filament winding process, Prepeg technology, injection and compression moulding, vacuum bag moulding, fiber placement process, reaction transfer molding, laminating techniques, expansion processes, radiation processes, coating processes, fabrication processes: adhesion, cohesion and mechanical processes & FRPs.

Unit-V

Design of composite products: Basic design practice – material considerations, product considerations and design considerations.

Reference Books

- 1. Polymer Blends Volume 1 & 2, by D. R. Paul and C. B. Bucknall, Wiley-Interscience (2000).
- 2. Polymer Blends by Lloyd M. Robeson, Hanser Gardner (2007).
- 3. Polymer Blends by D. R. Paul and Seymour Newman, Academic Press (2000).
- 4. Polymer Blends Handbook Vol 1 & 2 by L. A. Utracki, Kluwer Academic (2003).
- 5. Polymer Composites by S. Thomas, K Joseph, S. K Malhotra, K. Goda, M. S. Sreekala, Volume 1, Wiley-VCH (2012).

Suggested Readings:

(Ref. 1 & 2 for Chap. 1), (Ref. 3 & 4 for Chap. 2), (Ref. 5 for Chap. 3, 4 & 5),

TPP-603 PLASTICS PACKAGING TECHNOLOGY

LTP 310

Unit - I

Functions of packaging, advantages of plastic packaging, distribution hazards, special requirements of food and medical packaging, packaging legislation and regulation. Packaging as a system: Elements, approach, package, design, relation criteria for packaging materials, packaging equipment checklist, case histories Major packaging plastics PE, PP, PS, PVC, polyesters, PVDE, vinyl acetate, PVA, EVA, PV Alcohol, PA,PC ionomers & fluro polymers.

Unit-II

Conversion process – Moulding, Extrusion, Rotary thermoforming, Lamination, metalizing, decoration process, Shrink wrapping, Pallet & stretch wrapping, sealing methods, Plasma barrier coatings

Unit-III

Extrusion, film and flexible packaging – extrusion, cast film & sheet, Blow film, Multi layer film & sheet coatings, laminations & co-extrusions, stretch and shrink wrap, pouching, sealing, evaluation of seals in flexible packages, advantages of flexible packaging – flexible packaging products.

Unit-IV

Thermoformed packages: Position & thermoforming & wrap forming, variations in thermoforming and solid phase pressure forming, scrabbles, twin sheet & melt – to- mold thermoforming, skin packaging, thermoforming moulds, thermoforming fill- real, Polystyrene & other foams systems cushioning

Unit-V

Testing plastic packages- Barrier, Migration & compatibility, printing, labeling & pigmenting, Sterilization for health care products. Packaging hazards and their controls-Environmental considerations.

Reference Books

- 1. Susan E.M. Seleke, Understanding plastic packaging Technology, Hanser publications Munich, (1997)
- 2. A.S. Altalye, Plastics in packaging, Tata McGraw Hill publishing Co. Ltd., New Delhi, (2001)
- 3. Briston; John H. and Katan; Leonard L., Plastics in Contact with Food, Food Trade Press Ltd., London (1974).
- 4. Briston; John, Advances in Plastics Packaging, Pira International, Leatherhead (1992).

TPP-604

ADDITIVES & COMPOUNDING

L T P 3 1 0

Unit -I

Importance of additives and their selection criteria for commercial polymers.

Unit – II

Additives for plastics and their mechanism of function:

Stabilizers, Fillers, Plasticizers, Lubricants, Flame retardants, Foaming agents, Cross Linking agents, Metal deactivators

Unit – III

Additives for rubbers and their mechanism of function:

Vulcanizing agents and retardents, Accelerators, Activators, Fillers, Softeners, Colors and pigments, Tackyfing agents, Blowing agents, Surface properly modifiers

Unit –IV

Mixing Equipments.

Intensive and Extensive Mixers - Machine construction - specifications - temperature control system - operating characteristics. Pelletizers .

