

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: POLYMER SCIENCE
(Code: 3342804)**

Diploma Program in which this course is offered	Semester in which offered
Textile Processing Technology	4 th Semester

1. RATIONALE

Polymers are important component in textiles. This course provides in depth knowledge about polymers, its chemistry and chemical technology involved in the preparation of polymers. The course also provides technological set up and knowhow for variety of polymerization processes and techniques.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in students so that they are able to acquire the following competency:

- **Explain different methods and techniques of polymerization.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Describe concepts of polymers science
- Explain chemical synthesis of polymers
- Discuss different techniques of polymerization.
- Describe polymerization of various individual polymers
- Describe basics of polymer processing

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	100
4	-	-	4	70	30	-	-	

Legends: L-Lecture; T – Tutorial/Teacher Guided Student Activity; P - Practical; C – Credit; ESE - End Semester Examination; PA - Progressive Assessment.

5. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to Polymer Science	1a. Describe fundamentals of polymer science 1a1. Define the terms of polymer science 1b. classify polymers. 1c. Explain glass transition temperature of various polymers.	1.1 Terms of polymer science:- Monomers, Polymers, Functionality of monomers, Repeat unit and Degree of polymerization 1.2 Classification of polymers 1.3 Molecular mass / weight of polymers 1.4 Glass transition temperature of polymeric materials
Unit– II Chemistry of polymerization	2a. Classify polymerization methods 2a1. Describe each polymerization Methods viz. Addition polymerization, Condensation polymerization , Co – polymerization 2a2. Classify copolymers 2b. Explain basic chemistry involved in various polymerization methods	2.1 Classification of polymerization methods 2.2 Addition polymerization ⇒ Free radical polymerization ⇒ Cationic polymerization ⇒ Anionic polymerization ⇒ Coordination polymerization 2.3 Condensation polymerization ⇒ Polycondensation ⇒ Polyaddition polymerization ⇒ Ring – opening polymerization 2.4 Co – polymerization ⇒ Classification of copolymers ⇒ Examples and advantages of co-polymerisation
Unit– III Techniques of polymerization	3a. List Techniques of polymerization (3.1 to 3.9) 3a1. Describe various polymerization techniques. 3b. Explain process involved in each polymerization technique. (3.1 to 3.9)	Techniques of polymerization 3.1 Bulk polymerization 3.2 Solution polymerization 3.3 Suspension polymerization 3.4 Emulsion polymerization 3.5 Precipitation polymerization 3.6 Melt polycondensation polymerization 3.7 Interfacial condensation polymerization 3.8 Solid and Gas phase polymerization 3.9 Industrial polymerization
Unit– IV Synthesis of individual polymers	4a. List individual polymers 4a1. Describe various individual polymers 4b. Explain synthesis & applications of various polymers 4c. Describe different kinds of polymer degradation 4d. Explain various biopolymers	4.1. Polyethylene, Polystyrene, Polyvinyl alcohol & Polyvinyl chloride 4.2. Polytetrafluoroethylene (PTFE) 4.3. Polyurethane 4.4. Silicone polymers 4.5. Rubbers (Elastomers) 4.4.1 Natural Rubber (Poly isoprene) 4.4.2 Synthetic Rubber ⇒ Polybutylene & Polyisobutylene ⇒ Polybutadiene ⇒ Polychloroprene (Neoprene) ⇒ Styrene butadiene rubber (Buna

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		– S) ⇒Nitrile Butadiene rubber (Buna – N) ⇒Applications of all the above polymers 4.5.Different types of polymer degradation 4.5.1Chain – end degradation 4.5.2Random degradation 4.6.Biopolymers 4.6.1 Poly hydroxy butyrate co – β - a. Hydroxyvelurate (PHBV) 4.6.2Polyglycolic acid (PGA) 4.6.3Polylactic acid (PLA)
Unit – V Basics of polymer processing	5a. List Different forms of polymers: Plastics, Elastomers, Fibres & Adhesives / Resins 5a1. List Polymer additives 5a2. Explain various polymers additives 5b. List Processing Techniques 5b1.Describe various processing techniques for polymers.	5.1 Different forms of polymers: Plastics, Elastomers, Fibres & Adhesives / Resins 5.2 Polymer additives, Fillers, Plasticizers, Antioxidants, UV stabilizers, Flame retardant, colorants,Curing agents. 5.3 Processing Techniques ⇒Calendering ⇒Casting ⇒Thermoforming ⇒Foaming ⇒Lamination ⇒Moulding

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
1.	Introduction to Polymer Science	06	2	2	4	08
2.	Chemistry of polymerisation	12	4	6	8	18
3.	Techniques of polymerization	16	4	6	8	18
4.	Synthesis of individual polymers	14	4	6	6	16
5.	Basics of polymer processing	08	2	4	4	10
	Total	56	16	24	30	70

Legends: R = Remember; U=Understand; A = Apply and above levels (Bloom's Revised 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.

7. SUGGESTED LIST OF PRACTICAL/EXERCISES

Not Applicable

8. SUGGESTED LIST OF STUDENT'S ACTIVITIES

Following is the proposed list of student's activities such as:

- i. Literature survey of various polymers used in textiles.
- ii. Collection and Study of various samples of polymers used in textile.
- iii. Group discussion on recent Innovation in Polymer science.
- iv. Seminar/Quiz/Presentation on recent developments in the field of preparation of polymers.

9. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

- i. Computerize modules of structure of polymers,
- ii. Video clips of manufacturing process of polymers.
- iii. Guest lecturers from industry experts for processing of polymers.

10. SUGGESTED LEARNING RESOURCES**A. List of Books**

Sr. No.	Author	Title of Books	Publication
1.	V. R . Gowarikar N.V. Viswanathan Jaydev Sreedhar	Polymer Science	New Age International Limited, New Delhi
2	P. Bahadur N. V. Sastry	Principles of Polymer Science	Narosa Publishing House, New Delhi
3	Fred W. Billmayer, Jr.	Textbook of Polymer Science	John Wiley & Sons, New York
4.	O. P. Agarwal	Synthetic Organic Chemistry	Goel Publishing House, Meerut
5.	George Odian	Principles of Polymerization	John Wiley & Sons, New York

B. List of Major Equipment/ Instrument

Not Applicable

C. List of Software/Learning Website

- i. http://www.youtube.com/watch?v=3gpLM8UIA_w
- ii. http://www.en.wikipedia.org/wiki/Polymer_science
- iii. [http:// www.springer.com](http://www.springer.com) > Home > Chemistry > Polymer Science
- iv. [http:// www.polymerscience.com](http://www.polymerscience.com)
- v. [http:// www.spsi.co.in/](http://www.spsi.co.in/)
- vi. <http://www.polymerjournals.com/ipsat.asp>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. R G Patel**, Lecturer, Textile Processing Dept., R C Technical Institute, Ahmedabad.
- **Prof. J H Thakker**, Lecturer, Textile Processing Dept., R C Technical Institute, Ahmedabad.
- **Prof. R D Joshi**, Lecturer, Textile Processing Dept., R C Technical Institute, Ahmedabad.
- **Prof. R M Pandya**, Lecturer, Textile Processing Dept., Dr. S & S S Ghandhy College of Engg. & Tech., Surat

Coordinator & Faculty Members from NITTTR Bhopal

- **Dr. C. K. Chugh**, Professor Department of Mechanical Engineering
- **Dr. S. K. Gupta**, Professor and Coordinator for State of Gujarat.