

U.P. TECHNICAL UNIVERSITY, LUCKNOW



Syllabus

2nd , 3rd and 4th Year
[Effective from session 2009-10]

B. Tech. in Plastic Engineering

U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Plastic Engineering
[Effective Form session 2009-10]
Year 2nd, SEMESTER-III (Common with B. Tech . Mech. Engg.)

S.No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EHU-301	Industrial Psychology	2	0	0	15	10	25	50	75	2
2	EAS-301	Mathematics-III	3	1	0	30	20	50	100	150	4
3	ECE-301	Fluid Mechanics	3	1	0	30	20	50	100	150	4
4	EME-301	Material Science in Engineering	3	1	0	30	20	50	100	150	4
5	EME-302	Strength of Material	3	1	0	30	20	50	100	150	4
6	EME-303	Thermodynamics	2	1	0	15	10	25	50	75	3
Practical / Design / Drawing											
7	EME-351	Material Science & Testing Lab	0	0	2	10	10	20	30	50	1
8	EME-352	Machine Drawing-I	0	0	3	10	10	20	30	50	1
9	EME-353	Thermodynamics Lab	0	0	2	10	10	20	30	50	1
10	ECE-351	Fluid Mechanics Lab	0	0	2	10	10	20	30	50	1
11	GP-301	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	5	9					1000	26

Note : Details are available in B.Tech. Mechanical Engg. Syllabus.

U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Plastic Engineering
[Effective Form session 2009-10]

Year 2nd, SEMESTER-IV

S.No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EHU-402	Industrial Sociology	2	0	0	15	10	25	50	75	2
2	EOE-041- EOE-048	Science Based Open Elective	3	1	0	30	20	50	100	150	4
3	ECY-401	Industrial Chemistry	3	1	0	30	20	50	100	150	4
4	EPL-401	Principles of Polymerization	3	1	0	30	20	50	100	150	4
5	EME-403	Measurement & Metrology	2	1	0	15	10	25	50	75	3
6	EME-405	Manufacturing Technology	3	1	0	30	20	50	100	150	4
Practical / Design / Drawing											
7	ECY-451	Industrial Chemistry Lab	0	0	2	10	10	20	30	50	1
8	EME-451	Machine Drawing II	0	0	3	10	10	20	30	50	1
9	EME-453	Measurement & Metrology Lab	0	0	2	10	10	20	30	50	1
10	EME-455	Manufacturing Technology Lab	0	0	3	10	10	20	30	50	1
11	GP-401	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	5	10					1000	26
		Industrial Training – I of 4 weeks after IV Sem or minor fabrication project involving work for nearly 4 weeks , which will be evaluated in VII Sem.									

Paper Code: Science Based Open Electives:

EOE 031/EOE 041: Introduction to soft computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)

EOE 032/EOE 042: Nano Sciences

EOE 033/EOE 043: Laser Systems and Applications

EOE 034/EOE 044: Space Sciences

EOE 035/EOE 045: Polymer Science & Technology

EOE 036/EOE 046: Nuclear Science

EOE 037/EOE 047: Materials Science

EOE 038/EOE 048: Discrete Mathematics

Note : Mechanical Engg. & Related branches including Plastic Engineering students cannot take the Open Elective Course EOE037/EOE047 : Material Science.

U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Plastic Engineering
[Effective From session 2010-11]

Year 3rd, SEMESTER-V

S. No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EHU-501	Engineering & Managerial Economics	3	1	0	30	20	50	100	150	3
2	EPL-501	Plastic Materials - I	2	1	0	15	10	25	50	75	3
3	EPL-502	Plastic Product & Mould Design	3	1	0	30	20	50	100	150	4
4	EPL-503	Plastic Processing-I	3	1	0	30	20	50	100	150	4
5	EPL-504	Rheology & Testing of polymers	2	1	0	15	10	25	50	75	3
6	EME-504	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
Practical / Design / Drawing											
7	EPL-551	Analysis & Identification of Polymers Lab	0	0	2	10	10	20	30	50	1
8	EPL-552	Computer aided Product & Mould Design Lab	0	1	2	10	10	20	30	50	1
9	EPL-553	Plastic processing Lab	0	0	4	10	10	20	30	50	1
10	EPL-554	Synthesis & Polymerization Resins Lab	0	0	2	10	10	20	30	50	1
11	GP-501	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	7	10					1000	26

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Plastic Engineering

[Effective From session 2010-11]

Year 3rd, SEMESTER-VI

S. No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EHU-601	Industrial Management	3	0	0	30	20	50	100	150	3
2	EPL-011 to EPL-016	Department Elective-I	3	1	0	30	20	50	100	150	4
3	EPL-021 to EPL-026	Department Elective-II	2	1	0	15	10	25	50	75	3
4	EPL-601	Plastic Materials – II	3	1	0	30	20	50	100	150	4
5	EPL-602	Plastics Processing-II	3	1	0	30	20	50	100	150	4
6	EPL-603	Additives & Compounding	2	1	0	15	10	25	50	75	3
Practical / Training / Project											
7	EPL-651	Plastic Material Testing Lab	0	0	2	10	10	20	30	50	1
8	EPL-652	Plastic Product Testing Lab	0	0	3	10	10	20	30	50	1
9	EPL-653	Polymer Characterization Lab	0	0	3	10	10	20	30	50	1
10	EPL-654	Seminar	0	0	2	10	10	20	30	50	1
11	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	5	10					1000	26
Industrial Training – II of 4 – 6 weeks after VI Sem will be evaluated in VII Sem.											

Departmental Elective I

EPL-011: Plastic Packaging & Foam.

EPL-012/ECH-401: Chemical Engineering Thermodynamics

EPL-013: Polymer Degradation and Stabilization

EPL-014: Plastic Technology.

EPL-015: CAD / CAM Application in Mould Development.

EPL-016: Polymer Science

Departmental Elective II

EPL-021: Instrumentation.

EPL-022/ECH-022: Computational Fluid Dynamics

EPL-023/ECH-023: Statistical Design Of Experiments

EPL-024: **Plastic Extrusion Technology.**

EPL-025: Fiber Technology.

EPL-026: Mould Making Techniques.

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Plastic Engineering

[Effective From session 2011-12]

Year 4th, SEMESTER-VII

S. No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EOE-071 to EOE-074	Open Elective I	3	1	0	30	20	50	100	150	4
2	EPL-031 to EPL-036	Departmental Elective III	3	1	0	30	20	50	100	150	4
3	EPL-041 to EPL-046	Departmental Elective IV	3	1	0	30	20	50	100	150	4
4	EME-701	Computer Aided Design	3	1	0	30	20	50	100	150	4
5	EME-705	Mould & Die Manufacturing	3	1	0	30	20	50	100	150	4
Practical / Design / Drawing											
6	EME-751	CAD / CAM Lab	0	1	2	10	10	20	30	50	1
7	EPL-752	Mould & Die Manufacturing Lab	0	0	2	10	10	20	30	50	1
8	EPL-753	Project	0	0	3	-	50	50	-	50	2
9	EPL-754	Industrial Training I & II Evaluation & Viva	0	0	2	-	50	50	-	50	1
10	GP-701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	15	6	9					1000	26

Paper Code Open Electives – I

EOE-071 Entrepreneurship Development

EOE-072 Quality Management

EOE-073 Operations Research

EOE-074 Introduction to Biotechnology

Departmental Elective III

EPL-031 / EME-031: Computer Aided Manufacturing.

EPL-032 / EME-032: Project Management

EPL-033. Advanced Extrusion Process Technology.

EPL-034: **Technology of Elastomers.**

EPL-035: Secondary Processing Techniques.

EPL-036 / EME-036: Management Information System

Departmental Elective IV

EPL-041 / EME-041: Total Quality Management (TQM)

EPL-042. Biodegradable Polymers.

EPL-043. Polymer Blend & Alloy.

EPL-044 / ECH 501: Mass Transfer Operations I

EPL-045. Advance Polymeric Material .

EPL-046. Testing of Plastics Material and Product

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STUDY & EVALUATION SCHEME
B. Tech. Plastic Engineering
[Effective From session 2011-12]
Year 4th, SEMESTER-VIII

S. No.	Course Code	Subject	Periods			Evaluation Scheme			ESE	Subject Total	Credit
			L	T	P	Sessional Exam					
						CT	TA	Total			
Theory Subjects											
1	EOE-081 to EOE-084	Open Elective II	3	1	0	30	20	50	100	150	4
2	EPL-051 to EPL-056	Departmental Elective V	3	1	0	30	20	50	100	150	4
3	EPL-061 to EPL-066	Departmental Elective VI	3	1	0	30	20	50	100	150	4
4	EPL-801	Industrial Safety & Hazard Management	3	1	0	30	20	50	100	150	3
Practical / Design / Drawing											
6	EPL-851	Project	0	0	12	-	100	100	250	350	8
7	GP-801	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	12	4	12					1000	24

Paper Code Open Electives – II

EOE-081 Non Conventional Energy Resources

EOE-082 Nonlinear Dynamic Systems

EOE-083 Product Development

EOE-084 Automation and Robotics

Departmental Elective V

EPL-051 / EME-051: Operations Research.

EPL-052 / EME-052: Maintenance Engineering & Management

EPL-053: Plastic Waste Management.

EPL-054: Polyurethane Technology

EPL-055: Polymer Composites.

EPL-056: Advanced Blow Moulding Process Technology.

Departmental Elective VI

EPL-061 / EME-061: Finite Element Method

EPL-062 : Advanced Injection Moulding Technology.

EPL-063 / EMT601: Pneumatics & Hydraulics.

EPL-064 / ECH 601: Mass Transfer Operations II

EPL-065 / EME-065: Energy Management

EPL-066: Surface Coating Technology

ECY-401: INDUSTRIAL CHEMISTRY

L: T: P

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Unit –I

8

Stereoisomerism: Geometrical isomerism with and without chirality, concept of aromaticity directive influence of substitute. Criteria & techniques of purity of compounds. Melting point, Boiling point, recrystallisation, various distillations.

Unit-II

8

Chemical Kinetics : Kinetics of parallel side, opposite, consecutive and chain reactions, fast reactions fundamental aspect of kinetics of reactions in solution. Catalysis : Acid basis catalysis, Enzyme catalysis, heterogeneous reactions.

Unit-III

8

Reactions , Synthesis & mechanism: Hydrocarbons including cyclic , alcohol, phenols , aldehyde & ketones, carboxylic acids & their derivatives, halides , nitro, amino & diazo compounds.

Unit-IV

8

Conformational analysis: Various terms, conformation analysis of ethane, cyclohexane & 1,2 disubstituted cyclohexane Heterocyclic: Classification, preparation and properties of pyridine. Bimolecules: Structures & reactions of mono & disaccharides, proteins

Unit-V

8

Surface chemistry: adsorption, adsorption isotherms , surface tension and its determination . Colloids chemistry : General preparation properties and classification hydrophilic and lypophobic sols. Electrical and technique properties of solutions.