Unit-V

Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

Reference Books;

- 1. Polymer Modifiers and Additives, by Lutz, Dekker (2001)
- 2. Chemistry and Technology of Polymer Additives, by Al-Malaika, Elsevier Applied science(1999).
- 3. Plastic Materials, by J. Brydson, Butterworth-Heinemann(1999).
- 4. Handbook of Rubber Technology, by Martin and Smith, CBS Publishers(2007).
- 5. Polymer Science and Technology: Plastic, Rubber Blends and Composites, by P. Ghosh, Tata McGraw Hill (2010)

Suggested Reading:

(Ref. 1 for Chap.1), (Ref. 2 & 3 for Chap.2), (Ref. 4 & 5 for Chap. 3), (Ref.5 for Chap.4)

TPP 605PLASTIC WASTE MANAGEMENT AND RECYCLINGLTP331

Unit-I

Definition of plastic wastes and litter, basis for assessing plastic wastes, applications of plastics and their potential as sources of waste. Separation techniques (density - float sink and froth floatation methods, optical, spectroscopic, sorting by melting temperature).

Unit-II

Thermoplastic waste management: 4 R's approach (reduce, reuse, recycle (mechanical and chemical), recover), recycling classification- - primary – secondary - tertiary - quaternary recycling with examples.

Unit-III

Disposal processes and Various waste treatment methods – controlled tipping, pulverization, compositing, Energy from waste –(incinerators- pyrolysis, factors affecting incineration), new developments in thermal disposal of refuse, on-site disposal methods, compacting and baling.

Unit-IV

Recycling of Polyolefins, PVC, PET, Polystyrene, Polyamides (Nylon-6 and Nylon-6,6).

Unit-V

Recycling of Thermosets –reclaiming of rubber –pyrolysis, depolymerization of scrap rubber, tyre retreading, uses of recycled rubber.

Reference Books

- 1. Rubber and Plastic Waste: Recycling, Reuse and Future Demand by R. Chandra and A. Adab, CBS Publisher (2004).
- 2. Medical, Municipal and Plastic Waste Management Handbook by NIIR Board of Consultant and Engineers, National Institute of Industrial Research (2007).
- 3. Polymer Recycling by J. Scheirs, John Wiley & Sons (1998).
- 4. Handbook of Rubber Technology by S. Blow, Hanser Gardner (2000).
- 5. Recycling and Recovery of Plastics by J. E. Bandrup, Hanser Gardner (1996).
- 6. Introduction to plastics recycling by V. Goodship, Rapr (2007).

Suggested Reading

(Ref. 1 for Chap.1), (Ref. 2 for Chap. 2), (Ref. 3 & 4 for Chap. 3), (Ref. 5 for Chap.4), (Ref.6 for Chap. 5)

TPP 606PLASTIC PROCESSING-II

L T P 3 1 0

Unit - I

Basic concepts of injection moulding for thermoplastics. Machine layout, construction and specification, type of injectionunits. Principle and theory of standard operation, elements of moulding cycle, screw plasticizing and conveying output, screw driver principles, outline of mould features, clamping devices-hydraulic and toggle types.

Unit – II

Process variables and their importance, temperature, pressure, injection rate, etc. Faults and remedies in injection moulding. Injection moulding of thermosets. Reaction injection moulding.

Unit - III

Description of various thermoforming processes-simple vacuum, drape, bubble and plug assisted formings. Thermoforming and process variables affecting the product quality. Machining of Plastics

Unit - IV

General description of blow moulding processes, type of blow moulding machines, parison control, types of Dies, process variables, problems and their remedies. Stretch blow moulding.

Unit - V

Rotational moulding- description and features of rotational moulding and its comparison with blow moulding. Welding / Joining of Plastics - Defination, Principle of Working ; FRP Processes - Hand lay, Spray, Autoclave, Filament winding, Pultrusion , Matched mold - Principal & working. Faults and remedies.

