GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)

SYNTHESIS OF NANOMATERIALS-I

SUBJECT CODE: 2130403

B.E. 3RD SEMESTER

Type of course: Nanoscience and Nanotechnology

Prerequisite: For understand mention subject require basic knowledge of inorganic chemistry, physics of materials, and solid state chemistry up to 12th science level.

Rationale: To introduce the students to the basics concept of the synthesis of different Nanomaterials using various synthesis techniques

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 (I)	
					PA	ALA	ESE	OEP		
2	0	4	6	70	20	10	20	10	20	150

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION: Classification of Nanostructures, Nano - Scale Architectures Effects of nanometer length scale on Physical and Chemical Properties of Materials	6	20
2	FABRICATION METHODS:- Top down processes, Bottom-up processes, Methods for tinplating the growth of Nano-materials; Ordering of Nano-systems; Preparation, safety and storage issues	6	20
3	SOLID STATE RECACTIONS: Reactions between solid compounds Solid-Gas Reactions Decomposition and Dehydration Reactions Intercalation Reactions	6	20
4	FORMATION OF SOLIDS FROM THE GAS PHASE: Chemical Vapor Transport, Chemical Vapor Deposition (1)Metal CVD (2)Diamond CVD (3)CVD of Metal Oxide and semiconducting compound (4)CVD of Metal Nitrides Aerosol Processes Formation of Solids from Solutions and Melts Porous Materials.	8	20
5	NANOSTRUCTURE MATERIALS: Nano Particles and Nanocrystalline Materials 1)Nanocrystalline Ceramics 2)Semiconductor Nanoparticles 3)Metal Nanoparticles 4)Nanotubes	7	20

	5)Mono and Multilayer		

Reference Books:

1. Synthesis of Inorganic Materials , Ulrich Schubert, Nicola Husing (2nd Edition WILE/VCH)
2. Nano scale Science and Technology Robert Kelsall, Ian Hamley, and Mark Geoghegan (Editors) John-Wiley
3. Nanomaterials: Synthesis, Properties and Applications A.S.Edelstein and R.C.Cammarata (edits), Institute of Physics
4. Nanostructures and Nano materials-Synthesis, Properties and Applications (Cao, Imperial College Press)
5. Charles P.Poole Jr. "*Introduction to Nanotechnology*", John Willey & Sons , 2003. T. Pradeep , "*NANO The Essential , understanding Nanoscience and Nanotechnology".* Tata McGraw-Hill
6. Publishing Company Limited , 2007. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
7. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
8. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
9. S.Yang and P.Shen: "Physics and Chemistry of Nanostructured Materials",Taylor & Francis, 2000.
10. G.A. Ozin and A.C. Arsenault, "Nanochemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.

Course Outcome:

At the end of the semester, the student will be able to:

1. Understand solid state reaction
2. Understand different Nano - Fabrication methods
3. Lean about interesting effects take place at the Nanoscale
4. Be able to list a range of industries where Nanotechnology is applied

List of Experiments:

Sr. No	Topics
1.	Introduction of Nano synthesis The objective of this course is to make the students familiar with the different methods of synthesis for Nanomaterials.
2.	Synthesis of conducting glass using TiO2 Nanoparticles
3.	Synthesis of Solar cell using TiO2 Nanoparticles
4.	I-V Measurements of Nanomaterials solar cell with different particle size
5.	Synthesis of silver Nanoparticles
6.	Synthesis of nanocrystalline ceramics
7.	Understanding of manipulating matter at atomic level using Ni-Ti alloy demonstration
8.	Understanding of Nanoparticles of a magnetic material are dispersed in a liquid (Nano ferrofluids) using Ferro Fluid Demonstrator Comparison of bulk and Nano iron particles.

9.	Fundamental aspects of VLS and SLS growth – VLS growth of Nanowires – Control of the size of the Nanowires – SLS growth – Stress induced recrystalization.

Open ended/design based Projects on Science and technology :-

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 **approach of the student on his/her efforts** (not on completion) to study the design module of given task.

Examples:
1. To develop a visual understating of surface area, as items are made smaller and smaller
2. Synthesis of Nanomaterial using locally products and chemicals.
3. Fabrication of solar cell or p-n junction diode using Nanomaterials

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.