Books –

1. Finar, I.L. “Organic Chemistry : Vol. I & II”.
2. Morrison & Boyd “Organic Chemistry”.
3. March, J. “Organic Chemistry”.
4. Soloman, T. “Organic Chemistry”.
- 5- Glasstone, S. “Physical Chemistry”
- 6- Atkin, P. W. “Physical Chemistry”
- 7- Banwell, C. N. “Fundamentals of Molecular Spectroscopy”
- 8- Willard Merit & Dean “Instrumental Methods of Chemical Analysis”
- 9- Skoog & West “Instrumental Methods of Chemical Analysis”

EPL-401: PRINCIPLES OF POLYMERIZATION

L: T: P

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Unit - 1

Colligative properties : Lowering & elevation in B.P . depression in F.P. Osmotic pressure and relation with molecular weight.

Electro chemistry : Cells their classification liquid junction potential , E.M.F. and thermodynamic functions relations. Application of E.M.F. measurements activity coefficient concept. Polymer, functionality and structure of polymers. Classification of polymers.

8

Unit - 2

General characteristics of condensation polymerization, kinetics & mechanism, Molecular weight control and development of cross-linked structures. Step copolymerization and its utility.

8

Unit - 3

General theory of chain-growth polymerization. Free radical polymerization, initiators, Kinetics of free radical polymerization.

8

Unit - 4

Autoacceleration. Factors affecting molecular weight and molecular weight distribution.

Chaintransfer reactions, retardars, inhibitors, Effect of temperature on polymerization, kinetics & mechanism.

8

Unit - 5

Copolymerization reactions and its utility. Kinetics & copolymerization behavior. Block & graft copolymers. Stereo-chemistry of polymerization. Ring opening polymerization. Effect of Copolymerisation on properties.

8

Books -

1. Brydson, J.A “ Plastics Material”
2. Billmeyer, Fw “Text Book Of Polymer Science”
3. Principles Of Polymer Systems By Rodrigue
4. Principles Of Polymer Chemistry By Ravve
5. Introduction Of Polymer Science By Georgelias
6. Polymer Science & Technology By Fried
7. Kinetics Of Polymer Reaction By Schrodder

EME -403 : MEASUREMENT AND METROLOGY

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2 1 0

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. 2

Signal Display & Recording Devices 1

Unit-II

Time related measurements:

Counters, stroboscope, frequency measurement by direct comparison. 1

Measurement of displacement 1

Measurement of pressure: Gravitational, direct 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. 1

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 standardisation. 2

Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. 2

Limit gauges classification, Taylor's Principle of Gauge Design. 1

Unit-IV

Measurement of geometric forms like straightness, flatness, roundness. 2

Tool makers microscope, profile project autocollimator. 1

Interferometry: principle and use of interferometry, optical flat. 2

Measurement of screw threads and gears. 1

Surface texture: quantitative evaluation of surface roughness and its measurement. 1

Measurement and Inspection: Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection.

Books -

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonal and Co. 1963
5. Gupta, I.C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers

EME- 405 : MANUFACTURING TECHNOLOGY

L: T: P

3: 1: 0

Unit-I

Introduction :

Importance of manufacturing. Economic & technological considerations in Manufacturing. Classification of manufacturing processes. **3**

Sheet Metal working :

Presses and their classification, Die & punch assembly and press work methods and processes. **2**

Jigs & Fixtures :

Locating & Clamping devices & principles. Jigs and Fixtures and its applications. **2**

Unit-II

8

Casting (Foundry)

Basic principle & survey of casting processes. Types of patterns. Types of moulding sand. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting,. Sand casting, defects & remedies. Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting etc.

Unit-III

8

Metal Cutting-

Mechanics of metal cutting. Geometry of tool and nomenclature. ASA system, Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability.

Unit-IV

Machine Tools

(i) Lathe : Principle, construction, types, operations. **2**

(ii) Shaper, slotter, planer : Construction, operations & drives. **1**

- (iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. **3**
- (iv) Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills. **2**
- (v) Grinding : Grinding wheels, abrasive & bonds. Grinding wheel specification. Dressing and Truing. Surface and Cylindrical grinding. Centerless grinding. **2**

Unit-V

Introduction to Metal Joining (Welding) – such as Gas welding, Arc welding, Resistance welding & TIG & MIG processes. **2**

Introduction to Un-conventional Machining **5**

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding.

Books

1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
8. Fundamentals of metal cutting & machine tools - Juneja & Shekhon
9. Process & materials of manufacturing - Lindburg.
10. Advanced Machining Process - VK Jain

EME – 451 : MACHINE DRAWING-II LAB

L T P
0 0 3

Review of Orthographic Projections (1 drawing sheet)

Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views **2**

Part and Assembly Drawing (2 drawing sheet)

Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc. **2**

Specification of Materials (1 drawing sheet)

Engineering materials, representation, Code designation of steel, copper, aluminium etc. **1**

Limits, Tolerance and Fits (1 drawing sheet)

Limit system, Tolerances, Method of placing limit dimensions, Fits-types **2**

Surface Roughness (1 drawing sheet)

Introduction, nomenclature, machining symbols, indication of surface roughness **1**

Production Drawing (1 drawing sheet)

Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. **2**

Computer Aided Drafting (2 drawings)

Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts 3

Books and References:

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy - New Age
2. Machine Drawing - PS Gill - SK Kataria & sons
3. Machine Drawing -N. Siddeshwar, P Kannaiah, VVS Shastry -Tata McGraw Hill
4. Engineering Drawing - RK Dhawan - S. Chand
5. AutoCAD-S. Vshal - Dhanpat Rai
6. Engineering Graphics - BK Goel & PK Goel - SK Kataria
7. Computer Aided Engineering Graphics - Rajashekhar Patil - New Age
8. Engineering Drawing - Dhananjay A Jolhe - Tata McGraw Hill
9. Engineering Drawing - CM Agrawal - Tata McGraw Hill
10. Machine Drawing – Ajeet Singh – The Mc Graw Hill Companies

EPL451 / ECY-451 INDUSTRIAL CHEMISTRY LAB

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Minimum 8 experiments out of following

1. Identification of liquid organic compounds.
2. Identification of two organic compounds (one water soluble and one water insoluble) in a mixture.
3. Minor estimation of phenol, glucose & aniline.
4. Preparation of p- Nitro acetanilide from Acetanilide.
5. To find out the percentage composition of given solution by viscosity measurement with the help of Ostwald's viscometer.
6. To verify the distribution of Particle Size.
7. To determine the rate constant (K) for the hydrolysis of Ethyl Acetate catalyzed by HCl acid.
8. To determine the molecular weight of the given compounds by elevation of boiling point.
9. To determine the molecular weight of the given compounds by depression of freezing point.
10. To determine pH of a solution

EME 453: MEASUREMENT & METROLOGY LAB

L T P
0 0 2

Minimum 8 out of following (or such experiments)

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sinebar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector

5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances
9. Study of Pressure & Temperature measuring equipment.
12. Strain gauge measurement.
13. Speed measurement using stroboscope.
14. Flow measurement experiment
15. Vibration/work measuring experiment.
16. Experiment on Dynamometers.

EME-455 : MANUFACTURING TECHNOLOGY LAB

L T P
0 0 3

Experiments :

Minimum 8 experiments out of following (or such experiments)

1. Design of pattern for a desired casting (containing hole)
2. Making a mould (with core) and casting.
4. Injection moulding with plastics
6. Blow moulding with plastics
7. Press work experiment such as blanking/piercing, washer, making etc.
8. Bolt (thread) making on Lathe machine
9. Tool grinding (to provide tool angles) on tool-grinder machine.
10. Machining a block on shaper machine.
11. Finishing of a surface on surface-grinding machine.
12. Drilling holes on drilling machine and study of twist-drill.
13. Study of different types of tools and its angles & materials.
14. Experiment on tool wear and tool life.
15. Experiment on jigs/Fixtures and its uses
16. Arc welding experiment

EPL501: PLASTIC MATERIALS - I

L : T: P
2 : 1: 0

Unit -I

Introduction to Polymer Chemistry

6

Sources of raw materials –Monomers –Polymers – Polymerisation - Types of Polymerisation – Classification. Definition and Classification of Plastics – General properties – Historical development of plastic industry-future trends, Thermoplastics, Thermosetting, Engineering & High performance plastics.

Unit –II

8

Structure of Plastics : Molecules –Crystallinity – Effect of Crystallinity on properties – crosslinked plastics – Determination of Molecular weight – Effect of Molecular weight

on processing and properties – Molecular weight distribution. Linear, branched and cross linked structures in polymers. Flexibility and movement of macromolecules. Glass transition temperature (T_g). Relationship

Unit –III

8

Introduction – Sources and manufacture of raw materials – basic chemistry – Methods of manufacture – Flow behaviour – General properties and applications of Olefin Polymers and Co-polymers Vinyl chloride polymers and co-polymers

Unit –IV

8

Introduction – Sources and manufacture of raw materials – basic chemistry – Methods of manufacture – Flow behaviour – General properties and applications of Styrene and Styrene co-polymers PMMA. Cellulose polymers

Books -

1. Brydson, J.A “ Plastics Material”
2. Schwartz & good man “Plastics materials and processing”
3. Irwin rubin “Hand book of Plastic Materials and technology”

EPL502: PLASTIC PRODUCT & MOULD DESIGN

L : T : P

3 : 1 : 0

Unit – 1

8

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 – 2

8

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

Unit – 3

8

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 – 3

8

Split Mould and types of mechanism, Unscrewing mechanism, Introduction to Hot runner mould.

Unit – 4

8

Design concepts for compression moulds, transfer moulds and blow moulds.

Unit – 5	8
Extrusion Dies - Types of extrusion dies and design characteristics. Die Design for Pipe and Sheet.	8

Books –

1. David H Morton Jons John w ellis “Polymer product design materials and processing”
2. Rao NS “Design data for plastics engineers”
3. Rao NS “design formula for plastics engineers”
4. Joshi MV “dies for plastics extrusion”
5. Millar ,Edward “plastics product design part A& B”
6. DYM “product design with plastics”
7. Beck “plastics product design”
8. Dubois “plastics product design engineering hand book”
9. Malloy , Robert, A “plastics part design for injection moulding”
10. Bebb,R.H., “Plastics Mould Design Vol.1 Compression and Transfer Moulds
11. Pye R.G.W., “Injection MOULD Design for Thermoplastics”
12. DYM, “Injection Moulds and Moulding”
13. Lee NC “Blow moulding design guide”

PL503: PLASTIC PROCESSING-I

L : T: P
3 : 1: 0

Unit – 1	06
Processability of polymers and the role of rheology in polymer processing.	

Unit – 2	09
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 – 3	09
Individual extrusion systems, Dies, Sizing and Downstream equipments, Faults, Causes and Remedies for film, pipe, lamination, profiles, cables, sheet, Box Strapping .	

Unit – 4	08
Twin-screw extrusion and Co Extrusion systems. Casting of films. Multi layer systems for Films and Pipe . Faults , Causes & Remedies.	

Unit – 5	08
General description of Compression and Transfer moulding and its application in processing of thermosetting materials. Faults , Causes & Remedies.	

Books –

1. Berins , “Plastics engineering hand book” - society of the Plastics industry
2. Allen , WS & baker , pn “Hand book of Plastics technology
3. Chris Rauwendaal, “Polymer Extrusion” Hanser Publication
4. Iyeseu, A.I “Compression molding”
5. BOBB “COMPRESSION & TRANSFER THEORY & TECHNOLOGY”

EPL-504: RHEOLOGY AND TESTING OF POLYMERS

L : T: P
2 : 1: 0

Unit – 1

8

Introduction to polymer rheology, Newtonian and non-Newtonian fluids. Viscoelastic behaviour, dynamic and constitutive equations. Mechanical models. Discussion of models for flow and deformation in polymers and treatment of measureable rheological properties.