Reference Books;

- 1. Injection Moulding Handbook, Dominick V. Rosato and D.V.Rosato, CBS Publisher (2000)
- 2. Polymer Processing by Morton and Jones, Chapman & Hall, (2007)
- 3. Thermoforming by J.L.Thorne, Hanser Publishers, (1988)
- 4. Rotational Molding by Glenn L. Beall, Hanser Publishers, (1998)

PLASTIC MATERIAL TESTING LAB

L T P 0 0 3

Minimum 8 Experiments

PPP - 651

- 1. Determination of Ash Content in plastics materials.
- 2. Determination of Moisture Content in plastics materials.
- 3. Determination of Filler content in plastics materials.
- 4. Determination of Melt flow index of plastics materials.
- 5. Determination of Tensile strength, cross breaking strength and shearing strength of plastics materials.
- 6. Determination of Impact strength (Charpy and Izod type) and compressive strength of plastics materials.
- 7. Determination of Electrical Properties of plastics materials such as break down voltage, insulastion resistance and arc resistance.
- 8. Determination of Density of plastic materials.
- 9. Determination of Bulk density for powder materials.
- 10. Determination of heat distortion temperature of a plastic materials.
- 11. Determination of abrasion resistance of a polymer film.

TPP -701 INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

LTP 310

Unit I

Industrial safety, Industrial hygiene and safety aspects related to toxicity, noise, pressure, temperature, vibrations, radiation etc. Explosions including dust, vapor, cloud and mist explosion.

Unit II

Elements of safety, safety aspects related to site, plant layout, process development and design stages, identification of hazards and its estimation, risk, risk analysis and assessment methods; fault free method, event free method, scope of risk assessment, controlling toxic chemicals and flammable materials.

Unit III

Toxic substances and degree of toxicity, its estimation, their entry routes into human system, their doses and responses, control techniques for toxic substances exposure, use of respirators, ventilation systems.

Unit IV

Prevention of losses, pressure relief, provision for fire fighting, release of hazardous materials from tanks, pipes through holes and cracks, relief systems: types and location of reliefs.

Unit V

Handling, transportation and storage of flammable liquids, gases, and toxic materials and wastes, regulation and legislation, government role, risk management routines, emergency preparedness, disaster planning and management.

Reference Books;

- 1. D. A. Crowl and J.F. Louvar Chemical Process Safety (Fundamentals with Applications), Prentice Hall (1990)
- 2. H.H. Fawcett and W.S. Wood Safety and Accident prevention in Chemical Operations, 2nd Edition, John Wiley &Sons,New York, (1982).
- 3. Coulson & Richardson's Chemical Engineering Vol. 6 R.K. Sinnott, Butterworth Heinmann Ltd., (1996).
- 4. Sanjoy Banerjee, Industrial Hazards & Plant Safety, CRC Press, (2002)

CAD/CAM

UNIT I :

CAD TOOLS : Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, Review of C, C++, statements such as if else for while & switch, functions pointernotations, structure & class, concept of OOP. 4

GEOMETRICMODELLING: Output primitives- Bresenham's line drawing and Mid-point circle algorithms. Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves. 3 **UNIT II:**

SURFACE MODELING :Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder. 3

PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES -

Hermite Bicubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation – Displaying,

Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).4 **GEOMETRICMODELLING-3D :** Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

UNIT III :

CAD/CAM Exchange : Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. 4

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems. Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis. **UNIT – IV**

NC Part Programming-

Manual (word address format) programming. Examples Drilling and Milling. **UNIT** – **V**

System Devices- Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa.

4 Interpolators- Principle, Digital Differential Analysers. Linear interpolator, circulator Interpolator and its software interpolator. Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control

References;

1. CAD/CAM Theory and Practice – Ibrahim Zeid ,TMH

- 2. CAD/CAM Groover & Zimmers Pearson
- 3. Computer Oriented Numerical Methods Rajaraman PHI Learning

NYLON TECHNOLOGY

L T P 3 1 0

Unit -I

Introduction- nylon synthesis - principle of polyamidation- polymerization techniquespolymerization equilibria. Kinetic molecular mass, deformation of chemical attack.

