GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM

Course Title: Polymer Chemistry
(Code: 3322301)

Diploma Programme in which this course is offered	**Semester in which offered**
Plastic Engineering	Second Semester

1. RATIONALE

The course deals with structures, properties & fundamentals of polymer preparation by various polymerization techniques. This course will help students to understand micro structure analysis of polymers, its solutions & degradation. Study of this course would make students aware about the concepts of polymer chemistry and morphology for understanding the structure and manufacturing of plastics.

2. COMPETENCIES

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

i. **Manufacture industrial polymers using different polymerization techniques based on polymer morphology& structure**

3. 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**	150
3	0	2	5	70	30	20	30	

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

Note: It is the responsibility of the institute heads that marks for **PA of theory** & **ESE and PA of practical** for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

4. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I **Polymerization techniques**	1a. Comprehend different types of polymerization technique	1.1 Introduction 1.2 Bulk Polymerization 1.3 Solution Polymerization 1.4 Suspension Polymerization 1.5 Emulsion Polymerization
Unit– II **Glass transition temperature**	2a. Explain the visco elasticity of polymer, glass transition temperature & its effect on polymer.	2.1 Introduction 2.2 State & phase i. Glassy state ii. Visco-elastic state iii. Visco-fluid state iv. Solid phase v. Liquid phase 2.3 State of aggregation 2.4 Orientation of polymer (IBM & EBM) 2.5 Glass transition temperature and associated properties
Unit– III **Structure of polymer**	3a. Explain the polymer morphology, its significance and relation with properties	3.1 Introduction 3.2 Polymer morphology 3.3 Dispercity (Mono & Poly) 3.4 Molecular weight and distribution 3.5 Crystalline and amorphous structure of polymer 3.6 Degree of crystallinity 3.7 Polymer crystallization and crystallizability 3.8 Effect of crystallinity on polymer properties 3.9 Factors affecting crystallinity
Unit – IV **Polymer degradation**	4a. List the types of **Polymer** degradation 4b. Explain mechanism and solution for degradation.	4.1 Introduction 4.2 Types of degradation i. Chain end ii. Random 4.3 Thermal Degradation 4.4 Mechanical Degradation 4.5 Ultrasonic wave Degradation 4.6 Photo degradation
Unit – V **Polymer reactions and polymer solutions**	5a. Explain different types of reactions and its applications	5.1 Introduction 5.2 Hydrolysis 5.3 Acidolysis 5.4 Aminolysis 5.5 Hydrogenation 5.6 Addition and substitution reactions 5.7 Cross-linked reactions 5.8 Polymer dissolution
Unit – VI **Manufacturing of different Industrial polymers**	6a. Explain the methods of manufacturing of different polymers.	6.1 Introduction Manufacturing of different Industrial polymers - i. Low density polyethylene (LDPE) ii. High density polyethylene (HDPE) iii. Poly Propylene (PP) iv. Poly Styrene (PS)

Unit	Major Learning Outcomes	Topics and Sub-topics
		v. Poly Vinyl Chloride (PVC) vi. Acrylo Nitryl Butadine Styrene (ABS) vii. Poly Amide (Nylon) viii. PolyMethyl Methacrylate (PMMA) ix. Poly Urethane (PU) x. Phenol Formaldehyde (PF) xi. Urea Formaldehyde (UF) xii. Melamine Formaldehyde (MF) xiii. Epoxy xiv. Polyester (TS)

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Polymerization techniques	06	06	04	00	10
II	Glass transition temperature	05	06	06	00	12
III	Structure of polymer	08	06	03	03	12
IV	Polymer degradation	06	06	04	00	10
V	Polymer reaction and polymer solutions	07	05	03	04	12
VI	Manufacturing of different Industrial polymers	10	06	04	04	14
	Total	**42**	**35**	**24**	**11**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

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

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The exercises/practical/experiments should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire above mentioned competency. Following is the list of exercises/practical/experiments for guidance.

S. No.	Unit No.	Practical/Exercise
1	I	Compare different types of polymer techniques with respect to its physical parameters
2	II	Measure T_g of High Density Polyethylene by Dilatometic method
3	III	Measure number average molecular weight of Polypropylene by End Group Analysis
4	III	Measure degree of crystalline of Low Density Polyethylene
5	IV	Compare different types of polymer degradation .
6	V	Prepare polymer solution of PVC

7	VI	Prepare Polystyrene by Emulsion polymerization technique
8		Prepare PolyMethyl Methacrylate by suspension method
9		Prepare Phenol Formaldehyde by Polycondensation process

7. SUGGESTED LIST OF STUDENT ACTIVITIES

1. Students will prepare report for the above mentioned experiments.
2. Students will collect information related to the experiment through internet.
3. Students will list the rules for safety & precautions for above practical.

8. SUGGESTED LEARNING RESOURCES

A. List of Books

Sr. No.	Title of Book	Author	Publication
1.	Organic Chemistry	P.L.Soni	Sultan Chand & Sons
2.	Textbook of Organic Chemistry	Bahl & Tuli	S. C. Chand & Co., New Delhi
3.	Textbook of Polymer Science	Billmeyer Jr.	John wiley & sons, New York
4.	Polymer Science	V.R.Govariker	New Age International Delhi
5.	Polymer Science of Technology	Jod R. Fried	Prentice-Hall of India Pvt. Ltd., New Delhi
6.	Textbook of Organic Chemistry	R.K.Bansal	New Age Publications
7.	Polymer Science and Technology of Plastics & Rubber	Pramanoy Ghosh	Tata McGrow Hill
8.	Polymer Chemistry	Seymour & Carraher	CRC Press
9.	Polymer Chemistry	Arora & Singh	Anmol Publications Pvt.
10.	Principles of Polymer Chemistry	A Ravve	Springer

B. List of Major Equipment/ Instrument

1.Dilatometer
2.Heat Deflection Temperature Tester
3.Density Gradient Column
4.Three necked round bottom flask
5.Round bottom flask
6.Thermometer
7.Water condenser
8.High and medium speed stirrer
9. Digital weighing scale

C. List of Software/Learning Websites

http://www.metrotec.es/metrotec/WWW_DOC/PETech-09.pdf

http://zeus.plmsc.psu.edu/~manias/MatSE259/lecture6.pdf

http://plc.cwru.edu/tutorial/enhanced/files/polymers/orient/orient.htm

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. A.S.Amin**, Lecturer in plastics, Govt. polytechnic, Ahmedabad
- **Prof. M.K.Thakarar**, Lecturer in plastics, Govt. polytechnic, Valsad

Co-ordinator and Faculty Members from NITTTR Bhopal

- **Dr. Anju Rawlley**, Professor Dept. of Applied Sciences.