Unit – 2

7

Measurement of viscosity and normal stresses. Viscous heat generation Interpretation of time-temperature sensitivity of viscoelastic solids and liquids.

Unit – 3

9

Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, Prediction of solubility parameter, Effect of polymer structure on solubility in solvents and oils, Influence of structure in prediction of flame retardancy, water repellency , Chemical resistance of polymers, Polymer-in-solution: Polymer-solvent interaction, good and poor solvents, intrinsic viscosity and Mark-Houwink equation. Concept of fractionation processes.

Unit – 4

8

ASTM, BS, IS and its importance, correlation of these tests with actual performance. Degradation behavior of polymers. Introduction to polymer characterization by advance instrumental techniques such as IR, NMR, DSC, TGA, SEM, etc.

Books

- 1 Vishu shah “Plastics testing technology hand book”
- 2 Brown RP “Hand book Plastics test methods “
- 3 Mathur ,AB & Bhardwaj IS “Testing and evaluation of Plastics”
- 4 Ives GC, Mead JA & Riley MM “Hand book Plastics test methods”
- 1 Braun “simple methods for identification of Plastics”
- 2 Crompton “Analysis of Plastics”
- 3 Plastics engineering hand Ed 5 Society of the Plastics industry
- 4 Haslam “identification and analysis of plastics”
- 5 Allen , WS & Baker , PN “Hand book of plastics technology 2 vols”

EME-504 HEAT & MASS TRANSFER

L:T:P
3:1:0

UNIT-1

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. **2**

Conduction :

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. **3**

Steady State one-dimensional Heat conduction :

Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. **3**

UNIT-2

Fins:

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. **3**

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. **4**

UNIT-3

Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. **4**

Natural Convection :

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection. **3**

UNIT-4

Thermal Radiation :

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect. **8**

UNIT-5

Heat Exchanger :

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. **3**

Condensation And Boiling :

Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. **3**

Introduction To Mass Transfer :

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film. **2**

Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

EPL552: COMPUTER AIDED PRODUCT & MOULD DESIGN LAB

L : T : P

0 : 1 : 2

Design Minimum 4 mould using cad

1. Single Impression Two Plate mould
2. Multi Impression two Plate Mould
3. Three Plate Mould (Multi Impression)
4. Hand Mould For External Undercuts
5. Split Mould - Without Delayed Action
6. Split Mould - With Delayed Action
7. Mould for Internal Undercuts
8. Insert Mould
9. Mould Design for Internally Threaded
10. Components (Automatic Unscrewing)
11. Hot Runner Mould

Design Minimum 2 Product using cad

1. Product for Agriculture Application.
2. Product for Automobile Application.
3. Product for Medical Application.
4. Product for Household Application.
5. Product for Electronic Application
6. Design of Plastic Gear
7. Design of Plastic Bearing

EPL553: PLASTING PROCESSING LAB

L : T : P
0 : 0 : 4

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.

EPL554: SYNTHESIS & POLYMERIZATION LAB

L : T: P
0 : 0 : 2

Minimum 8 Experiments

1. Synthesis of polymers by Bulk polymerization techniques
2. Synthesis of polymers by solution polymerization techniques
3. Synthesis of polymers by suspension polymerization techniques
4. Synthesis of polymers by emulsion polymerization techniques
5. Determination of molecular weight by viscosity.
6. Preparation of phenol formaldehyde resin
7. Preparation of urea. formaldehyde resin
8. Preparation of unsaturated polyester resin
9. Determination of acid value in unsaturated polyester resin
10. Preparation of saturated polyester resin
11. Determination of acid value in saturated polyester resin
12. Synthesis of copolymers based on any common monomers like styrene, acrylates, maleic anhydride, acrylic acid and methacrylic acid
13. Modification of epoxy resin modification of any natural polymers such as cellulose, rosin, natural rubber, etc. .
14. Depolymerization of waste thermoplastics such as polystyrene or polymethyl methacrylate .

EPL-551 ANALYSIS AND IDENTIFICATION OF POLYMERS LAB

L: T: P
0: 0: 2

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 basic raw materials and auxiliaries used in polymer such as phenol, urea, formaldehyde.
4. Quantitative estimation of the basic raw materials and auxiliaries used in polymer such as glycerol, plasticizer's initiators.
5. Quantitative estimation of the basic raw materials and auxiliaries used in polymer industries such as antioxidants, etc
6. Determination of purity of solvents, monomers and other auxiliaries.
7. Determination of physical properties - boiling point using standards techniques.
8. Determination of physical properties - melting point.
9. Determination of physical properties - refractive index.
10. Determination of physical properties - specific gravity of polymer materials .

EPL601 : PLASTIC MATERIALS - II

L: T: P

3: 1: 0

Unit –I

8

Introduction – Sources and manufacture of raw materials – basic chemistry – Methods of manufacture – Flow behaviour – General properties and applications of - Polyamides – Nylon 6, 66 etc. ; Acetal-Homopolymer & Co-polymer Saturated polymers – PETP & PVTP ; Polymers containing fluorine – PTFE, PVDF etc.; Polycarbonate ; Thermoplastics Polyester, Poly urethane

Unit –II

8

Introduction – Sources and manufacture of raw materials – basic chemistry – Methods of manufacture – Flow behaviour – General properties and applications of Polyphenylene sulphide ; Polyphenylene oxide ; Polysulphones ; Poly ether ether ketone

Unit III

8

Introduction – Sources and manufacture of raw materials – basic chemistry – Methods of manufacture – Flow behaviour – General properties and applications of Speciality Plastics, Plastic Composites, , High performance Polymer

Unit –IV

8

Thermosetting plastics :

Introduction – Sources for raw materials – resin preparation – polymer structure additives – curing and cross linking–agents, processing behavior, general properties and applications of Phenol formaldehyde, Urea formaldehyde, Melamine formaldehyde, Unsaturated polyesters. Epoxide resins, Polyurethanes, Silicones, etc.

Unit – V

8

Alloys and blends

Introduction to polymer blends & alloys- Definitions and nomenclature reasons for making polymer blend, compatibilization mechanisms, Miscibility and flow behaviour of polymer blends, Immiscible blends,

Books –

1. Plastics Material by Brydson, J.A.
2. Irwin rubin “Hand book of Plastic Materials amd technology”
3. Athalye ,AS “Plastics Materials hand book”
4. Gowariker VR “Polymer science”
1. Berins “Plastics engineering hand book” Society of the plastics industry Inc . SPI
2. Schwartz & Good man “Plastics materials and processing”
3. Biriey & scott “Plastics materials (properties and application)”
4. Billmeyer, FW, “Text book of polymer science”
- 5 Harper, “Modern of Plastics hand book”

EPL-602: PLASTIC PROCESSING-II

L : T: P

3 : 1: 0

8

Unit – 1

Basic concepts of injection moulding for thermoplastics. Machine layout, construction and specification, type of injection units. 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 – 2

8

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

Unit – 3

8

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 – 4

8

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 – 5

8

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

Books-

- 1 Rubin , Irvin "Injection molding theory and practice"
- 2 Rasato ,dv & Rasato "Injection molding hand book"
- 3 Berins "Plastics engineering hand book" By society of the Plastics industry
- 4 Strong A Brent "Plastics materials and processing"
- 5 Rosato DV "blow molding hand book"
- 6 Allen , WS & Baker , pn "Hand book of Plastics technology – 2 vols
7. A guide to injection moulding of plastics By bolur P.C
8. Whelan A& craft JL "Development in injection moulding-1"
9. Schwartz & Goodman "Plastics materials & processing"
10. Injection moulding by athalye
11. Injection moulding technology by VDI
12. Stevenson "Innovation in polymer processing"
11. James L throne "Thermoforming"

12. Crawford, RJ and Throne, JL "Basic principles of rotational molding"
13. Bruin "Basic principles of rotational molding"
14. Bruin "Basic principle of thermoforming"
15. Bryce "Plastics injection molding"
16. Bown, John "Injection Moulding of plastic Components"
17. Beadle "Plastics Forming"

EPL603: ADDITIVES & COMPOUNDING

L : T: P

2 : 1: 0

Unit -I

Additives for plastics

8

Types & Mechanism of Additives :- Fillers, Antioxidants, Thermal Stabilizers, Lubricants, Plasticizers, Toughening-agents, Colourants, Fire retardants, Coupling agents, blowing agents, Ultraviolet stabilizer, Antistatic agents, Anti blocking agents, Slip and antislip agents, processing aids, mould releasing agents.

Unit –II

8

Compounding & Mixing - Selection of polymers and compounding-ingredients-general objectives-possibilities and limitation of additives into polymer matrices. Distributive and Dispersive mixing.

Unit –III

8

Mixing equipments.

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

Unit –IV

6

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.

Text Book

1. Polymer additives –by Muller

Reference Books

1. Al – Malaika; S. Golovoy; A and Wilkie (Eds), Chemistry and Technology of Polymer Additives, Black well Science Ltd, Oxford (1999)
2. Matthews; F.L. and Rawlings; R.D, Composite Materials, Engineering and Science Chairman and Hall, London (1994)
3. Plastics Testing Technology Hand Books by Vishu Shah
4. Hand Book of Plastics Test Methods by Brown R.P
5. Mascia; L., The Role of Additives in Plastics, Edward Arnold Publishers Ltd., U. K. (1974).
6. Murphy; John, Additives for Plastics Handbook, 2nd Edition, Elsevier Advanced Technology, Oxford

EPL 651: PLASTIC MATERIAL TESTING LAB

L : T: P
0 : 0: 3

Minimum 8 Experiments

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 Optical properties of plastics materials.
6. Determination of Thermal Properties of plastics materials.
7. Determination of Electrical Properties of plastics materials.
8. Study of Weathering properties of plastic materials.
9. Determination of Density of plastic materials.
10. Compounding or Blending using two roll mill
11. Specimen preparation using contour cutter .
12. Determination of Bulk density for powder materials.

EPL652: PLASTIC PRODUCT TESTING LAB

L : T: P
0 : 0: 2

Minimum 8 Experiments

1. Testing of HDPE Pipes
2. Testing of UPVC Pipes
3. Testing of Water Storage Tanks
4. Testing of Films/Sheets,
5. Testing of HDPE/PP Woven Sacks/Tapes,
6. Testing of Baby Feed Bottles,
7. Testing of Milk Packing Pouches
8. Testing of Meter box Cover .
9. Testing of UPVC Pipe Fitting
10. Testing of Irrigation Product-Lateral
11. Testing of Irrigation Product-Emitters
12. Testing of Irrigation Product-Quick Coupled Pipes
13. Testing of FRP Sheets
14. Testing of PVC Conduit .

EPL-653: POLYMER CHARACTRIZATION LAB

L : T: P
0 : 0: 3

Minimum 8 Experiments

1. Determination of Melt Flow Index of different Plastics Materials and Grades,
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 UV stabilization of polymer samples by UV-visible spectrophotometer.
11. Study of UV stabilization of polymer samples by UV-visible spectrophotometer.

