GUJARAT TECHNOLOGICAL UNIVERSITY

PLASTIC TECHNOLOGY (24)
PLASTICS CHARACTERIZATION TECHNIQUES
SUBJECT CODE: 2742402
SEMESTER: IV

Type of course: Theoretical + Practical

Prerequisite: Basic knowledge Plastics testing, plastics materials, strength of materials

Rationale: Correlate appropriate testing method for analysis and identification of plastics and its properties

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No	Course Content	Hours	% 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 Permeation Chromatography.	08	20
2	Spectroscopic Characterization: Introduction to Spectroscopic techniques - Ultraviolet - Visible Spectroscopy - Infra Red and FTIR, Raman Spectroscopy - Nuclear Magnetic Resonance (NMR) Spectroscopy - X -Ray Diffraction.	08	20
3	Microscopic And Chromatographic Characterization: Light Microscopy - Scanning electron microscopy (SEM) - Transmission electron Microscopy (TEM). Analysis of residual monomer like VCM, Acetaldehyde, Acrylonitrile and Styrene content in Polymers by Gas Chromatography.	08	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).	08	20
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	08	20

	measurements - capillary rheometer, viscometer, torque rheometers, cup flow and spiral flow tests for determination of flow behaviour.		

References 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,1981.

Course Outcome:

After learning the course the students should be able to: operate, identify and analyze individual test., can perform the test procedure, calculations, observation, and calibration of each test.

List of Practicals:

1. To determine the Storage modulus, loss modulus and tan delta of a given sample by DMA.
2. To identify the chemical compositions and functional group of unknown plastics by FTIR.
3. To analyze the VCM & chemical separation in GC.
4. To study the morphology of given sample by SEM.
5. To study the structure topography of given sample by TEM.
6. To study the cup flow and spiral flow test.
7. To study the DSC.
8. To study the TGA.
9. To study the UV spectrophoto meter.
10. To study Gel Permeation Chromatography.
11. To study the X- ray diffraction method.
12. Determination of molecular weight by End-group analysis.

Design Engineering Problems/Open Ended Problems:

1. Graphical analysis of storage modulus, loss modulus and tan delta of DMA results.
2. Calculations to determine the Tg in DMA.
3. Find the melting temperature, Tg, Crystalline temp. of sample by DSC.
4. Determine the Loss in weight of given sample by TGA.
5. Photographic analysis of given sample by SEM.

Major Equipments: DMA machine, FTIR machine, SEM machine, TEM machine, GC machine, DSC machine, TGA machine, UV spectrophotometer, GPC.

List of Open Source Software/learning website:
http://www.nptel.ac.in/

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.