GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)
SYNTHESIS OF NANOMATERIALS-II
SUBJECT CODE: 2143904
B.E. 4th Semester

Type of course: Nano science and Nanotechnology

Prerequisite: For understand Synthesis of Nanomaterials-II require basic knowledge of inorganic chemistry, physics of materials, and solid state chemistry up to 12th science level and Synthesis of Nanomaterials-I.

Rationale: To introduce the students to the basics concept of the synthesis of different Nano materials 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	6	8	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	PRINCIPLES OF ELECTRON BEAM LITHOGRAPHY: Physics and chemistry of resists. Processes of interaction electrons with solids, diffusion, secondary electrons, proximity effect and principles of its correction. Alignment of Nano-elements in hybrid nanostructures.	6	20%
2	SELF-ALIGNMENT TECHNIQUES: Self Narrowing Atomic-beam Pantography. Physical Vapour and Chemical Vapour thin layer Deposition techniques (CVD and PVD).Thickness and deposition rate monitoring. Medium, high, and ultra-high vacuum systems. Ion beam and plasma sources and principles of their operation.	6	20%
3	PHYSICAL VAPOUR AND CHEMICAL VAPOUR THIN LAYER DEPOSITION TECHNIQUES (CVD AND PVD)	5	15%
4	NANOFABRICATION METHODS COMBINING SPM AND E-BEAM LITHOGRAPHY	5	15%
5	VERSATILE SYNTHESIS METHOD RF PLASMA CHEMICAL METHOD: Introduction of RF Plasma Chemical Method, Working Principle, and Applications	5	15%
6	PULSED LASER DEPOSITION:	5	15%

	Introduction, Working Principle Of PLD, Applications Of PLD		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
14	19	30	7	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. 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 (Guozhong Cao, Imperial College Press)
5. Nanotechnology-Basic Science and Emerging Technologies

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 Nano scale
4. Be able to list a range of industries where Nanotechnology is applied

List of Experiments:

1. Study of the Dependence of Hall Effect Coefficient On Temperature
2. Study of the Hall Voltage as a function of magnetic field at constant Current.
3. Study of the Hall Voltage as a function of Current at constant magnetic field.
4. Study of the application of solar cell for domestics appliances
5. Experiment on calculation of Efficiency of the solar cell.
6. Study on nanoparticle TiO_2 Based Solar cell in presence of halogen and sunlight.
7. Study of the comparision between the bulk and nano size iron particles in liquid
8. To Study the absorption spectrum of silver Nanoparticle.

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 Nanomaterial

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.