

# GUJARAT TECHNOLOGICAL UNIVERSITY

## TEXTILE PROCESSING (28)

POLYMER CHEMISTRY

SUBJECT CODE: 2142807

B.E. SEMESTER IV

**Type of course:** Textile Processing Engineering

**Prerequisite:** Zeal to learn the subject

**Rationale:** This course provides a fundamental knowledge of various technochemical aspects of polymers. Thorough knowledge of polymer chemistry is highly indispensable to the students of textile processing as regards to the most of textile products are based on polymers.

### Teaching and Examination Scheme:

| Teaching Scheme |   |   | Credits | Examination Marks |     |        |                 |        |    | Total Marks |
|-----------------|---|---|---------|-------------------|-----|--------|-----------------|--------|----|-------------|
| L               | T | P |         | Theory Marks      |     |        | Practical Marks |        |    |             |
|                 |   |   | ESE (E) | PA (M)            |     | PA (V) |                 | PA (I) |    |             |
|                 |   |   |         | PA                | ALA | ESE    | OEP             |        |    |             |
| 4               | 0 | 2 | 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;

### Content:

| Sr. No. | Topics   | Total Hrs. | Weightage (%) |
|---------|--|------------|---------------|
| 1.      | Basic Concepts: Definition, Classification of Polymeric Material, General methods of preparation of polymers, Classifications of Polymerization reaction, Polymerization technique, Polymer structure - Polymer geometry, structural unit variety, Polymer tacticity, and Polymer utilization.   | 10         | 21            |
| 2.      | Polymer Reaction - Hydrolysis, Acidolysis, Hydrogenation, Addition & Substitution Reaction, cyclization, crosslinking etc.   | 4          | 8             |
| 3.      | Molecular weight of polymers: Different types and their methods of measurements  | 2          | 5             |
| 4.      | Analysis & testing of polymers - Chemical, Thermal Analysis, Spectroscopic method, X-ray diffraction, Microscopy   | 4          | 8             |
| 5.      | Scope, raw materials, preparation, structure, properties & important copolymers for the following chemical classes: Polyolefin - Polyethylene, Polypropylene, Butyl rubber, Polystyrene, Polyvinyl chloride, Polyvinyl acetate, Acrylic polymers, Polyamides & related polymers, Polyesters, Cellulose and related polymers, Silicones, Phenol - Formaldehyde polymers, Amino polymers, Polydiene and Natural rubber, Vulcanization, Epoxies etc | 20         | 42            |
| 6.      | Polymer Processing - Plastic Technology, Elastomer   | 4          | 8             |

|    |   |   |   |
|----|---|---|---|
|    | Technology  |   |   |
| 7. | Polymers & Environment: Pollution by polymers, Polymers & energy, Need of awareness for the future. | 4 | 8 |

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

| Distribution of Theory Marks |         |         |         |         |
|------------------------------|---------|---------|---------|---------|
| R Level                      | U Level | A Level | N Level | E Level |
| 24                           | 15      | 25      | 02      | 04      |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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:**

| Sr. No. | Title                        | Author  |
|---------|------------------------------|---|
| 1.      | Organic Polymer Chemistry    | J. Saunder, Chapman & Hall                            |
| 2.      | Text Book of Polymer Science | Fred W. Billmeyer Jr. John Wiley & Sons               |
| 3.      | Polymer Science              | V. R. Govariker, N. V. Vishvanathan, Jaydev Shreedhar |
| 4.      | The Chemistry of Polymers    | W. Nicholson, Royal Society Of Chemistry              |

**Course outcome:**

After learning the course the students should be able to:

1. Understand the fundamentals of polymer chemistry such as polymerization steps, types of polymerization, methods of polymerization etc.
2. Understand the structural aspects polymers,
3. Understand physical and chemical properties of polymers,
4. Applications of different polymers used in textiles and allied domain,
5. Able to analyze and characterize various polymers,
6. Understand the various possessing techniques,
7. Understand the impact of polymers from its manufacturing to end uses on environment and routed to minimize their negative effect.

**List of Experiments:**

1. To measure the density of given polymer samples using density gradient column.
2. To determine viscosity average molecular weight of given polymer.
3. To determine the melting temperature of given polymer samples.
4. To determine the refractive indices of given polymer samples.
5. To determine melt flow rate of given polymer using melt flow indexer.
6. To synthesize polyacrylamide from acryl amide by solution polymerization method using free radical initiator.
7. To synthesize polyacrylic Sacid by solution polymerization method using free radical initiator.
8. To synthesize DMDHEU by polycondensation reaction.
9. To synthesize polymethylmethacrylate by emulsion polymerization method.
10. To prepare polystyrene by bulk polymerization method.
11. To prepare polystyrene by suspension polymerization method.
12. To prepare melamine formaldehyde precondensate.

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

- To develop the polymer blend as per the requirement.
- To compare various polymerization techniques to get polymer with the best qualities.
- To study the effect of molecular weights of polymers on their various properties.
- To analyse the structure of polymers by various techniques.
- To study the effect on properties of polymers by analyzing the position of newly entering group by any polymer reaction.

**Major Equipments:**

Density gradient column, refractometer, melt flow indexer, Koflor hot bench, viscometer, oven, hot plate, magnetic stirrer, scientific balance etc.

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

1. <http://www.wto.org/>
2. <http://www.wtin.com/>
3. <http://textileinformation.blogspot.in/>
4. <http://www.fibre2fashion.com/>
5. <http://textilelearner.blogspot.in/>
6. <http://www.fashion-era.com/>

**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.