GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering (Chemical Engineering-30)
Subject Code: 3733008
Semester – III
Subject Name: Polymer science and Technology

Type of course: Elective V

Prerequisite: Basic knowledge of polymer chemistry at undergraduate level.

Rationale: The main theme of this course is to focus on understanding of polymer science, its 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	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Basic concepts of polymer:** Concepts of polymers, Classification of polymers based on: structures, configuration, application, tacticity crystalline etc.., 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) etc., measurement techniques, effect of molecular weight on polymer end use properties, Functionality principle, Theory of polymer solutions: solubility parameter, Mark-Houwink-Sakurda equation.	03
2	**Polymer Structure and Physical Properties:** The Crystalline Melting Point, The glass Transition, Properties Involving Large Deformation, Properties Involving small Deformation, Strength, Physical state of Polymers, Elastic property, Chemical resistance, Solubility, Intermolecular forces in monomers and polymers, Plastics- Elastomers & Fibers, Mechanical behavior of Polymers, Molecular weight & intermolecular forces, The amorphous state rheology, Stereochemistry, Crystallinity, Chemical Cross linking, Physical Cross linking, Polymer blends	10
3	**Chain growth polymerization:** Mechanism and kinetics of free radical, anionic, cationic and co-ordination polymerization, initiator efficiency, types of initiation reactions, auto acceleration chain transfer agents, inhibition and retardation reactions.	7

4	**Step growth polymerization:** Carothers's equation, kinetics of step growth polymerization, cross-linking and gelation, Comparison between addition and condensation polymerization, Co polymerization: Types of co polymers, monomer reactivity ratio, block and graft copolymers	6
5	**Polymer Degradation And Techniques of Polymerization:** Polymer degradation (chain and random), Methods of degradation of polymers such as mechanical, thermal, photo, oxidative and bio degradation, Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization and its kinetics, Comparison of bulk, solution, emulsion and suspension polymerization techniques.	10
6	**Polymerization Reaction Engineering :** Reactors for polymerization, analysis of polymerization reactions, Reactor design applied to polymer system, Average molecular weight of polymer in different reactor, Control of molecular weight, Reactors for Industrial polymerization Processes like manufacturing of PS, PBR SBR.	7
7	**Rheology of Polymeric System:** Unit operations in polymer industries. Polymer processing: moulding, calendaring, extrusion etc.	2

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	14	21	14	7	7

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, Ferdinend &Rodrigues, Tata McGraw-Hill Pub.
5. Polymer Science, Gowariker, Eastern Wiley Pub.

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering (Chemical Engineering-30)
Subject Code: 3733008

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Synthesize and characterize polymers based on their properties and applications.	25
CO-2	Understand the kinetics of polymers.	20
CO-3	Understand the basic concepts in design of a polymeric process.	20
CO-4	Understand and apply different techniques of polymerization.	15
CO-5	Discuss methodically the molding techniques.	10
CO-6	Apply the concepts learned to the different industrial applications.	10

List of Open Source Software/learning website:

- NPTEL lecture series.
- MIT Open course lecture on Polymer technology.