GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

SURFACE SCIENCE AND NANO TECHNOLOGY

SUBJECT CODE: 2743002

SEMESTER: IV

Type of course: Nanoscience and Nanotechnology

Prerequisite: Knowledge ofbasic 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. This course encourages engineering students to solve industrial problems with engineering and nano technology tools.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (M)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Topic	Teaching Hours	Module Weightage (%)
1.	**Introduction** Overview of properties of nanostructures and nanomaterials. How the performance of nanomaterials come about: size, structure-Mechanism-property-performance pathway	04	7
2.	**Important catalytic materials** Nanostructured metals like Pt, Pd and Fe, nanostructured ceramics like silica, silicate and alumina, pillared clays, colloids and porous materials (viz. mesoporous materials)	09	17
3.	**Mesoporous materials** Introduction, synthesis & characterization, properties and applications (with suitable examples), unipore size, bimodal pore size, graphs., supramolecular chemistry, synthesis (micelar rods).	07	13
4.	**Synthesis of Nano Structure** Template based nano synthesis, Electrochemical deposition and Electrophoretic deposition, Colloidal dispersion filling, Melt and solution filling, Deposition by centrifugation, Converting through chemical reactions, Electro spinning	07	13
5.	**Supercritical Fluids** Introduction, Physicochemical Properties, Solubility, Viscosity, Diffusion, Thermal Conductivity, Applications, Purification and Extraction, Synthesis.	08	16

6.	**Nanoporous Materials** Silicon, Zeolites, mesoporous materials, nanomembranes and carbon nanotubes, AgX photography, smart sunglasses, and transparent conducting oxides, molecular sieves, nanosponges.	07	12
7.	**Surface phenomena** Introduction to Adsorption, Desorption and Condensation, catalysis and Surfactants at solid-liquid interfaces.	05	9
8.	**Catalysis: At Solid Surfaces (Heterogeneous Catalysis), Interfacial synthesis (Phase transfer Catalysis),** Bio and Synthetic Enzymes, Active Sites, Molecular Mechanisms, Molecular simulations.	07	13

Reference Books:

1) Chemistry of Nanomaterials: Synthesis, properties & applications, Volume-I – CNR Rao, A Muller & AK Cheetham
2) Principles of Colloid and Surface Chemistry, Paul C. Hiemenz, Marcel Dekker, any edition starting with the 2nd edition, 1986.
3) "Nanostructured Materials and Nanotechnology", Hari Singh Nalwa, Academic Press Inc. (London), 2001
4) Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
5) Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
6) Handbook of Nanoceramics and their Based nanodevices(Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.
7) Nanostructures & Nanomaterials: Synthesis, Properties &Applications, G. Cao, Imperial College Press, 2004.

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

1) Understand difference between properties Nanomaterial and conversion materials
2) To understand about materials and their properties at the atomic level, including an understanding of the intimate relationship between scale and size, nanostructure and the properties of materials
3) Understand the application of Nanomaterials
4) Understand the template based nano synthesis4. understand the physical, chemical and mechanical properties of nanomaterials

List of Open Source Software/learning website:

1) www.virtuallab.com
2) Encyclopedia of Nanoscience and Nanotechnology, Ed.:Hari Singh Nalwa, American Scientific Publishers, 2004.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.