

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30) POLYMER SCIENCE AND TECHNOLOGY SUBJECT CODE: 2743002 SEMESTER: IV

Type of course: Chemical Engineering

Prerequisite: A course on polymer chemistry at undergraduate level.

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)	PA (V)		PA (M)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Basic concept of polymer: Concepts of polymers, Classification of polymers based on: 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.	04	7
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-Elstomers & Fibres, Mechanical behaviour of Polymers. Introduction, Molecular weight & intermolecular forces, The amorphous staterheology, Stereochemistry, Crystallinity, Chemical, Crosslinking, Physical Crosslinking, Polymer blends	10	20
3	Chain growth polymerization: Mechanism and kinetics of free radical, anionic, cationic and co-ordination polymerization, initiator efficiency, types of initiation	8	15

	reactions, auto acceleration chain transfer agents, inhibition and retardation reactions.		
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	8	15
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	20
6	Polymerization Reaction Engineering : Emulsion polymerization, dispersion polymerization etc . 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.	6	09
7	Rheology Of Polymeric System: Unit operations in polymer industries. Polymer processing: moulding, calendaring, extrusion etc.	4	7
8	Reactors for Industrial polymerization Processes like manufacturing of PS, PBR SBR.	4	7

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.

Course Outcome:

After learning the course the students should be able to:

1. Synthesize and characterize polymers based on their properties and applications.
2. Understand the kinetics of polymers.
3. Understand the basic concepts in design of a polymeric process.
4. Understand and apply different techniques of polymerization.
5. Discuss methodically the moulding techniques.
6. Apply the concepts learned to the different industrial applications.

List of Open Source Software/learning website: NPTEL lecture series.

- Literature available on Polymer technology.
- MIT Open course lecture on Polymer technology

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.