GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172321
Semester – VII
Subject Name: Nanotechnology in Plastics

Type of course: Open Elective

Prerequisite:

Rationale:. After completing this course students will be able to understand the basics and chemistry of nano size materials and their synthesis, characterization and applications and also know the manufacturing and processing of nanomaterial/polymer nanocomposites.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs
1	INTRODUCTION: Nanotechnology, Importance of length scale, meaning of NANO, uniqueness of Nano structured materials, Classification of Nanomaterials.	**03**
2	INORGANIC AND ORGANIC POLYMER NANOMATERIALS: Different types of Nanoparticles: Organic Nanofillers: Cellulose, Chitin etc. & Inorganic Nanofillers, Montmorillonite nanoclays, Carbon Nanofibers, Carbon Nanotubes, Graphene, Nanosilica, Nanoaluminium oxide, nanotitanium oxide,etc.	**11**
3	PREPARATION OF NANOCOMPOSITES: Solvent casting method, Thermocompression method, Solution Intercalation, Melt Intercalation, In-situ intercalative polymerization method. SELECTION OF RESIN MATRIX AND NANOPARTICLES FOR APPLICATIONS: Characteristics of Polymer nanostructures materials., Polymer Matrices : Thermoplastic based nanocomposites, Thermoset based nanocomposites, Elastomer based nanocomposites	**09**
4	CHARACTERIZATION OF POLYMER NANOMATERIALS: X-ray Diffraction, Transmission Electron Microscopy (SEM), Small Angle X-ray scattering (SAXS), Atomic force microscopy (AFM), Fourier Transform Infrared Spectroscopy(FTIR), Nuclear magnetic resonance (NMR), The Cone Calorimeter (CC), The Mass Loss Calorimeter (MLC)	**09**

5	APPLICATIONS OF NANO MATERIALS: High temperature applications, Polymer Nanocomposites for Food Packaging Applications, Polymer nanocomposite in membrane applications, Polymer nanocomposite in aerospace applications, Polymer Nanocomposites for Biomedical Applications, Polymer nanocomposite biodegradation	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**10**	**5**	**5**	**5**

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

1. POLYMER NANOCOMPOSITES " : Processing, Characterization and applications by Joseph H. Koo
2. Functional and Physical Properties of Polymer Nanocomposites by Aravind Dasari
3. Advances in polymer nanocomposites Types and applications by Fengge Gao
4. POLYMER NANOCOMPOSITES BASED ON INORGANIC AND ORGANIC NANOMATERIALS by Smita Mohanty, Sanjay K Nayak, B.S. Kaith and Susheel Kalia.
5. RHEOLOGY AND PROCESSING OF POLYMER NANOCOMPOSITES by SABU THOMAS RENE MULLER JIJI ABRAHAM

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Define and classify nanomaterials.	05
CO-2	Explain various types of Nanomaterials used in polymers.	25
CO-3	Describe preparation methods used for Nanomaterials.	25
CO-4	Explain characteristics of nanomaterial/polymer composites	25

CO-5	Discuss characterization of polymer nanomaterials.	15
CO-6	Analyze applications of nanomaterials in various fields.	05

List of Open Source Software/learning website:

1. **https://pslc.ws/**
2. **https://nptel.ac.in**