GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: UG

Branch: Plastics Technology

Subject Code : BE04023051

Subject Name : Plastics Material Science

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Basic Science Course

Prerequisite:	Students should be familiar types of polymers and basic polymer structures. Concepts like atomic structure, bonding (covalent bonds), intermolecular forces (van der Waals forces, hydrogen bonding), and basic solution chemistry (solutes, solvents) would be beneficial. Understanding of temperature, heat, and basic material properties.
Rationale:	This course introduces students to the fundamental of polymer behavior, focusing on how molecular characteristics such as molecular weight, crystallinity, and glass transition temperature (Tg) affect the physical and mechanical properties of plastics. Understanding these relationships is essential for selecting and processing plastic materials for various applications.

Course Outcome: After Completion of the Course, Student will able to:

No	Course Outcomes
01	Understand and explain the concepts of molecular weight, glass transition temperature (Tg), crystallinity, and polymer solution behavior, and their significance in polymer properties.
02	Analyze the factors affecting glass transition temperature (Tg), crystallinity, and polymer solubility, and their impact on polymer properties and discuss viscosity of polymer solution.
03	Calculate number average and weight average molecular weight, degree of polymerization, polydispersity index, degree of crystallinity, Tg, cohesive energy density for given polymer systems.
04	Understand molecular weight determination techniques and Polymer solutions.

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial /Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	00	00	45	90	03	70	30	20	30	0	150

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End- Semester Examination, PA = Progressive Assessment

Course Content:

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Unit No.	Content	No. of Hours	% of Weightage
1.	**Molecular weight:** Introduction- Concept of average molecular weight, Number and weight average molecular weight, molecular weight & Degree of polymerization, Polydispersity, Significance of polymer molecular weight, Calculations related to number average, weight average molecular weight.	9	20
2.	**Glass transition temp. (Tg):** Introduction of Tg, Glassy solids & Glass transition, Transition & Associated properties, Factors influencing the Tg. Molecular weight & Tg, plasticizers & Tg., Tg. of copolymers-Tm & Tg.-Importance of Tg.	9	20
3.	**Crystallinity in polymers:** Introduction, crystalline solids and their behaviour towards X-rays, degree of crystallinity, polymer crystallization, crystallisability, Structural regularity & crystallisability, factors affecting crystallisability, sperulites, Crystallization and melting, crystal formation, Effect of crystallinity on properties of polymers**.**	9	20
4.	**Molecular weight determination:** End Group Analysis, Cryoscopy, Ebulliometery, Membrane Osmometery, Vapor Phase Osmometry, Light Scattering, Size Exclusion Chromatography (SEC) / Gel Permeation Chromatography (GPC), Ultracentrifugation, Viscometry.	10	25
5.	**Polymer Solutions:** Introduction to Polymer Solutions, The process of polymer dissolution, Types and Behavior of Polymer Solutions, Good solvent, Poor solvent and Theta Solvent, Solubility Parameters, Solution Viscosity.	8	15
	Total	45	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	25	20	10	5	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Polymer Science by V.R.Gowarikar and N.V.Viswanathan, Willey eastern limited.
2. Polymer Science and Technology by Premamoy Ghosh, Tata McGraw Hill
3. Principles of Polymer Engineerin, by N.G McCrum, Oxford University press
4. Principles of Polymerization by George Odian Wiley Interscience.
5. Introductory Polymer Chemistry by G.S. Misra, Willey eastern limited.
6. Polymer Science and Technology by Joel R. Fried

(b) Open source software and website:

1. https://pslc.ws/
2. https://nptel.ac.in

Suggested Course Practical List: If any

Practical based on the above topics.

Self-Learning Activities:

Sr. No.	Activity	No. of hours	Total hours claimed	Evaluation Criteria
1	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10	Based on report submitted.
2	Poster/chart/power point preparation on technical topics	Duration = 10 h	10	Based on Poster/Chart/PPT preparation and

				presentation skills
3	Assignment writing.	5 assignments of 2h each.	10	Based on the assignment submitted.
4	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10	Report /presentation based on the video learning outcomes.
5	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	-	Based on performance in group discussion, technical depth, knowledge etc.
6	Attending Expert Lecture/Webinar/Seminar	Duration- 1hr each	--	Based on Short report
7	Self-learning on-line course	Minimum duration of the course should be 10h.	10	Examination based assessment at the end of course. Based on the certificate produced
8	Exhibition/ Conference/ Trade Fair/ Industrial exposure for 2-3 days	Visit- 15 hr Report preparation- 5 hr	20	Based on learning, observations and short report.
9	Working model on technical topics	Working = 15 h	15	Based on design, understanding & presentation of the model
10	Non-working model on technical topics	Non- working = 5 h	5	Based on design, understanding & presentation of the model
11	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10	Based on report submitted

Above activities are suggestive, faculty can choose any of these activities and cover up the rest of the 45 Self Learning Hours. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, the total number of hours is fixed.

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