EME-701 : COMPUTER AIDED DESIGN (CAD)

L T P
3 1 0

UNIT-I

Introduction:

4

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I

4

CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard

terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters.

UNIT-II

Computer Graphics-II

4

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations:

4

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation

UNIT-III

8

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending

function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics:

8

Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models
Application commands for AutoCAD & ProE software

UNIT-V

8

Numerical Methods:

Introduction, Errors in numbers, Binary representation of numbers, Root finding-Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

Books & References:

1. Computer Graphics Hearn & Baker Prentice Hall of India
2. Computer Aided Engineering Design Anupam Saxena & B. Sahay Anamaya Publishers
3. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
5. Computer Aided Design RK Srivastava Umesh Publications
6. Mathematical Elements for Computer Graphics DF Rogers & JA Adams McGraw Hill
7. Finite Element Method SS Rao
8. FE Analysis Theory and Programming CS Krishnamoorthy Tata McGraw Hill
9. Numerical Method for Engg Computation MK Jain, SRK Iyenger & RK Jain Wiley Eastern Limited
10. Computer Oriented Numerical Methods V Rajaraman Prentice Hall of India

EME-705 : MOULD & DIE MANUFACTURING

L : T : P

3 : 1 : 0

8

Unit-I

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. Mould material, Material selection for mould making, Properties of steels for moulds . Non-ferrous metals for moulds - Zinc base alloys and aluminium alloys, Beryllium

Copper, Polyesters, Epoxies, Silicones. Review of various machining operations.

Unit-II

8

Jig boring, Pentagraph, Profile grinding, Electrical discharge machining -Characteristics, physical processes, special technological features, types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making. Electroforming for mold manufacturing - discussion of the process, materials for electroforming, machining for electroformed blanks

Unit –III

Heat treatment processes, Various types of furnaces.

4

Hobbing for mold making –

4

Discussion of the hobbing process & its advantages, elements of hobbing like hobbing punch, shape of the hob, materials used for cavity, lubrication, and depth of hobbing, Hobbing presses, Hobbing operations & its economy with examples.

Unit –IV

8

Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, Effect of mold materials on polishability, Types of polishing tools, Methods of polishing.

Basic information on Electro sonic polishing.

Principles of Electro deposition in damaged molding surfaces.

Surface Texturing of molds - Process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.

Unit-V

8

Computer aided Manufacturing and Measurement.

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, , classification of NC machine tools, **NC Part**

Programming-

Manual (word address format) programming- SIMPLE Examples ; Canned cycles, Subroutine, and Macro. APT programming. Geometry, Motion and Additional statements, Macro- statement Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.

Text Books

1. R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.
2. Klus Stokhert (Edt.),Mold making handbook for Plastic Engineers, Hanser Publishers, NY,1983
3. Computer Aided Engineering Design Anupam Saxena & B. Sahay Anamaya Publishers

4. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
5. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill

References Books

- a. HMT Production Technology, TMH (India), 1992
- b. Bhattacharya, A New Technology, IB Publishers, 1984
- c. Stoeckert & Menning, Mold making handbook, 2nd edition, Hanser Publishers, Munich.
- d. W.A.J Chapman, Workshop Technology, Vol I & II, ELBS.
- e. Herbert Rees, Mold Engineering, Hanser Publishers, NY. George Menges & Paul Mohren
- f. How To Make Injection Molds, Hanser Publishers.
- g. DuBois; J. Harry and Pribble; W. I. (Eds.), Plastics Mold Engineering, SPE Polymer Technology

EME-751 : CAD/CAM LAB

L T P
0 1 2

Total TEN Experiments are to be carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting

8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mechatronics and controls

EME-755: MOULD & DIE MANUFACTURING LAB

L : T: P
0 : 0: 2

Minimum 8 experiments

1. Study of different types of Cutting tools.
2. Letter writing on Pantograph milling
3. Study of EDM,
4. Study of Wire cut EDM
5. Study and Detailing of mould assembly
6. Manufacturing of Guide Pillar
7. Manufacturing of Pocket By Milling
8. Gas assisted and Water assisted Injection mould and Hot runner mould
9. Hand compression mould design – positive, semi positive, displacement type mould, and design with split cavities
10. Transfer mould design (pot type & top plunger type)
11. Automatic unscrewing mould
12. Study of Mould for Rotational Moulding
13. Study of Mould for Thermoforming Moulding
14. Study of Mould design for industrial component

ECH 043 / EPL-801: INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

L : T: P
3 : 1: 0

Unit I

08

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

08

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

08

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**08**

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 relief's.

Unit V**08**

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.

Books Recommended

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, Taylor & Francis Group

Departmental Elective I

EPL 011. Plastic Packaging & Foam.
EPL 012/ECH401. Chemical Engineering Thermodynamics.
EPL 013. Polymer Degradation and Stabilization
EPL 014. Plastic Technology.
EPL 015. CAD / CAM Application in Mould Development.
EPL 016. Polymer Science

EPL011: Plastic Packaging and foam

LTP

3 1 0

UNIT-1

8

Introduction to packaging. Scope and functions of a package, advantages and disadvantages of polymeric packages over conventional packing materials.

UNIT-2

8

Forms of packages. Selection criteria of suitable polymeric packages for oils, fats and allied products, soaps and detergents, cosmetics, food, dairy products, beverages, medicines, chemicals, paints, household and industrial goods, etc. printing on polymeric packages.

UNIT-3

8

Testing, quality control and development in polymeric packaging.

UNIT-4

8

Introduction to rigid foam. Chemistry & physical formation, forming ingredients, their effect on foam morphology and physical properties of cellular plastics.

UNIT-5

8

Polymethane foam (rigid & flexible) pol expanded polystyrene foams, epoxy foam. Recent advance of foams.

BOOKS

1. Susan E.M. Seleke, "Understanding Plastic Packaging Technology", Hanser Publications – Munich
2. A.S. Altalye, "Plastics In Packaging", Tata Mcgraw–Hill Publishing Co. Ltd., New Delhi.
3. Mechanics Of Cellular Plastics By Hilyard
4. Plastics Materials By Brydson
5. Hand Book Of Polymeric Foams & Foam Technology By Klempner

EPL 012: CHEMICAL THERMODYNAMICS

Similar to (ECH 401 CHEMICAL Engg. THERMODYNAMICS)

LTP
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Unit-I Basic Concept The first law and conservation of energy. Applications to steady, non steady flow and other engineering problems. The second law. Applications to engineering problems relating to equilibrium, maximum and minimum work.	8
Unit-II Properties of Pure Substances Changes in thermodynamic properties and their inter-relationships. The ideal gas. Fugacity and Fugacity coefficients for real gases.	8
Unit-III Multicomponent System Partial molal properties. Mathematical models for the chemical potential. Ideal and non-ideal solutions. Activity and activity coefficients. The Gibbs Duhem equations. Excess properties of mixtures.	8
Unit-IV Phase Equilibria Criteria for equilibrium between different phases in Multicomponent no reacting systems. Applications to systems of engineering interest, particularly to vapour – liquid equilibria and solubility.	8
Unit-V Chemical Equilibrium The equilibrium constant and the variation of yield in chemical reactions with pressure, temperature and Composition.	8

Reference Books

1. Y.V.C.Rao, "Chemical Engineering Thermodynamics" University press (1997).
2. Smith, J.M., Van Ness, H.C. & Abbot, M.M. "Intro to Chemical Engineering Thermodynamics", 5th edition. New York: Mc-Graw Hill (1996)"
3. Daubert T.E., "Chemical Engineering Thermodynamics" McGraw Hill (1986).

EPL 013: POLYMER DEGRADATION AND STABILISATION

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UNIT I

8

Introduction and Thermal Degradation: Definition - Modes of Polymer Degradation - Mechanistic Aspects - Single Step Process and Chain Reactions - Auto Oxidation - Random and Specific Site Attack - Thermal Degradation: Introduction - Methods for Evaluation of Heat Resistance (DTA, DSC, TGA, TMA) - Mechanistic Aspects - Heat Resistance Polymers - Ablation –Stabilization – Thermal Degradation and Recycling - Heat Effect in Bio Polymers.

UNIT II

8

Mechanical Degradation and Ultrasonic Degradation: Introduction - Mechanistic Aspects - Degradation Studies - Polymer Degradation in Solution. Ultrasonic Degradation - Importance - Experimental Methods - Mechanism of Ultrasonic Degradation (Cavitations and Direct Effects) - Degradation Studies (Detection of Transient Species and Molecular Weight Distribution) Application of Mechanical Degradation: Stress - Induced Chemical Alterations of Polymers- Mastication of Natural and Synthetic Rubber - Mechano Chemical Synthesis of Block and Craft Copolymers.

UNIT III

8

Photo degradation: Introduction - Mechanistic Aspects (Excited States, Free Radicals and Ionic Species, Energy Transfer and Energy Migration) - Degradation in the Absence of Oxygen (Norrish Types I & II Reactions) - Photo Oxidation (Auto Oxidative Process, Sensitized Degradation) - Stabilization - Application: Polymers with Predictable Life Time, Photo resists.

UNIT IV

8

Degradation By High Energy Radiation and Biodegradation: Introduction - Aspects of Radiation - Mechanistic Aspects - Simultaneous Cross Linking and Degradation - Radiation Stability and Protection Radiation Effects in the Bio Polymers - Application: Lithography, X - ray Resists in Contact Microscopy- Graft and Block Copolymerisation Bio degradation - Modes of Biological Degradation - Enzymatic Degradation in Bio Polymers (Polysaccharides, Proteins, Malice Acids) - Microbial Degradation of Synthetic Polymers - General Applications of Bio Degradable Plastics - Examples of Biodegradable Polyesters and Polyamides.

UNIT V

8

Chemical Degradation: Introduction - Solvolysis - Polymer Characterization by Solvolysis - Stability of Polymer Against Solvolytic Agents - Commercial Applications - Ozonisation - Oxidative Degradation - Auto Oxidation of Polymers. Ionic Degradation: Alkaline Degradation of Poly Saccharides Acidic Degradation

of Polyaldehydes and Polyacetals and Cationic Degradation of Polypropylene Sulphide and Polyesters.

BOOKS

1. W. Schnabel, Polymer Degradation - Principles and Practical Applications Hanser Publishers, New York, 1992.
2. Ann - Christine Albertsson, Samuel J. Huang, "Degradative Polymers Recycling and Plastic Waste Management" Marcel Dekker, New York, 1995.

EPL 014: PLASTICS TECHNOLOGY

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Unit I

8

Plastics Materials

Plastics as a material, their load bearing capacity, effect of temperature, sunlight, load/stress, humidity, oxidation etc. on plastics.

Unit II

8

Advantages of plastics

Advantages of using plastics in comparison with other conventional materials (wood, steel) such as, reduction in weight by using specific weight concept, reduction in number of parts during construction, increased possibilities in number of shapes, new products, cost effectiveness and aesthetics, reusability.

Unit III

8

Plastics Applications

Applications of plastics in various areas such as agriculture, packaging, electrical and electronics, automobile, construction, sports, medical engineering and household etc

Unit IV

8

Plastics Conversion

Preliminary ideas of extrusion, injection molding, blow, molding, rotational molding, compression and transfer molding taking examples of commonly used products made by each process.

