GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170509
Semester – VII
Subject Name: Nanoscience and Technology

Type of course: Professional elective course

Prerequisite: None

Rationale:
To provide an idea on the fundamentals of nanotechnology with a approach towards the synthesis, characterization and applications of nanomaterials. Nanotechnology is a new and rapidly emerging branch. It is a field of research and originality related to creation of new materials and devices. Students will learn the concept of nanotechnology, different techniques for synthesizing nanomaterials, characterization of nanomaterials and its applications in different fields.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	%weightage
1	**Introduction to Nanotechnology:** Introduction, definition, history, effects of nanoscience and nanotechnology in different fields.	03	**10**
2	**Properties of nanomaterials:** Size and shape and based properties, colour, melting point, density of states, band gap and magnetism.	07	**15**
3	**Nanoparticles synthesis:** Top down and bottom-up approach, colloids, emulsions, micelles, polymers, mechanical attrition and high energy ball milling.	07	**15**
4	**Nanomaterials characterization:** Scanning electron microscopy, Transmission electron microscopy, Fourier transform infrared spectroscopy, Energy dispersive spectroscopy, Atomic force microscopy, X-ray diffraction, Dynamic light scattering, UV-Vis spectrophotometer.	10	**20**
5	**Fabrication:** Lithography, chemical vapor deposition, physical vapor deposition, sol-gel synthesis, molecular self-assembly, crystal growth, epitaxy, etching, masking.	10	**20**
6	**Applications of nanotechnology in chemical industry:** Catalysis, fuel cells, drug delivery and diagnostics, coatings, nanocomposite polymers, fluid inks, dyes, block copolymers, dendrimers, carbon nanotubes applications.	08	**20**

Text Books:

1. Nanoscale materials in Chemistry, K.J. Klabunde, Wiley, 2001.
2. Introduction to Nanotechnology, C.P. Poole Jr. and F.J.Owens, Wiley, 2003.

3. Nanotechnology, M. A. Ratner and D. Ratner, Pearson, 2003.
4. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R Rao, Achim Müller, A. K. Cheetham, Wiley, 2004.

References:

1. Hand book of Nanostructured Materials and Nanotechnology, H. Nalwa, Vol. 1 to 5, Academic Press, 1999.
2. Hand book of Nanotechnology, B. Bhusan, Springer, 2004.
3. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects, D. Schodek, P. Ferreira, M.F. Ashby, 2009.

Other references

List of Open Source Software/learning website: https://nptel.ac.in/courses/118/104/118104008/

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**15**	**15**	**5**	**5**	**0**

Legends: R: Remembrance, U: Understanding, A: Application, N: Analyze, 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.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To understand the principles of nanotechnology	**10**
CO-2	To understand the properties of nanomaterials	**15**
CO-3	To gain the knowledge of nanoparticles synthesis by different methods	**15**
CO-4	To understand the characterization of nanomaterials by various techniques	**20**
CO-5	To acquire the knowledge on the nanotechnology fabrication methods	**20**
CO-6	To study the applications of nanotechnology in chemical industry:	**20**

List of Open Source Software/learning website: Students can refer to video lectures available on various websites including NPTEL.