



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160511

Semester – VI

Subject Name: Polymer Science & Technology

Type of course: Professional elective course

Prerequisite: Basic knowledge of Chemistry.

Rationale: The main theme of the course on Polymer Science and Technology is to focus understanding of polymer science and technology, Polymer synthesis and its characterization. Knowledge of properties of polymers will enable their proper selection for applications in domestic as well as industrial appliances.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Basic concepts of Monomer, Types of Monomer, Functionality of Monomer, Basic concepts of Polymer, Effect of functionality on Polymer Structure, Chemical and geometric structure of polymer, Configuration and conformation, Linear, branched and cross-linked structure, Random, alternating, block and graft polymers, Stereo regular polymer, Classification of Polymer	6
2	Basic concept of polymer: structures, configuration, application, tacticity crystalline, mechanism and kinetics of polymerization, mode of formation, Poly dispersity and molecular weight distribution, Concept of Mn(Number average molecular weight), Mw((Weight average molecular weight), Mv(Viscosity average molecular weight) and Mz(Z average molecular weight) and measurement techniques, effect of molecular weight on polymer end use properties Functionality principle, Theory of polymer solutions: solubility parameter, Mark-Houwink-Sakurada equation.	8
3	Polymerization reactions: 1. Addition Polymerization reactions: a. Free radical polymerization b. Ionic polymerization c. Co-ordination polymerization 2. Condensation Polymerization a. Poly condensation polymerization b. Poly addition polymerization 3. Rearrangements and Stereo Polymerization 4. Co-Polymerization	10
4	Techniques of Polymerization: Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization, Comparison of bulk, solution, emulsion and suspension polymerization techniques	7



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5	Polymer Degradation : Polymer degradation (chain and random), Methods of degradation of polymers such as mechanical, thermal, photo, oxidative and bio degradation	6
6	Polymer processing: Unit operations in polymer industries. Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.	9

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	15	10	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Polymer science and technology, Joel R. Fried, Prentice Hall India Pvt. Ltd.
2. Textbook of Polymer Science, Fred W. Billmeyer, John Willy and Sons.
3. Rubber chemistry, Brydson, Elsevier Appl.
4. Principles of polymer system, Ferdinand & Rodrigues, Tata McGraw-Hill Pub.
5. Polymer Science, Gowariker, Eastern Wiley Pub.

Sr. No.	CO statement	Marks % weightage
CO-1	To Synthesize and characterize polymers based on their properties and applications.	20
CO-2	To know the various types of polymerization reactions.	20
CO-3	To Discuss techniques of polymerization.	25
CO-4	To be able to utilize the knowledge for the processing of polymers.	20
CO-5	To build a bridge between theoretical and practical concept used in industry.	15

List of Experiments: (Minimum 05 experiments need to be performed)



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1. Bulk polymerization of styrene.
2. Solution polymerization of acrylonitrile.
3. Emulsion polymerization of methylacrylate.
4. Synthesis of urea - formaldehyde by condensation polymerization.
5. To study injection moulding machine: Different materials and moulds; and optimization of cycle Time.
6. Determination of melt flow index for different materials.
7. Extrusion of strands / film and Pelletization.
8. To study Compression moulding.
9. To synthesis polymer using Bulk, solution, suspension & emulsion polymerization method.

Major Equipment

Extruder, compression molding machine, etc.

List of Open Source Software/learning website:

Reference to NPTEL lectures can be made for a better understanding

Literature available on Polymer technology.