Unit V

8

Plastics Storage

Storage and handling of plastics and chemicals used in plastics industry (such as resins, solvents, plasticisers, pigments etc), and problems such as flammability, toxic fumes, limitation of working under heat etc.

Books -

4. Irwin Rubin "Hand book of Plastic Materials and technology"
5. Berins, "Plastics engineering hand book" - society of the Plastics industry
6. William, J.P., Plastics Technology, Tarapore Vela sons pub.
7. Allen, WS & baker, pn "Hand book of Plastics technology"

EPL 015: CAD/CAM APPLICATION IN MOULD DEVELOPMENT

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Unit I **8**

Introduction to computers types of computers, process controllers – principles of programming – introducing to Fortran and Autolisp – types of variables – control statements – simple programming (only preliminary concepts) – communication devices interactive graphics – analysis - data management.

Unit II **8**

Basic concepts of computer aided design and drafting CAD system – shape and size description – parametric programming construction of engineering drawing – two dimensional drafting – 3D modeling – surface and solid modeling – concepts of engineering database – CAD/CAM process – advanced CAD/CAM technology – NC – DNC – CNC systems.

Unit III **8**

Computer Aided Engineering (CAE), introduction to mold flow analysis and application introduction to CAM software – Master CAM.

Unit IV **8**

Introduction to NC part programming – CNC machining – computer integrated manufacturing (CIM)- flexible manufacturing system.

Books –

6. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
1. Introduction To Computer Numerical Control By Nanfara
2. Cad/Cam Theory & Practice By Zeid
3. Cad/Cam Computer Aided Design & Manufacturing By Grooves
4. Automation Production System & Cim By Grooves
5. Cad/Cam Integration & Innovation By Taraman

7. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
8. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
4. Computer Aided Manufacturing by Kundra and Rao
5. Computer control of Manufacturing systems by Koren
6. NC Machine Tools by S.J. Martin.
7. NC Machines by Koren

EPL 016: POLYMER SCIENCE

LTP

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Unit I

8

Basic Concepts of Polymers

Hybridization of orbital – SP³, SP² and SP types of hybridization in organic compounds;
Introduction – Monomer, Polymer and Polymerisation, Functionality
Nomenclature of polymers, Classification of Polymers, Types of Copolymers

Unit II

8

Polymerisation methods with its Mechanism, Characteristics and uses

Addition Polymerisation – Free radical Polymerisation, Ionic Polymerisation – Anionic Polymerisation, Cationic Polymerisation, Co-ordination polymerisation – Condensation Polymerisation – Poly-condensation polymerisation, Poly-addition polymerisation, Ring opening Polymerisation

Unit III

8

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, Polydispersity and Molecular Weight Distribution in polymers ,

Polymerisation Techniques

Bulk Polymerisation, Solution Polymerisation, Suspension Polymerisation, Emulsion Polymerisation

Unit V

8

Crystallinity

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

Glass Transition Temperature (T_g)

T_g and its associative properties, Factors affecting T_g, Relation between T_g and Melting Temperature T_m, Importance of T_g, T_g and polymer properties relationship

Unit V

Polymer Degradation and Stability

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

Polymer Solution:

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

Books:

1. Polymer Science – V. R. Gowariker
2. Polymer Science – J. Fried
3. Principles Of Polymer Systems By Rodrigue
4. Principles Of Polymer Chemistry By Ravve
5. Introduction Of Polymer Science By Georgelias
6. Polymer Science & Technology By Fried
7. Kinetics Of Polymer Reaction By Schrodder

Departmental Elective II

EPL 021. Instrumentation.

ECH 022 / EPL 022: Computational Fluid Dynamics

ECH 023 / EPL 023: Statistical Design Of Experiments

EPL 024. Plastic Extrusion Technology.

EPL 025. Fiber Technology.

EPL 026. Mould Making Techniques.

EPL 021: Instrumentation

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Unit I

6

Basic measurement/control set-up: Fundamentals of measurement, basic standards and accuracy of measurement, types of I/P quantities, generalized configuration and functional description of measuring instruments, causes and types of experimental errors

Unit II

8

Transducers: Displacement, Velocity, Stress, Strain, Pressure, Flow, Level, Density and magnetic properties. NDT testing: Ultrasonic, X-ray, Electromagnetic testing.

Temperature transducers and measurement: Thermocouple, pyrometer, Study of hot film and hot wire anemometry.

Recorder, Data loggers and Data processing Systems.

Unit III

8

Controllers: Two steps, Proportional, Integral. Differential and Composite controllers, Transient Response and Stability of control systems, Safety and control strategy in furnace instrumentation, material handling systems

Unit IV

8

Analytical instrumentation systems: gas analyser, Spectrophotometer, Atomic absorption, Atomic Emission, Chromatography etc.

Application of Instrumentation and control in Metallurgical Engg.

Reference Books

1. Process Measurement- B.G. Ciptak
2. Process Control- B.G. Ciptak
3. Handbook of Analytical Instrumentation-R.S. Khandpur
4. Instrumentation Handbook-Considine

ECH 022/ EPL 022 : COMPUTATIONAL FLUID DYNAMICS

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Unit I

6

Basic Concepts of Fluid Flow: Philosophy of computational fluid dynamics, conservation principles of mass, energy, and momentum, simplified flow models such as incompressible, inviscid, potential and creeping flows, classification of flows.

Turbulence and its Modelling: Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models

Unit II **7**

Grid Generation: Structured and unstructured grids, choice of grid, general transformation of equations, some modern developments in grid generation in solving the engineering problems.

Finite Difference Method: Discretization of ordinary and partial differential equations, approximation of first, second and mixed derivatives, implementation of boundary conditions, discretization errors, applications to the engineering problems.

Unit III **10**

Finite Volume Method: Discretisation methods, approximations of surface integrals and volume integrals, interpolation and differentiation practices, implementation of boundary conditions, applications to the engineering problems. Introduction, one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems. The Finite Volume Method for Unsteady Flows and Implementation of Boundary Conditions: One-dimensional unsteady heat conduction,

Unit IV **7**

Special Topics: Flow in a sudden pipe contraction / expansion, flow and heat transfer in a complex tubes and channels, reactive flow, multiphase flow, and turbulent flow processes.

Suggested Books:

1. Anderson Jr J. D., "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill. 1995
2. Muralidhar K. and Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House. 2003
3. H. K. Versteeg and W. Malalasekera, An introduction to computational fluid dynamics: the finite volume method, Longman scientific & technical publishers 2007
4. Ferziger J. H. and Peric M., "Computational Methods for Fluid Dynamics", 3rd Ed., Springer. 2002
5. Ranade V. V, "Computation Flow Modeling for Chemical Reactor Engineering", Academic Press. 2002

ECH 023 / EPL 023: STATISTICAL DESIGN OF EXPERIMENTS **L T P**
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Unit I **8**

Introduction: Strategy of experimentation, basic principles, guidelines for designing experiments;

Simple Comparative Experiments: Basic statistical concepts, sampling and sampling distribution, inferences about the differences in means, randomized and paired comparison design.

Experiments with Single Factor: Analysis of variance, Covariance and analysis of covariance, analysis of fixed effects model, model adequacy analysis, non-parametric methods.

Unit II

6

Design of Experiments: Fundamental and types of Design of Experiment, Randomized blocks, latin squares, and related design, factorial design, two-factor factorial design, blocking in a factorial design, the 2^2 & 2^3 factorial design, the general 2^k factorial design, blocking and compounding in the 2^k factorial design, two-level, three level and mixed level factorial and fractional factorial designs.

Unit III

8

Parameter Estimation: Linear regression models, estimation of the parameters in linear regression models, hypothesis testing in multiple regression, non-linear regression, logistic and weighted regression, Chi-squared tests, confidence intervals in multiple regression, prediction of new response observations, regression model diagnostics, testing for lack of fit.

Unit IV

8

Response Surface Methods: Central composite and Box-Behnken designs, method of steepest ascent, analysis of a second-order response surface, experimental designs for fitting response surfaces, mixture experiments, Simultaneous optimization of several responses, Simplex method, evolutionary operation, robust design.

Experiments with Random Factors: Random effect model, two factor factorial with random factors, two-factor mixed model, sample size determination with random effects, approximate F tests.

Design and Analysis: Nested and split-plot design, non-normal responses and transformations, unbalanced data in a factorial design.[8]

Suggested Books:

1. Lazic Z. R., "Design of Experiments in Chemical Engineering: A Practical Guide", Wiley, 2005.
2. Antony J., "Design of Experiments for Engineers and Scientists," Butterworth Heinemann, 2004,
3. Montgomery D. C., "Design and Analysis of Experiments", 5th Ed., Wiley, 2004.

EPL 024: PLASTIC EXTRUSION TECHNOLOGY

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Unit I

6

Introduction to processing

Processing fundamentals, Types of processing techniques

Single screw Extruder

Introduction and terminology, Machine construction and working – Driving mechanism, Thrust bearing, Electrical motor and gear box, Barrel design and Cooling system – Types of screws, Variation in screw design and its effect, Heaters – heat controls, Hopper and feed mechanism, Processing parameters, Breaker plate and Screen changer, Vented extruder.

Unit II	8
Introduction to dies and post extrusion equipments	
Types of dies and it's geometry – Center feed die head, Side feed die head, off set die head, Types of sheet extrusion dies, Post extrusion equipments – Calibration system, Take off units, Slitting unit, cutting system, Winding units, tracking units.	
Unit III	8
Extrusion lines, equipments, accessories, Process variables and troubleshooting	
Granulation, Pipe extrusion, Blown film, Cast film extrusion, Rod Extrusion, Wire coating, Mono-filament and Box strapping.	
Unit IV	8
Twin Screw Extruder	
Introduction and advantages of twin screw extruder, Introduction and advantages of co extrusion process, Post operations, Extruder and die characteristics, Machine specifications, Starting and shutdown procedure.	
Compounding	
Introduction, Mixing theory, Mixing evaluation, Methods of compounding – Interactive dry mixer, Internal – interactive batch mixer, Continuous mixer, Two roll mill.	
Text books:	
1. Plastic extrusion technology – Fisher	
2. Plastics Engineering hand book (SPI) – Berrins	
3. POLYMER EXTRUSION by RANWENDAAL	
4. PLASTIC EXTRUSION TECHNOLOGY HAND BOOK by LEVY	
5. Hand Book Of Polymeric Foams & Foam Technology By Klemptner	

EPL 025: FIBRE TECHNOLOGY

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UNIT-1	6
Introduction to natural and synthetic polymers. Essential characteristics and molecular architecture of fibre forming polymers.	
UNIT-2	8
Concept of order in polymers, crystallinity, orientation, physical structure of natural and man-made fibers. Physical methods for investigating fiber structure. Optical properties of oriented polymers and fibres, refractive index and birefringence.	
UNIT-3	8
Melt spinning, dry and wet spinning of fibers. Fiber drawing, heat setting, texturing and mechanical properties of fibers based on viscose, cellulose acetate, polyamides.	
UNIT-4	8
Fiber drawing, heat setting, texturing and mechanical properties of fibers based on polyesters, acrylics, polypropylene, glass and carbon-fibres. General	

principles of finishing and dyeing of fibers. Common types of finishes applied to textile fibers.

