

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CHEMICAL ENGINEERING (05)

SUBJECT NAME: NANO TECHNOLOGY

SUBJECT CODE: 2170508

B.E. 7th SEMESTER

Type of course: Nanoscience and Nanotechnology

Prerequisite: Fundamental of Chemistry, thermodynamics and material Science

Rationale: To make students understand the use of concept of nanotechnology and nanoscience in the chemical industries and in consumer products. Nanotechnology will mean complete control of the structure of matter, building complex objects with molecular precision. In current scenario, engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger scale counterparts. So in order to move towards advanced materials and devices students should have the knowledge of nano science.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
PA	ALA	ESE		OEP						
3	0	0	3	70	20	10	0	0	0	100

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1.	Generic methodologies for nanotechnology: classification and fabrication: Introduction and classification, Summary of the electronic properties of atoms and solids, Effects of the nanometer length scale, Fabrication methods, Preparation, safety and storage issues.	8	15
2.	Strategies for the scalable synthesis of quantum dots and related Nano dimensional materials –I: Introduction, Defining Nano dimensional Materials, Potential Uses for Nanodimensional Materials, The General Methods Available for the Synthesis of Nanodimensional, Materials, Precipitative Methods, Reactive Methods in High Boiling Point Solvents.	9	16
3.	Strategies for the scalable synthesis of quantum dots and related Nano dimensional materials –II: Reactive methods in high boiling point solvents 20, hydrothermal and solvothermal methods 22, gas-phase synthesis of semiconductor nanoparticles 23, synthesis in a structured medium 24, the suitability of such methods for scaling	9	16

4.	Nanotechnology and ceramics : Introduction, Synthesis, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods	9	16
5.	Tools to characterize nanomaterials: X-Ray Diffraction (XRD), Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, UV/Visible Spectroscopy	9	18
6.	Applications of nanomaterials: Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.	10	19

Reference Books:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, Imperial College Press, 2004.
2. Nanoscale Science and technology by Robert Kelsall (editor), Ian W. Hamley (co-editor), Mark Geoghegan (co-editor) , ISBN: 978-0-470-85086-2
3. The Chemistry of Nanomaterials: Synthesis, Properties and Applications by C. N. R. Rao, A. Muller, A. K. Cheetham, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 3-527-30686-2.
4. Nanoscale Materials in Chemistry Edited by Kenneth J. Klabunde, John Wiley & Sons, Inc., ISBNs: 0-471-38395-3 (Hardback); 0-471-22062-0.
5. Textbook of Nanoscience and Nanotechnology, B.S. Muty, P. Shankar, Baldev Raj, B.B Rath and James Murday, University Press, IIM (ISBN-978 81 7371 738 3).
6. Introduction to Nanotechnology by Charles P. Poole Jr and. Frank J. Owens, Wiley-Inter science, 2003.

Suggested Specification table with Marks (Theory):

Distribution Of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	30	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.

Course Outcome: After learning the course the students should be able:

- 1) Understand bulk and Nanostructured materials.
- 2) Understand synthesis of nanomaterial with different.
- 3) Understand the basic principal of various characterization technique.
- 4) Understand the use of nanoscience and nanotechnology for various applications.
- 5) Students can understand the difficulties in synthesizing Nano particles and can work in the field of commercialization of Nano materials.

List of Tutorials:

Students can study different synthesis techniques for producing nanoparticles depending upon the types and properties of Nano materials. Each group of students are expected to create a way to synthesize nanomaterials in cheap and easier way at laboratory level and prepare report of project assigned to his/her group even students can study the instruments related to the characterization of Nano materials. In addition, each group is expected to give a power point presentation during the semester. The presenter will be selected randomly just prior to the presentation.

List of Open Source Software/learning website:

- Students can refer to video lectures available on various websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solutions of problems using software. Students can develop their own programs for the solutions using excel, Chemical and other simulation software.

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.