



Gyanmanjari
Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-5 (B.Tech.)

Subject: Fundamentals of Polymer Science and Engineering– BETCH15314

Type of course: Professional Elective courses

Prerequisite: Basic Understanding of Chemistry

Rationale: To provide a broad and fundamental knowledge of polymers and their chemical, physical and mechanical behavior, emphasize polymer synthesis, reaction engineering, and various processing techniques like moulding and extrusion. To equip the students with the knowledge necessary for deciding which characterization technique(s) would be appropriate for determining properties of interest.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	0	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No.	Course content	Hrs.	Weightage
1	Introductory Concepts and Definitions: Some definitions: Polymer, Monomer, Oligomer, Repeating Unit, Representation of Polymer Structures, End groups, Degree of Polymerization: Polymerization and Functionality, Copolymers: Random copolymers, Alternate copolymers, graft copolymers, block copolymers. Molecular Architecture, Thermoplastics, and Thermosets, Elastomers. Fibers, and Plastics, Polymer molecular weights, and molecular weight distribution, the practical aspect of molecular weight measurement. Configuration and crystallinity of polymers, Effect of polymer isomerism, and conformational changes.	15	30%



2	Polymer Synthesis and Reaction Engineering: Polymerization techniques: Addition polymerization: Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization, Condensation polymerization: melt polycondensation, solution polycondensation Polymerization reaction mechanism: Step growth polymerization, Free radical polymerization, Copolymerization, Ionic and coordination polymerization Polymer reaction engineering: Homogeneous and Heterogeneous Polymerization Processes, Batch, Semibatch, and Continuous Processes, Polymerization Reactors.	15	20%
3	Polymer Material Structure and Properties: Polymer structure and physical properties, Thermal transitions, Crystallization of polymers, Glass transition temperature, Viscoelastic behavior of polymers, Dynamic mechanical behavior at thermal transitions, Strain-stress tests, crazing in glassy polymers, Fracture mechanics, toughness and brittleness, polymer rheology, the effect of fabrication processes	15	30%
4.	Manufacturing of Polymers: Polyethylene, polypropylene, polyvinylchloride and copolymers, polystyrene, polyamides, polyesters, Acrylics, Phenol-formaldehyde, Melamine-formaldehyde, Polyurethane, Epoxides, Rubbers and elastomers Polymer Mixtures: Blends, Alloys, Reinforced Plastics And Composites: Polymer compatibilization, Thermodynamic theories for polymers solutions, solubility parameter, Flory-Huggins theory, modified solubility parameter model, solvents and plasticizers, Polymer blending, reinforced plastics and elastomers, additives for polymers, polymer composites	15	20%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	Polymer industries and manufacturing processes Explain Manufacturing process of any 3 daily use polymer, list of polymer will be provided by faculty to students, students must upload report on GMIU web Portal	10
2.	Poster presentation on Polymer synthesis methods Make a poster on different polymer synthesis methods provided by faculty and upload them on GMIU web portal.	10
3.	Polymer production industries of Gujrat Explore Polymer industries in different districts of Gujrat area and prepare a report on including the following topic- type of polymer producing, manufacturing process of polymer (faculty can provide specific production parameters to students/group of students). prepare report and submit on GMIU	10

	web portal.	
4.	Simulation of Polymer Industry Process Run a Simulation of Polymer industry using DWSIM software, faculty will provide terms and conditions of simulation, students have to submit simulation report on GMIU web portal.	10
5.	Recent advancement in polymer industries and future scope Students have to prepare short communication on topic of polymer technologies and recent advancement using last one year research articles, and present in class. presentation will be submitted on GMIU web portal.	10
Total		50

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	40%	30%	30%	0%	0%	0%

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 the above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Evaluate the different molecular weight and size of the polymers. Identify the various polymers.
CO2	Decide which test methods are suitable for the measurement of various properties such as rheology and mechanical properties of polymers.
CO3	Understand the various mechanisms of polymerization and choose suitable techniques for polymer synthesis.
CO4	Identify various polymer processing techniques used for the fabrication of polymer-based products.

Instructional Method:

The course delivery method will depend upon the requirement of content and needs of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.



From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done based on Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

- [1] F.W. Billmeyer, "Textbook of Polymer Science"
- [2] A. Kumar, "Fundamentals of Polymer Engineering"
- [3] F. Rodriguez, "Principles of polymer systems"