BOOK

1. A.A. Vaidya, Production of synthetic fibres, Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

EPL 026: MOULD MAKING TECHNIQUES

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Unit I

8

Introduction to numerical control system – CNC machine – lathe – milling – EDM – types of control system for CNC machine – CNC processing – co-ordinate system – CNC axis and motion – CNC milling – CNC turning – CNC EDM – machining concepts – concepts of CNC program – tool motion – canned cycles – CNC interface with CAD – CNC stimulation softwares.

Unit II

8

CNC milling – programming, linear & circular interpolation – cutter diameter compensation – commands for CNC milling and standard milling cycles – selection of cutters and programming.

Unit III

7

CNC lathe – CNC turning – linear & circular interpolation – tool nose radius compensation – commands for CNC lathe – multiple/ repetitive cycles – selection of cutters and programming.

Unit IV

7

CNC EDM – selection of electrode – electrode holding devices, axis movement, and spark gap – size of electrode – accuracy level and finish.
CNC wire EDM – selection of wire – programming for wire EDM – application of wire EDM.

Books -

1. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
2. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
3. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
4. Computer Aided Manufacturing by Kundra and Rao
5. Computer control of Manufacturing systems by Koren
6. NC Machine Tools by S.J. Martin.
7. NC Machines by Koren

Departmental Elective III

EME-031 / EPL 031: Computer Aided Manufacturing.

EME-032 / EPL 032 : Project Management

EPL 033. Advanced Extrusion Process Technology.

EPL 034: Technology of Elastomers.

EPL 035: Secondary Processing Techniques.

EME-036 / EME 036: Management Information System

EME-031 / EPL 031: COMPUTER AIDED MANUFACTURING

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UNIT-I

Automation

4

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

Features of NC Machines-

3

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.

UNIT-II

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro.

5

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement.

4

UNIT-III

System Devices

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

3

Interpolators

Digital differential Integrator-Principle of operation, exponential deceleration; DDA

Hardware Interpolator- Linear, Circular; DDA Software Interpolator.

4

Control of NC Systems Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.

3

UNIT-IV

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.

6

UNIT-V

Robotics

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples.

6

Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing.

2

Books/References-

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of Manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

EME-032 / EPL 032 : Project Management

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Unit – I

8

Project Management Concepts:

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction.

Unit –II

8

Project Organization & Project Contracts:

Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

Unit –III

Project Appraisal & Cost Estimation:

8

Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

Unit –IV

Project Planning & Scheduling:

8

Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of

networks, linear programming formulation of event oriented networks, updating of networks, LOB technique.

Unit –V

8

Modification & Extensions of Network Models:

Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

Books:

1. Project Management by K. Nagarajan
2. Project Management by Harvey Maylor

EPL 033: ADVANCE EXTRUSION PROCESS TECHNOLOGY

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Unit I

Extrusion lines (with calibration system and takeoff / haul off units)

Dies, Pipes, Corrugated pipes, Nylon braided PVC hose pipe, PVC reinforced PVC suction hose pipe, Post extrusion process

Blown film Extrusion

Dies, Tubular film extrusion, Blown film Co – extrusion, Polymers, combinations and properties, Advantages, **Flat film & sheets** – Dies, Introduction, Calendaring mechanisms, Polishing stack operation

Unit II

8

Manufacture of oriented films

Advantages, Process, Temperature control of film System, Stretching units

Extrusion coating & lamination

Dies, Introduction & Advantages, Paper film & foil lamination, Material combination, Adhesion, Pretreatment, Co - extrusion as adhesion promoter

Unit III

8

Extrusion of foamed intermediate products.

Dies, Manufacturing process, Raw material, Post extrusion, Single stage & multi stage process, Dies & calibrating devices.

Rod extrusion of PTFE and UHMWPE, Description of the process, Processing machine, Extrusion dies

Unit IV

8

Packaging

Introduction & Advantage, Monolayer & Multilayer Packaging, Additives & Plastic materials, Equipments, Bag making machinery, Thermoform / fill / seal packaging, Vertical form / fill / seal packaging, Labeling, Printing & welding

Maintenance (Electrical & Mechanical)

Process control system – Introduction, Temperature controlling system & elements, Hydraulic Controlling system & elements, Electrical controlling system & elements, Micro process control, Type of sensors, Process control, Product control

Unit V**8****Technical cost analysis,**

Introduction to Technical cost modeling, Cost analysis method, Direct & indirect cost elements, Fixed and variable cost elements, Extrusion molding cost model – (case study for product to be manufacture), Break even point – cycle time, Annual production volume –Comparative cost analysis – (case study), Summary of cost comparisons

Books:

1. Plastic Extrusion Technology – Fisher
2. Plastics Engineering Hand Book (Spi) – Berrins
3. Polymer Extrusion By Ranwendaal
4. Plastic Extrusion Technology Hand Book By Levy
5. Hand Book Of Polymeric Foams & Foam Technology By Klemperer

EPL 034: Technology of Elastomers**L T P****3 1 0****8****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**8**

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**8**

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

Unit-IV**8**

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

Unit-V**8**

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

Books –

1. C. Keith Riew, “Rubber toughened Plastics, American Society
2. John Dick, “Rubber Technology” Hanser Gardner Publications

EPL 035: SECONDARY PROCESSING TECHNIQUES

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Unit –1

FRP Laminates: Introduction, FRP processing methods contact moulding hand lay up, spray up method vacuum bag & pressure bag moulding, filament winding, centrifugal casting, pultrusion, matched die moulding laminates, definition of terms high, pressure laminating process, types of machinery, impregnation systems – decorative and industrial laminates, continuous high pressure laminating process, application.

Unit-II

8

Cellular Plastics: Introduction process to create foam in resins mechanical foaming, chemical foaming, physical foaming processes to shape and solidify foams low pressure foam moulding, high pressure foam moulding, RIM extrusion foaming, casting foams, steam chest moulding structural foam moulding applications.

Unit III

8

Machinery & joining of Plastics: Introduction – Importance of machining methods viz. cutting, drilling, blending, filling, etc. Joining principles cohesion Principle, adhesion principle- solvent cementing, DOP cementing, welding, vibration welding, hot plate welding, ultrasonic welding, Adhesive bonding examples: Mechanical fasteners.

Unit –IV

8

Casting Processes: Dip casting, slush casting, continuous casting, cell casting, processes and applications. Calendering – Types of Calendering systems.

Unit –V

8

Coating Processes: Roller coating, powder coating, fluidized bed coating, electrostatic spray coating, processes and applications. Other Secondary Processes: Printing, painting, hot stamping, in mould decoration, Electro plating and vacuum metallising, decorating.

Book:

1. Donatar Satar, Plastics Finishing and Decoration, Van Nostrand Reinhold company, New York, 1986.
2. James M. Margolis, Decorating Plastics, Hanser Publishers, New York, 1986.
3. Berins “Plastics engineering hand book” By society of the Plastics industry
4. B.T.Astrom, “Manufacturing of polymer Composites”, Chapman and Hall, London (1995).

References:

1. Donal V.Rosato & Dominick V.Rosato, Plastics Processing Data Book, Van Nostrand Reinhold, New York, 1990.
2. A. Brent Strong, Plastics: Materials and Processing Practice- Hall, New Jersey, 1996.
3. M.N.Watson, Joining Plastics in Production, The Welding Institute, Cambridge, 1988.

EME-036 / EPL 036: MANAGEMENT INFORMATION SYSTEM

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Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS. 6

Unit-II

Foundation of Information System : Introduction to Information System in Business, Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc. 10

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage. 8

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change.
Reports: Various types of MIS reports, GUI & Other Presentation tools. 6

Unit-V

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies. 10

Books

1. O.Brian, "Introduction to Information System", Mc-Graw Hill.
2. O.Brian, "Management Information System", TMH.
3. Alter, "Information Systems : A Management Perspective", Addison Wesley.
4. Arora & Bhatia, "Information Systems for Managers", Excel
5. Bansal, "Information System Analysis & Design", TMH.
6. Jawadegar, "Management Information System", TMH.
7. Murdick, "Information System for Modern Management", PHI.
8. Alexis Leon, "Enterprise Resource Planning", TMH.

Departmental Elective IV

EME-041 / EPL 041: Total Quality Management (TQM)

EPL 042. Biodegradable Polymers.

EPL 043. Polymer Blend & Alloy.

ECH 501 / EPL 044: Mass Transfer Operations I

EPL 045. Advance Polymeric Material .

EPL 046. Testing of Plastics Material And Product

EME-041 / EPL 041: TOTAL QUALITY MANAGEMENT (TQM)

Unit-I

8

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 sales and services, Guarantee, analysis of claims.

Unit-II

8

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

8

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-chart.

Unit-IV

8

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, quality circle.

Unit-V

8

ISO-9000 and its concept of Quality Management:

ISO 9000 series, Taguchi method, JIT in some details

References:

1. Lt. Gen. H.Lal, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. "Beyond Total Quality Management". McGraw Hill, 1994.
1. 3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

EPL 042: BIODEGREDEABLE POLYMERS

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UNIT I

8

CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION

Introduction, enzymes – enzyme nomenclature – enzyme specificity – physical factors affecting the activity of enzymes – enzyme mechanism, Chemical degradation initiates biodegradation, Hydrolysis of synthetic biodegradable polymers.

UNIT II

8

PARTICULATE STARCH BASED PRODUCTS

Development of Technology, Current objectives, relative starch technology, Manufacture of master batch, Conversion technology – processing precautions – moisture and temperature – rheological considerations, cyclic conversion process, physical properties of products – sample preparation – physical testing methods – test results, Quality control testing of degradation – auto oxidation measurement – biodegradation assessment – soil burial test.

UNIT III

8

BIOPOLYESTERS

Introduction, History, biosynthesis, Isolation – solvent extraction - sodium hypo chloride digestion, enzymatic digestion, Properties – crystal structure – nascent morphology, degradation - Intracellular biodegradation - extra cellular biodegradation – thermal degradation – hydrolytic degradation – environmental degradation – effects of recycling, applications, economics, future prospects.

UNIT IV

8

RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS

Introduction, conventional recycling – economic incentive – recycling problems, degradable complicate recycling – polyethylene/starch film, reprocessing polyethylene/corn starch film scrap – learning to reprocess PE/S - Calcium oxide moisture scavenger – temperature control – accounting for pro-oxidant – handling PE/S repro – economics of in-plant recycling, Using PE/S repro – comparative study of PE/S repro on film properties, recycling other degradables.

UNIT V

8

TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS

Introduction, defining biodegradability, criteria used in the evaluation of biodegradable polymers, tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods – screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability – petri dish screen – environmental chamber method – soil burial tests, Test method developments for the future.

TEXT BOOKS

1. G.J.L Griffin Blackie(ed.), Chemistry & Technology of Biodegradable Polymers Academic & Professional London 1994.
2. Yoshiharu Doi, Kazuhiko Fukuda (ed.) Biodegradable Plastics & Polymers Elsevier 1994.

REFERENCES

1. Abraham J.Donb & Others (ed.) Handbook of Biodegradable polymers.
2. Harvard Academic Publishers Australia 1997.

043: POLYMER BLENDS & ALLOYS

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Unit-I

8

Introduction to polymer blends & alloys- Definitions and nomenclature reasons for making polymer blend – how to select blend components preparation of alloys & blends – economy of blending.