Unit-II

Physical structure: Structure properties relationship-crystallizing, melting temperature, to solubility, molecular weight, melt viscosity, degradation and stabilization, Identification and characterization of nylon. Properties (tribological, durability, water absorption dimension stability (immersion resistance, thermal/ electrical/optical properties, flammability, resistance to permeation).

Unit -III

Fundamentals of Melt Processing: Measurements of viscosity, PVT relationships, importance of moisture, effect of molecular mass, shear, temperature, additives and channel shape.

Unit - IV

Processing techniques of melt processing: Processing reagents, material handling and drying, injection moulding, extrusion, blow moulding and monomer processing.

Other processing Techniques: Powder coating, blending and solution coatings. Secondary Treatments: Assembly, Moisture conditioning, mechanical surface clearing, and decorating.

Unit -V

Modification: Physical change- co-polymerization-transparent nylons, filled and reinforced nylons, toughened nylons, fire retardant nylons, plasticized and lubricated nylons, additives for heat stabilization, processing and color and other modifications. Commercial Nylon Blends And Their Applications

Raw materials- preparation –polymerization- Methods of manufacturing, modifications, processing (methods, procedure processing parameters etc)

Reference Books:

- 1. Malvin I. Kohan (ed.) Nylon plastics hand book, Hanser publisher, (1995).
- 2. Nicholar P. Chermisinof (ed.) Hand book of engineering Polymeric materials Marcel Dekker inc.N.Y.(1994)
- 3. Nylon Plastic Technology by William Edger Nelson, Plastic and Rubber Institute, (1976)
- 4. Nylon Fiber Reinforced Polymer Composites by Thomas S, et, al, Valerio Causin, (2012)

TPP -703FIBRE MANUFACTURING TECHNOLOGYLTP310

Unit – I

Introduction to manmade fibres: Definition of made fibres. Brief history of manmade fibres.Relative merits and demerits of manmade fibres and natural fibres. **Unit – II**

Conversion of polymers into fibres: Basic production systems of the man made fibre. Concept of melt spinning, dry spinning and dry jet wet spinning process. Factors influencing selection of a particular process for fibre formation. Relative merits and demerits of melt, dry and wet spinning processes. Effect of parameters on fibre breakage and fibre structure. Spinnability and factors affecting chain length. Variables of spinning. Different components of spinning process, i.e., extruder, gear pump, filters, manifold, spinning head, quenching chamber, winders. Quenching/Solidification techniques.

Unit – III

Melt spinning: Raw material, technology of polymerization and extrusion of polyester, nylon -6, nylon 66 and polypropylene. Effect of process parameters on structure and properties of melt spun filament. Characteristic features of PET, polyamide and polypropylene spinning.

Unit – IV

Solution dry spinning: Dry spinning of cellulose acetate. Acetylation of cellulose. Dope preparation and spinning of cellulose diacetate and triacetate. Dry spinning of acrylic. Significance and types of co-monomers used during polymerization of acrylic.

Unit – V

Solution wet spinning: Wet spinning of viscose rayon. Formation of structure in viscose and thermoplastic fibres. Influence of various additives and temperature of the regeneration bath and their influence on the process and properties of viscose rayon.

Drawing and heat setting of fibres: Introduction to drawing and heat setting in thermoplastic fibres. Concept of neck drawing. Effect of drawing conditions on the structure and properties of fiber. Effect of heat setting parameters on the structure and properties of fiber.

Reference Books:

- 1. Production of Synthetic Fibres by A A Vaidya, 1st Ed., Prentice Hall of India, New Delhi,(1988).
- 2. Manufactured Fibre Technology by V B Gupta and V K Kothari, 1st Ed., Chapman and Hall, London, (1997).
- 3. Synthetic Fibres by J. E. Macintyre, Wood Head Fiber Science Series, UK, (2003).
- 4. Textile Fibers: Developments and Innovations by V K Kothari, IAFL Publications, New Delhi(2000).

