

# GUJARAT TECHNOLOGICAL UNIVERSITY

## PLASTIC TECHNOLOGY (23) TESTING AND IDENTIFICATION OF PLASTIC MATERIALS SUBJECT CODE: 2162307 B.E. 6<sup>th</sup> SEMESTER

**Type of course:** Core

**Prerequisite:** NA

**Rationale:** NA

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Basic concepts of testing-specifications and standards-purpose of specifications-basic specification format-ion and short term testing of plastics.	02	05
2	Mechanical properties : Introduction to stress-strain curves-understanding of terms like stress, strain, elongation, yield point, yield strength, proportional limit, toughness, modulus of elasticity, secant modulus, etc. • Tensile tests with test specimen preparation and conditioning, apparatus, calculations of tensile strength, modulus, and elongation; factors affecting the test results. • Flexural tests with apparatus, specimen, etc. • Compressive properties - creep tests like tensile and flexural creep; creep curves and their study calculations of maximum fiber stress - interpretation and applications of creep data-isochronous stress -strain curves- stress relaxation-stress-time curves and application. • Impact tests like— Izod and Charpy, factors affecting impact strength, Dart Impact, Tensile impact tests. • Shear strength and abrasion resistance tests in detail. • Fatigue resistance tests: flexural fatigue, tensile fatigue; factors affecting test results and applications. • Hardness tests: Rockwell hardness, durometer hardness, barcol hardness tests with factors affecting test results and limitations. • Creep-stress relaxation • Influence of temperature on modulus, visco-elasticity,	10	20

	Burgess Model of creep, Maxwell model of stress relaxation		
3	Thermal properties: Introduction-tests for elevated temp performance-short term tests like HDT, Vicat softening point-torsion pendulum test-long term tests like heat resistance test-all temp index-creep modulus/creep rupture tests-test variables and limitations of all tests with test procedure-specimen preparation, etc. Thermal conductivity and thermal expansion test-coefficient of linear thermal expansion-brittleness temp. etc.	05	10
4	Electrical properties: Introduction-tests like dielectric strength-dielectric constant-dissipation factor-surface and volume resistance-arc resistance-test procedures with specimen preparation in detail.	05	10
5	Weathering properties: Introduction-accelerated weathering tests like exposure to carbon arc lamps-exposure to xenon arc lamps-exposure to fluorescent UV lamps-outdoor weathering of plastics.	05	07
6	Optical properties: Introduction to refractive index-light transmittance and haze-photo elastic properties-color-gloss-tests for each of these.	04	08
7	Material characterization tests: Melt index test in detail-capillary rheometers test with (1) melt viscosity v/s. shear rate curves (2) shear stress v/s. shear rate curves- viscosity tests in detail-GPC-thermal analysis tech .like DSC, TGA, TMA.	07	15
8	Plastic identification : Introduction, concept of identification, various tests for thermoplastics and thermosets- flame tests-solution test- density measurement-plastic film identification-selection of plastics-criteria and application, design consideration etc.	07	15
9	Flammability tests: Incandescence resistance test-ignition properties-oxygen index test-surface burning characteristics-smoke generation tests.	03	05
10	Chemical properties: Immersion-stain resistance, solvent stress cracking resistance and ESCR tests in detail.	03	05

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>10</b>	<b>15</b>	<b>20</b>	<b>15</b>	<b>10</b>	<b>0</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

1. Testing of plastics by Vishu Shah
2. Testing of polymers vol-1, 2, 3 By J.V.Schmitz and W.E.Brown
3. Handbook of plastics Test Methods By R.P.Brown
4. The Properties and Testing of Plastic Materials By A.E. Lever and J. Rhys

**Course Outcome:**

After learning the course the students should be able to:

1. Test Plastic Materials and Products
2. Interpret the results of tests and utilise for end use
3. Suggest suitable plastic materials for various applications.
4. Identify various plastic materials

**List of Experiments:**

1. To determine the tensile strength and percentage elongation of film in machine/longitudinal and transverse direction.
2. To determine the tensile strength at break & yield & % elongation of dumbbell shaped specimens of various polymers.
3. To determine the Izod impact strength for various polymer
4. To determine the falling dart impact strength for films.
5. To determine the heat deflection temperature.
6. To determine the Vicat softening temperature.
7. To determine the coefficient of friction of films.
8. To Study the Creep behaviour in Plastic Materials
9. To Determine MFI of various Plastic samples.
10. To do the HDT test for plastic samples.

**Design based Problems (DP)/Open Ended Problem:**

1. Study of volume & surface resistivity and to determine the same experimentally.
2. To find out environmental stress crack resistance for polyethylene and other polymeric samples.
3. To carry out water absorption test for various polymers.
4. Determination of burst strength of pipes and determination of pressure rating of pipes.

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

1. [www.wikipedia.org](http://www.wikipedia.org)
2. [www.sciencedirect.com](http://www.sciencedirect.com)
3. [www.mit.edu](http://www.mit.edu)

**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. The best three works should submit to GTU.