

# GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Plastic Technology (23)

SUBJECT NAME: **Plastic Structure Property Relationship**

SUBJECT CODE: 2172309

B.E. 7TH SEMESTER

Type of course: **ELECTIVE**

Prerequisite: **CHEMISTRY OF PLASTIC MATERIALS, IPMS**

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
3	0	3	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

**Learning Objectives: To educate students on the importance of relationship of Plastic Structure with properties and applications of plastics**

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Structure of Polymers</b>  * Thermo set and thermoplastic behavior of polymers  * Molecular arrangement of polymers: linear, branched and cross linked  • Homo chain & hetero chain plastics • Molecular orientation in polymeric material • Sub molecular structure of polymers	5	5
2	<b>Elements &amp; their importance in polymer composition:</b>  • Effect of elements and their presence in polymer composition • Carbon, Hydrogen, Oxygen, Nitrogen, Halogens,	10	20

	<p>Sulphur, Silicon</p> <ul style="list-style-type: none"> <li>• Additives and their effects on properties of polymers</li> <li>• Plasticizers and softeners</li> <li>• Effects of plasticization upon structure and behaviour</li> <li>• Effect of plasticization upon mechanical, thermal and electrical properties</li> <li>• Effect of other additives like Fillers and reinforcement, Anti ageing agents, Flame retardants, Blowing agents, Cross linking agents &amp; Colorants on properties of polymers.</li> </ul>		
3	<p><b>Mechanical Properties.</b></p> <ul style="list-style-type: none"> <li>• Various mechanical properties of polymers such as tensile strength, flexural strength, impact strength.</li> <li>• Effect of polymer structure on mechanical properties</li> </ul>	7	10
4	<p><b>Effect of morphology on polymer properties</b></p> <ul style="list-style-type: none"> <li>• Structure of polymer crystals</li> <li>• Factors affecting crystallinity in polymers</li> <li>• Difference in properties of crystalline and amorphous polymers</li> <li>• Effect of crystallinity on properties of polymer</li> </ul>	5	15
5	<p><b>Chemical properties and Thermal properties</b></p> <ul style="list-style-type: none"> <li>• Relation of structure of polymer to chemical properties by: Chemical bond , Chemical Reactivity, Exposure to energy sources, Other effects</li> <li>• Glass Transition temperature (T<sub>g</sub>), Melting temperature (T<sub>m</sub>)</li> <li>• Effect of plasticizers on T<sub>g</sub></li> </ul>	6	10
6	<p><b>Electrical Properties and Optical Properties</b></p> <ul style="list-style-type: none"> <li>• Electrical properties of polymers</li> <li>• Effect of polymer structure on electrical properties of polymers</li> <li>• Optical properties of polymers</li> <li>• Effect of polymer structure on optical properties of polymers</li> <li>• Birefringence and Polarization of light</li> </ul>	7	10

<b>7</b>	<p><b>Intermolecular Bonding</b></p> <ul style="list-style-type: none"> <li>• Polarity and effect of polarity on properties of polymers such as:</li> <li>• Processibility</li> <li>• Mechanical properties</li> <li>• Thermal properties</li> <li>• Electrical properties</li> <li>• Optical properties</li> <li>• Hydrogen bonding between polymer molecules</li> <li>• Effect of hydrogen bonding on melting behavior, solubility, mechanical strength</li> </ul>	5	15
<b>8.</b>	<p><b>Relation of structure with properties of individual polymers and their applications</b></p> <ul style="list-style-type: none"> <li>- PET</li> <li>- Nylon</li> <li>- PMMA</li> <li>- PP (isotactic, syndiotactic and atactic)</li> <li>- PE (HDPE,LDPE and irradiated PE)</li> <li>- PVC</li> <li>- Unsaturated polyester resin</li> <li>Etc.</li> </ul>	6	15

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

<b>Distribution of Theory Marks</b>							
<b>Remembrance R Level</b>	<b>Understanding Level</b>	<b>U</b>	<b>Application Level</b>	<b>A</b>	<b>Analyze N Level</b>	<b>Evaluate Level</b>	<b>E</b>
<b>15</b>	<b>15</b>		<b>20</b>		<b>10</b>	<b>10</b>	

**Legends: R : Remembrance ; U = Understanding; A = Application 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**

## **Text Book:**

1. Outlines of polymer Technology by R.Sinha
2. Polymer Structure, Properties and Applications by R.Deanin.

## **Course Outcome:**

**After learning the course the students should be able to:**

1. Understand and apply the knowledge of polymer structure and properties in practical life.
2. Know how to effectively use this knowledge to design new polymer systems

## **List of Experiments:**

1. To study effect of presence of Carbon on polymer properties.
2. To study how presence of hydrogen affects polymer properties
3. To study how the presence of halogen atoms affects polymer properties.
4. To study the effects of polymer structure on mechanical properties
5. To study effects of polymer structure on Electrical properties
6. To study effects of polymer structure on Optical properties.
7. To study effects of polymer structure on thermal properties.
8. To study the effect of morphology on properties and applications of Nylon.
9. To study effect of morphology on properties and applications of PC.
10. To study effect of morphology on properties and applications of PMMA

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

**Major Equipment: 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.