GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)
NANOPOLYMERS AND NANO-COMPOSITES
SUBJECT CODE: 2163902
B.E. 6th SEMESTER

Type of course: Material Science and Chemical Technology

Prerequisite: Fundamental of Chemistry , Synthesis of Nano materials, Physics of Nano materials

Rationale: The purpose of this course is to provide a basic knowledge about polymer and the composite materials with its application

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)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weig
1	**INTRODUCTION OF POLYMERS** Importance of polymers: Basic concept-Classification of polymers on the basis of microstructures, macrostructures and applications- Chain Structure and configuration. Homo and heteropolymers - Copolymers-Chemistry of polymerization.Properties : Glass transition temperature (Tg) and melting point (Tm) – Factors affecting Tg and Tm, Importance of Tg. Molecular weights and degree of polymerization- Reactions and kinetics of polymerization	**10**	**20%**
2	**POLYMERIC NANOSTRUCTURES** The formation of ordered polymer structures at interfaces- Block copolymers for ordered polymeric nanostructures- Surface micelles and surface induced Nano patterns- Surface nano and microstructuring with organometallic polymers	**10**	**20%**
3	**NANOCOMPOSITES** Polymer/ clay nanocomposites- polypropylene layered silicate nanocomposites biodegradable polymer/layered silicate nanocomposites - poly(ethylacrylate)/bentonitenanocomposites- poly(butylene terephthlate) (PBT) based nanocomposites - polymer/calcium carbonate nanocomposites	**10**	**20%**
4	**METAL MATRIX NANOCOMPOSITES** Metal-containing polymers: cryochemical synthesis, structure, and physicochemical properties-nanostructured polymeric nano reactors for metal nanoparticle formation- optical extinction of metal nanoparticles	**10**	**20%**

	synthesized in polymer by ion implantation-optically anisotropic metal polymer.		
5	**CERAMIC MATRIX NANOCOMPOSITES** Nanophase ceramic composites- Processing- microstructural control of metal reinforced ceramic matrix nanocomposites- Machinable nanocomposite ceramics. Silicon nitride and silicon carbide based ceramics- Functionally graded ceramics clay nanocomposites.	**10**	**20%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	**19**	**20**	**7**	**00**	**00**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Viswanathan V.R.,N.V. and JayaderSreedhar, "Polymer Science", New age International publications, 2005.
2. Yiu-Wing Mai and Zhong-Zhen yu"Polymernanocomposites", CRC press,2006.
3. Alfred rudin , "The elements of polymer science and engineering", 2ndedition, Academic press publication, 1999.
4. Alan Kin-TakLau, Farzanahussain, Khalidlafdi, "Nano and Biocomposites",CRC press, 2010.
5. Abe, A.-C. Albertsson, R.Duncan "Advances in polymer science",Springer,2006.
6. Low I. M. "Ceramic matrix composites:Microstructure, properties and Applications",Woodhead Publishing Limited, 2006.
7. Luigi Nicolais Gianfranco Carotenuto"Metal – polymer Nanocomposites",Wiley Interscience, 2005.

Course Outcome:

After learning the course the students should be able to:

1. Understand the basics of polymer science.
2. To impart knowledge on theoretical background about nano composites.
3. To gain insight about the importance of polymers in nanotechnology.
4. To emphasize the need for polymers and composites in various

List of Experiments: (Any Five + Opend Ended Experiment)

1. Cross-Linking of Polymer
2. Preparation of Plasticized PVC and testing tensile modulus.
3. Preparation of ceramic based nanocomposites.
4. Preparation of metal-polymer nanocomposites.
5. Polymerization of Acrylamide in Water.
6. Preparation Nanopolymer using Electronspinning Technique.

7. Conversion of Polyacrylamide to Sodium Polyacrylate and Subsequent Conversion of Polyacrylate Salt to Poly -(Acrylic Acid).
8. Synthesis of Hydrogels from Acrylamide and N-isopropyl Acrylamide with Bisacrylamide in Water
9. Characterization of Polymer (prepared in the lab)

Design based Problems (DP)/Open Ended Problem:

Open Ended /design based project: Apart from above experiments a group of students (Maximum Three) has to undertake one open ended problem/design problem. **(Students are free to select any area of science and technology may be based on their branch to define the project).**

Aims:

1. To provide experience in laboratory based experimentation, data recording and analysis and drawing of conclusions.
2. To develop report writing skills for scientific material.
3. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.
4. To develop skills in literature searches and reviews.

Evaluation of Open ended / design based small project

1. Open ended / design based small project will be evaluated by external examiner with appropriate marks allotment given by GTU time to time.
2. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
3. Evaluation should be done on **the approach of the student on his/her efforts** (not on completion) to study the design module of given task.

Examples

1. Write a reivew article on **polymers and composites**
2. Study the physical properties of nanoploymer.
3. Prepare polymers using simple techning .
4. Prepare water Absorbing Crystals

Major Equipment:

1. UV-Visible Spectrometer
2. Spin coater
3. Distil Water Unit
4. PH Meter
5. Necessary Chemicals and glassware for sol-gel and chemical synthesis.

List of Open Source Software/learning website:

1. http://ocw.mit.edu/courses/chemical-engineering/10-467-polymer-science-laboratory-fall-2005/labs/

2. UPAC Polymer Education Website (http://iupac.org/polyedu/index.html).
3. Macrogalleria (http://pslc.ws/macrog/index.htm)
4. POLYED (http://www.uwsp.edu/chemistry/polyed/)
5. Carnegie Mellon Education Website - Macromolecular products http://gelfand.web.cmu.edu/scimodules/)

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.