GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)

ELEMENTS OF NANOSCIENCE AND TECHNOLOGY-II

SUBJECT CODE: 2153904

B.E. 5th SEMESTER

Type of course: Nanoscience and Nanotechnology

Prerequisite: Knowledge of basic and engineering sciences as well as fundamental of nanotechnology

Rationale: The purpose of this course is to provide an advance understanding of Nanoscience and Nanotechnology. In addition, the course is expected to encourage engineering students to think about solving industrial problems with engineering tools.

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		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Surface Effect and Physical Properties of Nanomatrials Surface Energy, Surface stress, Shape of Nanocrystals Comparison of Solid and Liquid Surfaces Shape of Cluseter and Nanocrystals Thermal expansion of bulk materials	**6**	**8%**
2	Surfaces and interfaces in nanostructures. Ceramic interfaces, Superhydrophobic surfaces, Grain boundaries in Nanocrystalline materials, Defects associated with interfaces.	**12**	**19%**
3	Overview of properties of nanostructures and nanomaterials. How the performance of nanomaterials come about: size, structure-Mechanism-property-performance pathway	**12**	**19%**
4	Template based nano synthesis Electrochemical deposition and Electrophoretic deposition Colloidal dispersion filling Melt and solution filling Deposition by centrifugation Converting through chemical reactions Electrospinning	**14**	**22%**
5	Supercritical Fluids –Introduction – Physicochemical Properties - Solubility - Viscosity - Diffusion -Thermal Conductivity - Applications - Purification and Extraction - Synthesis.	**10**	**16%**

6	Nanoporous Materials – Silicon - Zeolites, mesoporous materials - nanomembranes and carbon nanotubes - AgX photography, smart sunglasses, and transparent conducting oxides –molecular sieves – nanosponges.	**10**	**16%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
18	**19**	**25**	**8**	**-**	**-**

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. Edward L. Wolf, ―NANOPHYSICS AND NANOTECHNOLOGY*: An Introduction to Modern Concepts in Nanoscience*‖, Wiley-VCH (2006).
2. NANOMATERIALS, NANOTECHNOLOGIES AND DESIGN: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
3. HANDBOOK OF NANOPHASE AND NANOSTRUCTURED MATERIALS (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
4. HANDBOOK OF NANOCERAMICS AND THEIR BASED NANODEVICES (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.
5. G. Cao, NANOSTRUCTURES & NANOMATERIALS: Synthesis, Properties &Applications , Imperial College Press, 2004

ADDITIONAL READINGS

Encyclopedia of Nanoscience and Nanotechnology, Ed.:Hari Singh Nalwa, American Scientific Publishers, 2004.

Course Outcome:

After learning the course the students should be able to:

1. Understand difference between properties Nanomaterial and conversion materials
2. Understand the application of Nanomaterials
3. Understand the template based nano synthesis4. understand the physical, chemical and mechanical properties of nanomaterials

List of Experiments:

1. Verification of Lambert Beer's law and determination of concentration of unknown solution by UV-Vis spectrophotometer.
2. Preparation of metal oxide nanoparticles by microemulsion technique

3. Synthesis of at least two different sizes of Copper Oxide Nano Particles Using Sol-Gel Method
4. Synthesis of at least two different sizes of Zinc Oxide Nano Particles Using Sol-Gel Method
5. Synthesis different size of Cu nanoparticles using electrochemical methods.
6. Deposition of thermal insulating materials on the glass surface using deep coating or Spray coating.
7. Prepare conducting glass using chemical deposition
8. Synthesis of nanofulids and study of its thermal conductivity.

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 examiners 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 giving task.

Examples

1. Study report on chrome coating
2. Study report on industrial plastic coating

Major Equipment:

1. Visible spectrometer
2. Spin coater
3. PH Meter
4. Setup for Electrodeposition
5. Distill water unit
6. Necessary glassware and Chemicals for the sol-gel synthesis.

List of Open Source Software/learning website:

www.virtuallab.com

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.