GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: POLYMER TECHNOLOGY
(COURSE CODE: 3360506)

Diploma Programme in which this course is offered	Semester in which offered
Chemical Engineering	Sixth

1. RATIONALE

Polymers account for around 70% of petrochemicals in India. Indian polymer industry is growing at very impressive rate in 21st century. India has become the world's third largest consumer of polymers after China and US. We cannot imagine modern day life without using polymers. The Diploma chemical engineers have to deal with identification and characterization of raw material to ensure the quality of polymer product along with different techniques of processing. The content of this course is designed to enable diploma holders to develop the skills required for working in production, processing, testing, marketing and sales department of plastics, rubbers and fibres manufacturing Industries.

2. COMPETENCY

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

- **Operate polymer manufacturing plants to produce quality products**

3. COURSE OUTCOMES (COs)

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

i. Select appropriate techniques of polymerization
ii. Produce plastics using appropriate reactions and unit operations steps
iii. Produce rubbers using appropriate reactions and unit operations steps
iv. Produce fibres using appropriate reactions and unit operations steps
v. Apply different polymer processing techniques

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

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

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
Unit – I Properties of Polymers	1a. Describe techniques of polymerization 1b. Explain impact of properties on polymer	1.1 Techniques of polymerization, Bulk polymerization, Solution polymerization 1.2 Suspension polymerization, Emulsion polymerization 1.3 Molecular weight, Crystallinity and Glass transition temperature
	1c. Describe the salient properties of plastics	1.4 Properties of Plastics: Electrical Resistance, Chemical Resistance, Thermal Stability, Biodegradability
	1d. Describe the salient properties of Rubber	1.5 Properties of Rubbers: Elasticity, Electric Conductivity, Resistance to fatigue
	1e. Describe the salient properties of Fibres	1.6 Properties of Fibres: Resiliency, Elongation, Strength
Unit – II Plastics	2a. Describe the synthesizes various types of plastics	2.1 Properties, applications and manufacturing of: Polyethylene by high pressure ICI process for LDPE, Polyethylene by Ziegler low pressure process for HDPE, Polypropylene, Polystyrene, ABS, Polytetrafluoro Ethylene (PTTE /Teflon), Urea Formaldehyde
Unit – III Rubbers	3a. Describe the properties, applications and manufacturing of various types of rubber	3.1 Properties, Applications and Manufacturing of: Ethylene Propylene Terpolymers, Butyl rubber Polyurethane, Silicone rubber
Unit – IV Fibres	4a. Describe the properties, applications and manufacturing of various types of fibres	4.1 Properties, applications and manufacturing of: Viscose rayon fibres, Cellulose Acetate fibre, Nylon-6, Glass fibres
Unit – V Processing of Polymers	5a. Describe different processing techniques of polymers	5.1 Mastication, Mixing, Moulding, Extrusion, Calendaring, Vulcanization, Compounding Coating

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Properties of Polymers	8	5	6	3	14
II	Plastics	12	7	7	6	20
III	Rubbers	8	5	4	4	13
IV	Fibres	8	5	4	4	13
V	Processing of Polymers	6	4	3	3	10
Total		**42**	**26**	**24**	**20**	**70**

Legends: R = Remember**, U** = Understand**, A=** Apply and above Level (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 PRACTICAL / EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note*: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of* ***Course Outcomes*** *related to affective domain. Thus over all development of* ***Programme Outcomes (****as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
1	I	Prepare classification chart based on properties and uses.	2
2	I	Demonstrate thermosetting and thermoplastic properties	2
3	I	Test the effects of solvents on plastic, rubber and fibre	2
4	I	Test the effects of acids and alkalies on plastic, rubber and fibre	2
5	I	Test effects of temperature on plastic, rubber and fibre	2
6	I	Determine the acid value of glyptal resin	2
7	II	Prepare Glyptal resin	2
8	II	Prepare thermo-plastics PMMA(Poly Methyl Methacrylate)	2
9	II	Prepare Polystyrene from styrene	2
10	II	Prepare Phenol Formaldehyde resin from Phenol	2
11	II	Prepare Urea Formaldehyde resin from Urea	2
12	II	Prepare Melamine Formaldehyde	2
13	IV	Prepare primary cellulose acetate from cellulose	2

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
14	V	Perform Vulcanization of Rubber	2
	Total		**28**

8. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities. These could be individual and group based.

i. Explore internet, visit websites of reputed polymer/plastic/rubber/fibre production companies and prepare ppt presentations on different topics (in group of four-five) and present in class
ii. Study (in group of four-five) the design of some real polymer/plastic/rubber/fibre production plant and identify good features of design and also weaknesses in it, present in class to have a group discussion.
iii. Survey market for different types of polymer/plastic/rubber/fibre items available and identify their composition, further explore their production processes.

9. SPECIAL INSTRCTIONAL STRATEGY (If Any)

i. Show animations/ videos and drawings/models of polymer/plastic/rubber/fiber production processes
ii. Arrange visit to nearby polymer/plastic/rubber/fiber production plants
iii. Arrange expert lectures.

10 SUGGESTED LEARNING RESOURCES

A) Books

S. No.	Title of Books	Author	Publication
1	Outlines of Chemical Technology,	Rao,M. Gopal, Sittig, Marshall	Affiliated East West Press (Pvt) Ltd, New Delhi 3rd Edition
2	Chemical Technology, Vol. I & II	Pandey , G. N. and Shukla	Vani books company, Hyderabad2nd Edition
3	Shreve's Chemical Process Industries,	Austin, G.T.	McGraw Hill publication, New Delhi 5th edition
4	Polymer science	Gowarikar, V, R., Viswanathan, N.V. Sreedhar, Jayadev	New Age International Pvt. Ltd., New Delhi
5	Polymer science and Technology	Joel R.; Fried	PHI Learning, New Delhi, 2007, 2nd Edition
6	Text on etrochemicals	Rao, B. K. Bhaskar	Khanna Publishers, Delhi, 1998, 2nd Edition

B) Major Equipment/Materials with Broad Specifications

i. Glassware: Conical flask, burette, pipette, round bottom flask, measuring cylinder, beaker
ii. Glass Assembly: Round bottom flask, condenser
iii. Burner
iv. Weight balance (minimum 0.1gm)
v. Heating and cooling bath

C) Software/Learning Website

i. www.mossrubber.com/pdfs/Rubber_Prop.pdf
ii. www.ias.ac.in/resonance/Volumes/02/04/0055-0059.pdf
iii. www.unuftp.is/static/fellows/document/ramos99-ff.pdf
iv. www.epa.gov/ttnchie1/ap42/ch06/final/c06s09.pdf
v. www.zorge.com/assets/Documents/Rubber-technology.pdf
vi. www.nzic.org.nz/ChemProcesses/polymers

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnic

- **Prof. N. N. Hansalia**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof. (Mrs.) Kajal J. Sareriya**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot
- **Prof. R. P. Hadiya**, Lecturer in Chemical Engineering, Government Polytechnic, Rajkot

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Abhilash Thakur**. Associate Professor, Department of Applied Sciences,
- **Dr. Joshua Earnest**, Professor, Department of Electrical & Electronics Engineering.