

GUJARAT TECHNOLOGICAL UNIVERSITY
CHEMICAL TECHNOLOGY (36)
SUBJECT NAME: EVALUATION & TESTING OF POLYMERS & RUBBERS
(DE-VII)
SUBJECT CODE: 2173603
B.E. VII SEMESTER

Type of Course: Chemical Technology

Prerequisite: Studied subject PR-07 (Evaluation & Testing of Polymers & Rubbers). Basic knowledge of testing and how to evaluate the properties of Polymers & Rubbers.

Rationale: The main objective of this subject is to study the properties that are present in the various types of Polymers & Rubbers present in chemical industries. This subject provides fundamental knowledge of various types of testing equipments and how to evaluate them and get the result in chemical industries.

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)	
					PA	ALA	ESE	OEP		
4	0	3	7	70	20	10	20	10	20	150

L-Lectures; T-Tutorial/TeacherGuidedStudentActivity;P-Practical;C-Credit;ESE-EndSemesterExamination; PA-Progressive Assessment, ALA- Active Learning Assignment, OEP- Open Ended project

Content:

Sr. No.	Topic	Teaching Hrs	Module Weightage (%)
1	Thermal Properties of Polymers- Glass transition temperature, melting temperature, heat distortion temperature, etc. Sample preparation, standardization, conditioning of sample, processability test.	8	16
2	Dynamic Mechanical Analysis- Melt flow rate, Vicat softening temperature. Scanning calorimeter & their applications to polymers with suitable examples	8	16
3	Structural Evaluation of Polymers- Principles, theories & applications to polymers system with suitable illustration of the following techniques: Fourier transform infrared spectrometry, Ultraviolet Visible spectrometry, Nuclear magnetic resonance spectrometry, Mass spectrometry, X-ray diffraction spectrometry, Gas chromatography	9	18
4	Determination of Viscosity- Polymer solutions & polymer melts: Their significance, application to polymers using different viscometers. Determination of viscoelastic properties of polymers & rubbers	7	14
5	Electrical Properties- Surface volume resistivity, Breakdown voltage. Arc resistance, Ten Delta, etc. The theory behind these phenomena, application to	9	18

	polymers & evaluation., Mechanical properties : Their principles & applications to polymers, Tensile strength, flexural strength, impact resistance, percentage elongation, Griffin theory, tear test, fatigue & wear, hardness, compressive strength time dependant properties like creep, stress, relaxation, etc		
6	Environmental Resistance- Stress cracking, effect of weathering, biological degradation, fire radiation Staining. Optical properties: Refractive index, gloss, colour matching, haze. Fire test: Ignition of flame & spread, limiting oxygen index, rate of heat release, smoke toxicity test	9	18

Suggested Specification table with Marks (Theory):

Unit No	Unit Title	Distribution of Theory Marks					
		R Level	U Level	A Level	N Level	E Level	Total
1	Thermal Properties of Polymers	9.6	1.6	1.6	1.6	1.6	16
2	Dynamic Mechanical Analysis	9.6	1.6	1.6	1.6	1.6	16
3	Structural Evaluation of Polymers	10.8	1.8	1.8	1.8	1.8	18
4	Determination of Viscosity	8.4	1.4	1.4	1.4	1.4	14
5	Electrical Properties	10.8	1.8	1.8	1.8	1.8	18
6	Environmental Resistance	10.8	1.8	1.8	1.8	1.8	18

Legends: R: Remembrance; U: Understanding; A: Application and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Handbook of Plastics Analysis, H. Lobo & J.V. Bonilla, Marcel Dekker, 2003.
2. Handbook of polymer Testing Roger Brown, Marcel Dekker Inc, 1999.
3. Instrumental Methods. Dyer, Mc Graw Hill, 1997
4. Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, P Ghosh, Mc Graw Hill, 2nd ed., 1990
5. Polymer Chemistry, Seymour and Carraher, Marcel Dekker, 2003
6. Handbook of Rubber Technology, S Blow, Galgotia Publications Pvt. Ltd, 1998

Course Outcomes:

1. To get knowledge about the testing as well as evaluation in Polymer & Rubber Technology.
2. To know the various types of machines and to know how they work and their basic principle.
3. To be able to apply this knowledge in Polymer & Rubber industries.
4. To build a bridge between theoretical and practical concept used in industry.

List of Experiments:

1.	Thermal properties of polymers and Rubbers: Differential scanning calorimetry (DSC) and Thermogravimetric analysis (TGA)
2.	Melt Flow Index
3	Structural characterization of polymers and Rubbers: Fourier transform infrared spectroscopy (FTIR) and Wide angle X-ray D (WAXD)
4	Determination of surface and volume resistivity of polymeric materials
5	Determination of dielectric strength of polymeric materials
6	Surface morphology of polymeric materials: Scanning electron microscopy (SEM)
7	Determination of limiting oxygen index
8	Study the hardness and abrasion resistance of polymeric materials
9	Mooney Viscometer
10	Mechanical properties of polymeric materials: Universal testing machine (UTM)

Open Ended Project fields:-

Students are free to select any area of science and technology based on chemical technology applications to define Projects.

Some suggested projects are listed below:

1. Industrial practices for various testing parameters for polymer & rubbers
2. Industrial practices for mechanical testing of polymer & rubbers
3. Industrial practices for thermal testing parameters for polymer & rubbers
4. Industrial practices for electrical testing parameters for polymer & rubbers

List of Open Source Software/learning website:

1. Literature available on internet
2. Polymer & Rubber dictionaries
3. Literature available under R&D in Polymer & Rubber industry
4. Polymer & Rubber journals

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide

