GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor/Master of Engineering Syllabus

Subject Code : 3174403

Subject Name : Sustainable Polymer Engineering

WEF Academic Year:	2023-24
Semester:	VII
Category of the Course:	Professional elective course

Prerequisite :	Basics of Chemistry
Rationale :	The primary objective of the Polymer Science and Technology course is to emphasize comprehension of polymer science, technology, the synthesis of polymers, and their characterization. Acquiring knowledge about the properties of polymers is essential for making informed decisions regarding their suitable use in both domestic and industrial appliances..

Course Scheme:

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

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Basic concepts and definitions** Monomer, polymer, oligomers, repeating units, structural units, degree of polymerization, molecular weight. Classification of polymers: natural vs. synthetic, linear, branched, cross-linked, amorphous, crystalline, thermoset, thermoplastic, homopolymer, co-polymer, fibre, plastics, elastomers.	6	14
2	**Structures and properties of polymer:** Structures, configuration, application, tacticity crystalline, mechanism and kinetics of polymerization, mode of formation, Poly dispersity and molecular weight distribution, measurement	8	16

	techniques, effect of molecular weight on polymer end use properties Functionality principle, Theory of polymer solutions: solubility parameter, Mark-Houwink Sakurda equation.		
3	**Polymerization reactions:** 1. Addition Polymerization reactions: 2.Condensation Polymerization 3.Rearrangements and Stereo Polymerization 4.Co-Polymerization	8	18
4	**Techniques of Polymerization:** Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization, Comparison of bulk, solution, emulsion and suspension polymerization techniques	10	18
5	**Polymer Degradation :** Polymer degradation (chain and random), Methods of degradation of polymers such as mechanical, thermal, photo, oxidative and bio degradation	6	14
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.	10	20
	Total	**48**	**100**

Reference Book:

1. Dr. P. Ghosh, Polymer Science and Technology - Plastics, Rubber, Blends and Composites-McGraw-Hill Education (2011)
2. Joel R. Fried, Polymer science and technology, Prentice Hall India Pvt. Ltd.
3. Robert O. Ebewele, Polymer Science and Technology, CRC Press, Taylor & Francis
4. Textbook of Polymer Science, Fred W. Billmeyer, John Willy and Sons

Course Outcome:

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
CO-1	Classify different types of Polymers	5
CO-2	Understand the types of polymerization, polymerization steps, and methods of polymerization	20
CO-3	Calculate number average, weight average molecular weight and polydispersity index of polymers	20
CO-4	Categorize microstructure structures based on the chemical and geometrical structure	15
CO-5	Understand importance of glass transition temperature in polymers	20
CO-6	Distinguish crystalline and amorphous behavior of polymers	20

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. Bulk polymerization
2. Emulsion polymerization
3. Determination or reactive ratio for copolymerisation of styrene with MMA
4. Solution polymerization
5. Synthesis of urea - formaldehyde by condensation polymerization.
6. Determination of melt flow index for different materials.
7. Injection moulding
8. Compression moulding

List of Laboratory/Learning Resources Required:

1. Students can refer to video lectures available on the websites including NPTEL.

2. Students can perform experiments on Virtual lab by IITs.

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