



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Plastic Engineering

Subject Code: ME02084031

Subject Name: Polymer Characterization Techniques

w.e.f. Academic Year:	2024-25
Semester:	2
Category of the Course:	PCC-03.1 (Professional Core Course)

<b>Prerequisite:</b>	Nil
<b>Rationale:</b>	Nil

## Course Outcome:

After Completion of the Course Student will able to:

No	Course Outcomes
01	Students will be able to understand the tests to determine molecular weights
02	Spectroscopic characterization like NMR, IR spectroscopy; Thermal characterization
03	SEM and TEM tests for higher characterization and development of new materials
04	Rheological tests of all types of tests

## Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial/ Practical	
			ESE (E)		PA/ CA (M)	PA/CA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

## Course Content:

Unit No.	Content	No.of Hours	%of Weightage
1.	Molecular Weight Determination: Molecular weight averages - Molecular weight determination techniques like End-group analysis, Colliquative Properties - Ebulliometry, Osmometry and Vapour phase Osmometry, Light scattering techniques, Solution viscometry, and Gel	5	15



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	Permeation Chromatography.		
2.	Spectroscopic Characterization: Introduction to Spectroscopic techniques - Ultraviolet - Visible Spectroscopy - Infra Red and Raman Spectroscopy - Nuclear Magnetic Resonance (NMR) Spectroscopy - Electron Spin Resonance Spectroscopy, X-Ray Diffraction.	10	20
3.	Microscopic And Chromatographic Characterization: Light Microscopy - Scanning electron microscopy - Transmission electron Microscopy and Scanning transmission electron microscopy. Analysis of residual monomer like VCM, Acetaldehyde, Acrylonitrile and Styrene content in Polymers by Gas Chromatography	10	20
4.	Thermal Characterization: The basis of Thermal Analysis - Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) - Thermo-mechanical Analysis (TMA) - Thermo gravimetric Analysis (TGA) - Dynamic Mechanical Thermal Analysis (DMA) and Dielectrical Thermal Analysis.	10	25
5	Rheological Characterization: Introduction and definitions related to fluid flow - Newtonian and non-Newtonian and visco elastic fluids. Rheological properties - viscosity, melt-flow, relationships describing temperature and shear rate dependence on the rheological behaviour of amorphous and crystalline plastics materials, Simple shear flow and its application for measurement of viscosity as well as normal stresses. Simple elongation flow and its significance. Dynamic flow behaviour, time dependent fluid responses. Viscosity measurements - capillary rheometer, viscometer, torque rheometers, cup flow and spiral flow tests for determination of flow behaviour.	10	20
	<b>Total</b>	<b>45</b>	<b>100</b>

## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	20	10	5	5

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

Revised



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## **References/Suggested Learning Resources:**

### **Books:**

1. Fred W. Billmeyer, J. R. Text book of Polymer Science, John Wiley & Sons, Singapore, 1994.
  2. Seymour/Carraher's Polymer Chemistry An Introduction, Marcel Dekker, Inc., New York, 1996. 3  
Campbell and J. R. White, Polymer Characterization Physical Techniques, Chapman and Hall, London, 1989.
  4. J. Spells, Characterization of Solid Polymers, Chapman and Hall, London, 1994.
  - 5 Charles L. Rohn, Analytical Polymer Rheology, Hanser Publishers, Munich, 1995.
  6. Edith A. Turi, Thermal Characterization of Polymeric Materials, Academic Press, New York,
- (b) Open source software and website:

- 1) <https://nptel.ac.in/>
- 2) <https://www.bpf.co.uk/>

**Suggested Course Practical List: : As per the above syllabus topics**

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