Suggested Readings:

(Ref. 1 for Chap.1 & 2), (Ref. 2 for Chap. 3& 4), (Ref. 3 for Chap. 5), (Ref.4 for hap.6),

POLYMER CHARACTRIZATION LAB

L T P 0 0 3

Minimum 8 Eperiments

- 1. Determination of Melt Flow Index of different Plastics Materials.
- 2. Determination of molecular weight by viscometry.
- 3. Determination of K-value of PVC.
- 4. Study of rheological properties of concentrated polymeric solution by Brook field viscometer or Rheoviscometer under variable shear rates.
- 5. Characterization by Weight loss of common polymers by Thermogravimetric, Analysis, (TGA).
- 6. Characterization of Filler Content /Ash Content of common polymers by Thermogravimetric, Analysis, (TGA).
- 7. Characterization of Thermal stability of common polymers by Thermogravimetric, Analysis, (TGA).
- 8. Characterization by Melting Range of common polymers by Differential Scanning Calorimetry (DSC).
- 9. Characterization by Tg of common polymers by Differential Scanning Calorimetry (DSC).
- 10. Study of the curing behaviour of epoxy resin system by Differential Scanning Calorimetry (DSC).
- 11. Determination of Gel time of a thermoset resin at a given temperature.
- 12. Identification of a polymer by Infrared Spectroscopy.

MINOR PROJECT

PPP - 702

L T P 0 0 3

The student would be allotted a project in the beginning of the VII semester itself. The project will be based in the area of polymer science/ technology. The student will draw the action plan and complete the literature review during this semester in consultation his/her assigned teacher and submit a report of his work carried out during this semester. The practical/design work shall be carried out in the eighth semester.

PPP – 703 IDUSTRIAL TRAINING REPORT PRESENTATION

L T P 0 0 2

The Student will make a presentation about the work done in industry where he/she has undergone in plant training during summer vacations and also submit a Industrial Training Report in the Department.

LTP 310

Unit-I

Quality Concepts Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality Methods and Techniques for manufacture, Inspection and control of product, Quality in salesand services, Guarantee, analysis of claims.

Unit-II

Quality Management Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme. Human Factor in Quality Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Charts Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-Charts.

Unit-IV

Defects Diagnosis and Prevention Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, qualitycircle.

Unit-V

ISO-9000 and its concept of Quality Management: ISO 9000 series, Taguchi method, JIT in some details

References:

1. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, (1990). .

- 2. Greg Bounds. "Beyond Total Quality Management". McGraw Hill, (1994).
- 3. Menon, H.G, "TQM in NewProduct manufacturing", McGraw Hill (1992)

TPP 801 SURFACE COATING TECHNOLOGY

UNIT-I

Origin and development of surface coatings. Constituents of paint, varnishes and Lacquers.

UNIT-II

Functions of coating and mechanism of film formation. Characteristics of natural and synthetic film forme

UNIT-III

Pigments and pigmentation. Dispersion techniques. Fundamentals of coating formulations based on natural and synthetic polymers. Role of wetting agents, driers, solvents and plastisizers in coatings.

UNIT-IV

Surface preparation and pretreatments. Rheological behaviors of coatings. Application methods and curing techniques.

UNIT-V

Specialty coatings like water based, powder and high solid, etc. industrial and architectural finishes.

Reference Books-

- 1. Organic Coatings: Science and Technology, Zeno W. Wicks, John Wiley and Sons Ltd , (2006)
- 2. Surfactants in Polymers, Coatings, Inks and Adhesives, Edited by D.R. Karsa, (2003)
- 3. Arthur A. Tracton, Coatings Materials and Surface Coating ; ; Taylor & Francis Ltd, CRC Press (2006)
- 4. Donatas Satas, Arthur A Tracton , Coatings Technology Handbook, (2004)
- 5. Socrates Peter Pappas, Zeno W Wicks, Organic_Coatings: Science and Technology, Wiley Interscience, (1999)
- 6. Arthur A Tracton, Coatings Technology: Fundamentals Testing, CRC Press, (2007)

POLYURETHANE TECHNOLOGY

L	Т	Р
3	1	0

UNIT - I

Introduction to polyurethane- chemistry and materials of polyurethane manufacture: basic reaction, cross linking in polyurethane, important building blocks for polyurethane (isocynates, polyols, amines and additives) - The manufacturer of polyurethanes (the process, parameters and controls).