Unit-II

8

Compatibilization and reactive blending:

Introduction – compatibilization mechanisms – compatibilization methods compatibilization by addition of copolymer reactive blending – future trends.

Unit- III

8

Rheology of polymer blends- Introduction – Miscibility and flow behaviour of polymer blends – Immiscible blends Flow behaviour of immiscible and miscible polymer blends. Complex flow processing of polymer blends flow through a contraction.

Unit – IV

8

Techniques for studying blends and alloys light microscopy the microscope, microstructure scanning electron microscopy specimen preparation application to polymer blends.

Unit –V

8

Thermal analysis Differential thermal analysis, Differential scanning calorimeter Glass transition temperature.

Other techniques: Light scattering – X- ray scattering – spectroscopy

Text Book:

1. LA. Utracki, Commercial Polymer Blends, Chapman & Hall, London, 1998.
2. RP.Singh, C.K.Das, S.K. Mustafi, Polymer Blends and Alloys an Overview, Asian Books Pvt.Ltd, New Delhi, 2002.

References:

1. D.R.Paul & Seymour Newman, Polymer Blends, Vol.1 & 2, Academic Press, New York, 1978.
2. Chris Rauwendaal, Polymer Mixing A self- study Guide, Hanser Publishers. Munich, 1998.

ECH 501 / EPL 044: Mass Transfer Operations - I

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8

Unit-I

Diffusion

Molecular and turbulent diffusion, diffusion coefficient. Fick's Law of diffusion, measurement and estimation of diffusivity. Diffusion in multi component gas mixtures. Diffusion in solids: Molecular, Knud sen and surface diffusion. Inter phase mass transfer: Mass Transfer Coefficients, diffusion between phases, equilibrium solubility of gases in liquids. Mass Transfer theories. Mass transfer in fluidized beds.

Unit-II**8**

Adsorption and Stripping Equipments, gas-liquid equilibria, Henry's Law, selection of solvent, adsorption in tray column, graphical and analytical methods. Adsorption in packed columns. HTU, NTU & HETP concepts, design equations for packed column.

Unit-III**8**

Humidification and Dehumidification

Vapour liquid equilibrium and enthalpy for a pure substance, vapour-pressure-temperature curve, vapour gas mixtures, definitions and derivatives of relationships related with humidity, fundamental concept of humidification, dehumidification and water cooling, wet bulb temperature, adiabatic and non-adiabatic operation, evaporation cooling, classification and design of cooling towers.

Unit-IV**8**

Drying

Solid-gas equilibria, definition of moisture contents, types of batch and continuous dryers, rate of batch drying, time of drying, mechanism of batch drying, continuous drying.

Unit-V

8

Crystallization

Equilibrium yield of crystallization, heat and mass transfer rates in Crystallization, theories of crystallization. Classification and design of crystallizers.

Books

1. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and ilke P. "Mass Transfer" McGraw Hill (1975).

Reference Books

1. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).
2. Geankoplis, C.J.. "Transport Processes and Unit Operations", 3rd ed. Prentice Hall. (1993)

EPL 045: Advanced Polymeric MaterialsL T P
3 1 0**Unit-I**

8

High tech-areas for applications of plastics. High temperature polymers.

Unit-II

8

Polymer blends and alloys, interpenetrating polymers networks.
Introduction – basic chemistry – General properties and applications of thermoplastic elastomers.

Unit-III

8

Polymer concretes and polymer reagents. Introduction – basic chemistry – General properties and applications of Ultra-high modulus fibres.

Unit-IV

8

Introduction – basic chemistry – General properties and applications of Liquid crystalline polymers.

Introduction – basic chemistry – General properties and applications of Polymeric foams.

Unit-V

8

Introduction – basic chemistry – General properties of Polymers for low temperature and Bio-medical applications.

Books-

1. Collyer, A.A, High Temperature Engg. Thermoplastics, Elsevier pub.
2. Jeigler, J.M., Silicon Based Polymers, Noyes.
3. Brydson, J.A " Plastics Material"
4. LA. Utracki, Commercial Polymer Blends, Chapman & Hall, London, 1998.
5. RP. Singh, C.K. Das, S.K. Mustafi, Polymer Blends and Alloys an Overview, Asian Books Pvt.Ltd, New Delhi, 2002.

EPL-046: TESTING OF PLASTICS MATERIAL AND PRODUCT

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3 1 0

Unit – I

8

Consideration of the importance of testing-identification of plastics – Determination of necessary manufacturing conditions – Assessment of properties of finished products in relation to service requirements. Standard and specification – National and International standards – Test specimen preparation– Preconditioning and test atmosphere.

Unit – II

8

Identification of common plastics materials by simple tests e.g., Visual inspection, density, effects of heat, combustion and solvents, analysis with common solvents.

Mechanical Properties: Density and dimensions – Hardness-tensile strength – compressive strength – strength –flexural strength-heat strength – impact strength – dynamic stress-strain properties – creep – relaxation, friction and wear-abrasion test-fatigue-burst strength-and folding endurance.

Unit –III

8

Thermal Properties: Specific heat and thermal conductivity thermal dependant properties-thermal endurance-glass transition temperature-thermal yield tests – Heat deflection temperature – Vicat softening temperature – Marten’s heat resistance test-low temperature brittle point and flexibility test-coefficient of thermal expansion-shrinkage – Thermal stability – Thermal ageing and flammability.

Permeability Properties: Water absorption – soluble and insoluble matter – chemical resistance, environmental stress cracking resistance – ageing – gas permeability – water vapour permeability and weathering.

UNIT –IV

8

Processing and flow properties-Melt flow index, relationship of melt flow index on processing behavior and properties.

Optical Properties – Refractive index – light transmission – haze – clarity – gloss – colour guard and microscope.

Electrical properties- Effect of polymer structure , Insulation resistance-power factor-permittivity-dielectric strength-tracking resistance-arc resistance and antistatic test.

UNIT –V

8

Product testing-pipe and fittings-film and sheets, Pipe and tube, blow bottle testing and FRP based products.

Factors for designing tests for newer products.

Factors affecting the quality of materials and products.

Books -

1. Vishu shah “Plastics testing technology hand book”
- 2 Brown RP “Hand book Plastics test methods “
- 3 Mathur ,AB & Bhardwaj IS “Testing and evaluation of Plastics”
- 4 Ives GC, Mead JA & Riley MM “Hand book Plastics test methods”

Departmental Elective V

EME 051 / EPL 051. Operations Research.
EME-052 / EPL 052 Maintenance Engineering & Management
EPL 053. Plastic Waste Management.
EPL 054: Polyurethane Technology
EPL 055. Polymer Composites.
EPL 056. Advanced Blow Moulding Process Technology.

EME-051 / EPL 051 : OPERATIONS RESEARCH

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Unit-I

Introduction: Basics of Operations Research

1

Linear Programming-

7

Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal & dual problem sensitivity analysis.

Unit-II

Transportation & Assignment problems.

4

Deterministic Dynamic Programming-

4

Multistage decision problems & solution, Principle of optimality.

Unit-III

Decision theory-

4

Decision under various conditions.

Game Theory-

2

Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Linear Programming

Sequencing-

2

Basic assumption, n Jobs through two / three machines, 2 Jobs on m machines.

Unit-IV

Stochastic inventory models-

5

Single & multi period models with continuous & discrete demands, Service level & reorder policy

Simulations-

3

Use, advantages & limitations, Monte-carlo simulation, Application to queuing, inventory & other problems.

Unit-V

Queuing models-

3

Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration

Project Management:

6

Basic concept, Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

Text Books

Operations Research by : Wangner

Operations Research by : Taha

Introduction to Management Science by: Hiller & Hiller

Operations Research by : Wayne L. Winston

EME-052 / EPL 052: MAINTENANCE ENGINEERING & MANAGEMENT

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Unit-I

8

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off.

Unit-II

8

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit-III

8

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.

Unit-IV

8

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT.

Unit-V

8

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Books:

1. Management of systems – R.N. Nauhria & R. Prakash.

2. **Operations Research – Wangner.**

EPL 053: PLASTIC WASTE MANAGEMENT

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Unit –I

8

Introduction – Sources of plastics waste – Separation technologies, viz. Sorting – Manual, automated, Density separation, Flotation, Solvent separation, Melt filtration, Separation of resin from fiber in waste FRP.

Unit – II**8**

Plastics waste management – 4 R & I approach viz. Source reduction, Reuse, Repair, Recycling, and Incineration with examples. Plastics recycling Classification Code of practice – Primary, secondary, tertiary and quaternary recycling with examples – Co-extrusion and co- injection moulding – Waste plastics as fillers.

Unit – III**8**

Mechanical recycling of commonly used plastics, such as PP,PE,PET,etc. mixed waste recycling – co-extruded films waste, commingled waste Extrusion flow moulding for production of plastics lumbars, chemical recycling/feedtoch recycling processes for recovery of oil, monomer and energy – thermolytic processes.Solvolyis – process outline for PMMA, PET,etc. Fluidised bed incinerator with energy recovery.

Unit – IV**8**

Recycling of plastics by surface refurbishing – Application of a coating, polishing with examples – Plastics ageing – Environmental ageing – Thermal ageing – Chemical degradation – Wear and erosion.

Unit – V**8**

Biodegradable plastics – an overview. Environmental issues, policies and legislation in India. Plastics – Energy saving, Eco-friendly – Case studies. Life cycle analysis – a model.

Text Book:

1. R.Johanner Brandrup, Recycling and recovery of plastics, Hanser Publishers, New York, 1996.
2. Nabil Mustafa, Plastics Waste Management, Disposal Recyding and reuse, Marcel Dekker, Inc. New York, 1993.
3. Anthony L. Andrady (Ed.), "Plastics and the Environment", Wiley Interscience, New York (2003).

Reference:

1. R.J.Ehrig, Plastics Recycling, Products and Processes, Hanser Publishers, New York, 1992.
2. Technologies in Plastics Recyding, American Chemical Society, Washington, DC 1992.

EPL 054: POLYURETHANE TECHNOLOGY**L T P****3 1 0****8****UNIT I**

Introduction to polyurethane- chemistry and materials of polyurethane manufacture: basic reaction, cross linking in polyurethane, important building

blocks for polyurethane (isocyanates, polyols, amines and additives) - The manufacturer of polyurethanes (the process, parameters and controls).

UNIT II

8

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

8

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

8

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

UNIT V

8

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.

TEXT BOOKS

1. Dr. Gumter Oertal (ed.), Polyurethane Hand Book, Hanser Publication Munich.
2. George woods, The ICI Polyurethane book -published journals by ICI, John Wiley and sons NY

EPL 055: POLYMER COMPOSITES

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UNIT-1

8

Introduction of composite material, comparison of different materials with composites-advantages and disadvantages. Principles of composite reinforcement. Effect of fibrous reinforcement on composite strength.

UNIT-2

8

Fibrous and particulate composites , Types of reinforcement such as natural, glass, carbon/graphite, aramid fibers, high strength and high modulus fibers. Surface treatment and various forms of fibers. Micro mechanical and Macro mechanical behavior of orthotropic laminae and laminated composites

UNIT-3

8

Thermosetting and thermoplastic materials for the composites and their selection for a

particular application. Evaluation of strength and failure criteria of composites, Optimum fiber reinforcement criteria, Kelly – Davies model.

