# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**
**Subject Code: 3722416**
**Semester – II**
**Subject Name: Plastics Characterization Techniques**

**Type of course: Program Elective III**

**Prerequisite: Plastics Materials**

**Rationale:**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| | | | | | | | | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | Molecular Weight Determination:<br>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 Permeation Chromatography. | 10 |
| 2 | Spectroscopic Characterization:<br>Introduction to Spectroscopic techniques - Ultraviolet - Visible Spectroscopy - Infra Red and Raman Spectroscopy - Nuclear Magnetic Resonance (NMR) Spectroscopy - Electron Spin Resonance Spectroscopy, X -Ray Diffraction | 12 |
| 3 | Microscopic And Chromatographic Characterization:<br>Light Microscopy - Scanning electron microscopy - Transmission electron Microscopy and Scanning transmission electron microscopy.<br>Analysis of residual monomer like VCM, Acetaldehyde, Acrylonitrile and Styrene content in Polymers by Gas Chromatography | 12 |
| 4 | Thermal Characterization:<br>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 |
| 5 | Rheological Characterization:<br>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 | 10 |

| | | |
|---|---|---|
| | 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. | |

**Reference Books:**

1. Handbook of Plastic Testing Technology by Vishu Shah
2. Plastic Characterization by Barbara Stuart
3. Fred W. Billmeyer, J. R. Text book of Polymer Science, John Wiley & Sons, Singapore, 1994.
4. Seymour/Carraher's Polymer Chemistry An Introduction, Marcel Dekker, Inc., New York, 1996.
5. Campbell and J. R. White, Polymer Characterization Physical Techniques, Chapman and Hall, London, 1989.
6. J. Spells, Characterization of Solid Polymers, Chapman and Hall, London, 1994.
7. Charles L. Rohn, Analytical Polymer Rheology, Hanser Publishers, Munich, 1995.
8. Edith A. Turi, Thermal Characterization of Polymeric Materials, Academic Press, New York, 1981.

**Course Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Identify various Plastics Charaterization Techniques | 10 |
| CO-2 | Understand various Molecular weight determination and Spectroscopic Characterization techniques | 20 |
| CO-3 | Understand methods types of Microscopic And Chromatographic Characterization, Thermal Characterization & Rheological Characterization techniques | 35 |
| CO-4 | Apply the knowledge of various characterization techniques to determine molecular weight, Tg, Tm, morphology, size of particle, composition of materials, etc. in a given polymer or polymer composite. | 35 |

**List of Experiments:**

As per the above subject topics

**Major Equipment: SEM, TEM, TGA, FTIR, DSC**

**List of Open Source Software/learning website:**

**www.plasticsnet.in**

**www.sciencedirect.com**