UNIT - II

Polyurethane processing-basic design principles of polyurethane processing equipment - steps in the polyurethane processing.

Flexible foams-(production, properties and application slabstock foam, carpet backing, flexible molded foams & semirigid molded foams.

Reinforced RIM - trends in the use of RIM and RRIM.

UNIT-III

Rigid polyurethane foams-chemistry of raw materials, manufacturing of rigid polyurethane (manufacturing of buns, panels, foaming of applications, molded rigid foams), properties, relationship between production methods and properties- application of rigid polyurethane. Polyurethane skin integral foam- production, properties and applications.

UNIT - IV

Solid polyurethane materials- polyurethane casting systems (cast elastomers and casting resins)-thermoplastic polyurethane elastomers: productions / processing, properties and applications, polyurethane, pains, technique and coatings, adhesives builders, elastomers fibers, manufacture / processing and applications.

UNIT - V

Determination of composition and testing of polyurethane-chemical compositions, detection methods, identification of functional groups, determinations of properties materials and products (Characterisation, physics/mechanical, temp dependence, chemical performance, combustibility) polyurethane and environment health and safety: making and using polyurethane safety.

Reference Books

1. Dr. Gumter Oertal (ed.), Polyurethane Hand Book, Hanser Publication Munich.(1985)

- 2. George woods, The ICI Polyurethane book -published Journals by ICI, John Wiley and sons NY, (1990)
- 3. Bruins; Paul F. (Ed.), Polyurethane Technology, Interscience Publishers, NewYork(1969)
- 4. Polyurethane and Related Foams Chemistry and Technology by Kaneysoshi Ashida, Taylor & Francis Group, (2006)

TPP 804TECHNOLOGY OF ELASTOMERS

L T P 3 1 0

Unit-I

Sources and history of natural and synthetic elastomers, significance of structure of elastomers. Mastication, compounding ingredients and methods of compounding. Reinforcing fillers and mechanism of reinforcement of elastomers.

Unit-II

Production of different grades of natural rubber from latex, modified and natural rubber derivatives, Reactions of rubber, application of latex, technically specified rubber, chemistry and technology of vulcanization.

Unit-III

Manufacturing processes, properties and application of synthetic elastomers viz. styrene-butadiene rubers, Acrylonitrile-butadiene rubber, butyl rubber, polychloroprene rubber.

Unit-IV

Manufacturing processes, properties and applications of ethylene-propylene rubber, polyurethane elastomers, chlorosulphonated polyethylene, polysulphide and silicon rubber, thermoplastic elastomers.

Unit-V

Industrial fabrication of rubber article such as transmission belts, hoses, tyres, purged goods, compounding and processing techniques, Direct manufacture of articles from latex.

Reference:Books -

1. C. Keith Riew, "Rubber toughened Plastics, American Chemical Society, (1989)

- 2. John Dick,"Rubber Technology" Hanser Gardner Publications, (2001).
- 3. Rubber Technology, Morell S.H. Applied Science Publication, (1981)
- 4. Hand Book of Rubber Technology by Smith and Martin, CBS Publisher, (2007)
- 5. Hand Book of Rubber Technology by S.Blow, Hanser Gardner, (2000)

PPP - 801

PROJECT

L T P 0 0 3

0 0 2

The student would be allotted a project in the beginning of the seventh semester itself. The project will be based on the area of polymer science/ technology. The student will draw the action plan and complete the literature review during seventh semester in consultation his/her assigned teacher.

The practical / design work on the topic assigned in the seventh semester will be carried out during this eighth semester. The student will submit the dissertation and make a presentation on his work to the board of faculty members of the department and University examiner.

PPP 802 SEMINAR L T P

The student would be assigned a topic in the field of polymer science/ technology in the beginning of the semester itself. The student will work on the assigned topic and submit a report and present the work to faculty members of the department.