UNIT-4 **8**

Processing and production techniques like hand-lay-up, spray-up, bag moldings, filament winding and pultrusion.- defects.

UNIT-5 **8**

Pre pares, their manufacture and characterization. Sheet moulding and dough moulding compounds and their processing, preform and resin transfer moldings. Hybrid and sandwich type composites. Testing, joining, environmental effects , Brief on interpenetrating network.

TEXT BOOKS:

1. Lawrence E.Nielsen and Robert F. Landel, “ Mechanical Properties of Polymers and Composites”, 2nd Edn., Marcel Dekker, New York (1994).
2. B.T.Astrom, “Manufacturing of polymer Composites”, Chapman and Hall, London (1995).
3. T.G.Gutowski, “Advanced Composites manufacturing”, John Wiley and Sons, New York (1997).
4. Jones, R.M., “Mechanics of Composites Materials” Script a Book Co.

EPL 056: ADVANCED BLOW MOULDING PROCESS TECHNOLOGY

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UNIT I **8**

Blow moulding of Irregular shaped parts.

Introduction, Blow molding light weight irregular shaped parts, Moving mould sections, Integral HDPE Handle lid, Double wall internally threaded lid, Drum integral Handling HDPE Ring (L-Ring), Caps and closures, Multiple parting lines, Industrial Double wall Blow Molding, Mold preparation and other considerations.

Type of auto feeding mechanisms

Hopper loader, Screw feeders, Hopper mounting & emptying devices, Metering devices

UNIT II **8**

Dies/Moulds

Design guideline, Introduction – Die assembly and its parts – Flow of parison, Blowing of parison, Parison thickness control, Parison swell, Calculation of Die and Mandrel dimensions, Thread closer

Mold design basics

Shrinkage, Parting line, Pinch off, molded neck finishing, Venting, Clamping tonnage, Part ejection, mould cooling,

UNIT III **8**

Introduction to moulds

Simple blow moulds, Stretched Blow moulds, Preform moulds, Mold materials

Control system for Blow molding machines

Introduction, Temperature controlling system & elements, Hydraulic controlling system & elements, Electrical controlling system & elements, Micro process control, Types of sensors, Process control, Product Control

UNIT IV

8

Maintenance

Maintenance of machines, Preventive & breakdown maintenance of different Controlling mechanism, Start and shut down process, Handling of Dies, molds and accessories, Assembly of dies & molds, Dismantling of dies & molds, Cleaning of moulds and dies, Maintenance of auxiliary equipments

UNIT V

8

Technical cost analysis,

Introduction to Technical cost modeling, Cost analysis method, Direct & indirect cost elements, Fixed and variable cost elements, Blow molding cost model – (case study for product to be manufacture), Break even point – cycle time, Annual production volume – Comparative cost analysis – (case study), Injection molding, Thermoforming , and Summary of cost comparisons

Text books:

1. Blow Moulding of Plastics – Fisher
2. Design of Blow Moulds – R. C. Batra

Departmental Elective VI

EME-061/ EPL 061: Finite Element Method
EPL 062 : Advanced Injection Moulding Technology.
EMT 601/ EPL 063. Pneumatics & Hydraulics.
EPL 064/ECH601: Mass Transfer Operations-II
EME-065 / EPL 065 : Energy Management
EPL 066. Surface Coating Technology.

EME-061/ EPL 061: FINITE ELEMENT METHOD

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UNIT-I

8

Introduction

Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayleigh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II

8

Types of Elements Used

Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III

8

Finite Element Formulation of Field Problems

1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV

8

Finite Element Formulation of Solid Mechanics Problems

1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, thin plate problems; Vibration of shafts & beams.

UNIT-V

8

Numerical Methods in FEM

Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.

Books:

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill

3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis, R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
7. Finite Element and Approximation O.C. Zenkiewicy & Morgan -
8. Numerical Methods E Balagurusamy Tata McGraw Hill

EPL 062: ADVANCED INJECTION MOULDING TECHNOLOGY

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UNIT I

8

Introduction to light weighted formed / hollow injection molded articles

Gas-assisted injection moulding – Introduction, Field of application, Materials – Gasinjection systems & mechanisms, Processing technology & steps, Discontinuous pressuregeneration Continuous pressure generation, Gas pressure control, Gas Injection units (through nozzle & into mould), Mould technology, Product properties, Design guidelines & quality, Troubleshooting

Injection moulding with fusible core technology

Introduction, application and advantages

UNIT II

8

Injection moulding machine for thermosets

Feeding system, Oil heated barrel, Oil temperature controller, Screw / barrel / nozzle design

Controlled low pressure injection moulding

Concept of low- pressure moulding, Alternative injection moulding strategies, Operating conditions, Foaming agents, Equipments, Process Control, Thermoplastic solid moulding, Structural foam moulding

UNIT III

8

Hydraulic application

Hydraulic system, Multi pump, Variable pump, Accumulator, High capacity valves, Intensifier, Hydraulic safety gate

Introduction and process in brief

Co injection (sandwich) moulding, Injection Blow Moulding, Injection Stretch Blow Moulding – Resin Transfer Moulding, Injection Moulding Decoration, Assembly Techniques (introduction only), Moulding-injection Assembly – Chemical Bonding system, Thermal welding Method, Assembly with Fasteners, Orientation and Warpage Prediction in polymer processing, Lamellar injection moulding (LIM) process for multi phase polymer System.

UNIT IV

8

Type of Moulds

Introduction to mould design only, Hot runner moulds, Gas – assisted injection moulds, Low– pressure injection moulds, Moulds for two - colour/ two component moulding,

Moulds for rotating core process, Moulds for retractable core process, Reaction injection moulds.

Introduction to packaging products its process & printing Techniques

Equipments, Auto labeling, Surface treatment, Printing techniques & its process

UNIT V

8

Technical cost analysis

Introduction to Technical cost modeling, Cost analysis method, Direct & indirect cost elements, Fixed and variable cost elements, Injection molding cost model – (case study for product to be manufactured), Break even point – cycle time, Annual production volume, Comparative cost analysis – (case study), Summary of cost comparisons

Text books:

1. Plastic Engineering Handbook – Berrins
2. Injection Moulding Theory and Practice – Rubins

EMT-601 / EPL 065: Pneumatics & Hydraulics

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UNIT 1 (Introduction to Fluid Power And Drives)

8

Fluid Power Systems – Application of fluid power – Properties of hydraulic fluids – Hydraulic pumps – Characteristics – Pump Selection -, Hydraulic Actuators – Linear, Rotary – Selection – Characteristics – Cylinder Mountings, cushioning, pipe fittings.

UNIT 2 (Fluid Power Elements)

8

Pressure control valves, flow control valves, directional control valves – working principle and construction, special type valves, servo valves, Cartridge valves

Actuation methods, Shock absorbers – Accumulator – Symbol for fluid power elements

UNIT III (Hydraulics Circuits)

8

Hydraulics circuits – automatic reciprocating circuit – speed control circuit - Meter in - Meter out – Sequencing Circuits – Synchronizing circuits, Accumulator circuit – Safety circuits – Hydraulic Motor braking System. Design of Hydraulic circuits

UNIT IV (Pneumatic Systems)

8

Pneumatic fundamentals Filter, regulator, lubricator, air motors, air cylinders, pneumatic valves, Basic Pneumatic circuits – Hydro Pneumatic Systems – air- oil cylinder, air – oil reservoir, air – oil intensifier and simple circuits

UNIT V (Fluid Logic Control)

8

Principle of fluid Logic control, Basic fluidic devices - Fluid sensors

Fluidic circuits – sequencing control, continuous reciprocation,

Electrical controls – electrical components – simple electro hydraulic/ pneumatic circuits.

PLC application in fluid power control.

BOOKS

1. Antony Esposito “Fluid Power with applications”
2. Mazumdar S. R “Pneumatic Systems – Principles and Maintenance”
3. Mazumdar S. R “Oil Hydraulics Systems – Principles and Maintenance”

4. John Pipenger & Tyler Hicks "Industrial Hydraulics"
5. Chandashekhara P. K. "Fluid Power"
6. Kripal Singh "Automobile Engineering Vol. I"

ECH 601 / EPL 064: MASS TRANSFER OPERATIONS – II

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Unit I [8] **Distillation**

Pressure-composition, Temperature-concentration, Enthalpy-concentration diagrams for ideal and non-ideal solutions, Raoult's law and its application, Maximum and minimum boiling mixtures, concept of relative volatility, Single Stage Distillation Differential distillation, Flash vaporization, Vacuum, molecular and steam distillation.

Unit II [8] **Continuous Distillation of Binary Mixtures**

Multistage contact operations, Characteristics of multistage tower, McCabe Thiele method, Ponchon Savarit method, Reflux, maximum, min. and optimum reflux, Use of open steam, Tray efficiency, Determination of height and column diameter, Multistage batch distillation; Principles of azeotropic and extractive distillation, Introduction to multicomponent distillation system.

Unit III [8] **Liquid-Liquid Extraction**

Ternary liquid equilibria, Triangular graphical representation concept of theoretical or ideal stage, Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation Super critical fluid extraction.

Unit IV [8] **Solid /Liquid Extraction**

Leaching, Solid liquid equilibrium, Equipment used in solid-liquid extraction, Single and multistage cross current contact and counter current operations. Concept of an ideal stage, Overall stage efficiency, Determination of number of stages

Unit V [8] **Adsorption**

Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents adsorption equilibria and adsorption hysteresis, Stage wise and continuous contact adsorption operations, Determination of number of stages, Equipments; Ion exchange, Equilibrium relationship, Principle of ion-exchange, techniques and applications, Principles and application of dialysis, osmosis reverse osmosis, thermal diffusion, sweep diffusion. [8]

Text Books

1. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and Wilke P. "Mass Transfer" McGraw Hill (1975).

Reference Books

1. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).
2. Geankoplis, C.J.. "Transport Processes and Unit Operations", 3rd ed. Prentice Hall. (1993)

EME-065 / EPL 065 : ENERGY MANAGEMENT

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UNIT-1

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics,, Energy consumption and GDP, energy database , Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan.

7

UNIT-2

Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. **7**

UNIT-3

Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management , Energy conservation through controls, Computer aided energy management, Program organization and methodology.

7

UNIT-4

Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes. **9**

UNIT-5

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. **7**

BOOKS:

1. Energy Management and condevtion, by Clive Beggs, Butterwoth- Heinemann Elsevier Science.
2. Optimising Energy Efficiency in the Industry, By Rajan, Tata Mc Graw Hill Publishers.
3. Guide to energy Management , By C.L Capehart, Fairmont Press.

EPL 066: SURFACE COATING TECHNOLOGY

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UNIT-1

6

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

UNIT-2	8
Functions of coating and mechanism of film formation. Characteristics of natural and synthetic film forms	
UNIT-3	9
Pigments and pigmentation. Dispersion techniques. Fundamentals of coating formulations based on natural and synthetic polymers. Role of wetting agents, driers, solvents and plasticizers in coatings.	
UNIT-4	9
Surface preparation and pretreatments. Rheological behaviors of coatings. Application methods and curing techniques.	
UNIT-5	8
Specialty coatings like water based, powder and high solid, etc. industrial and architectural finishes.	

Books-

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