GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3153907
SUBJECT NAME: FABRICATION OF NANO- DEVICES
B.E. 5th SEMESTER

Type of course: Nanotechnology

Prerequisite: Fundamental of Soli state technology, Synthesis of Nano materials, Physics of Nano materials

Rationale: To make students understand the use of nanotechnology based devices in the industries and day by day life in consumer products

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)	
3	0	4	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**BULK NANOSTRUCTURED MATERIALS:** Quantum wells, wires and Dots – Size and dimensionality effects, Carbon nanotubes (CNTs)- Single walled carbon nanotubes (SWNTs), Multi walled carbon nanotubes (MWNTs), Graphenes, Fullerenes- Structure and Properties, Metal/oxide nanoparticles, Nano rods, Nanowires, Nanotubes, and Nano fibres, Semiconductor Quantum Dots- Excitons, Magnetic Nanoparticles- Nanostructured Ferromagnetism, Polymer nanoparticles, Single electron tunnelling – Applications.	**8**	**16%**
2	**GAS SENSOR MATERIALS:** Criteria for the choice of materials, Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity; Discussion of sensors for various gases, Gas sensors based on semiconductor devices.	**8**	**16%**
3	**BIOSENSORS:** Principles- DNA based biosensors – Protein based biosensors – materials for biosensor applications- fabrication of biosensors - future potential	**6**	**14%**
4	**SEMICONDUCTOR NANODEVICES-I:** Single Electron devices- Nano scale MOSFET – Resonant Tunnelling Transistor – Single Electron Transistors - Single Electron Dynamics - Nano robotics and Nano manipulation - Mechanical Molecular Nano devices - Nano computers: Theoretical Models - Optical Fibres for Nano devices - Photochemical Molecular Devices	**7**	**19%**
5	**SEMICONDUCTOR NANODEVICES-II:** Schottky devices - Quantum Structures and Devices - Quantum layers, wells, dots and wires - Mesoscopic Devices - Carbon Nanotube based logic gates, optical	**7**	**19%**

	devices - Connection with quantum dots, quantum wires, and quantum wells- Single Molecule electronic devices – photonic band gap systems: applications and devices		
6	**X-RAY LITHOGRAPHY:** Ion beam lithography - Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography - Masked ion beam direct structuring - atom lithography	**6**	**16%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	**Understanding U Level**	**Application A Level**	**Analyze N Level**	**Evaluate E Level**
14	19	30	7	-

Legends: R: Remembrance; U: Understanding; A: Application 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. INTRODUCTION TO NANOTECHNOLOGY ,
Charles P. Poole Jr and. Frank J. Owens, Wiley Inter science, 2003.
2. NANOSTRUCTURES AND NANOMATERIALS: SYNTHESIS, PROPERTIES AND APPLICATIONS, G. Cao, Imperial College Press, 2004.
3. NANOBIOTECHNOLOGY, CONCEPTS, APPLICATIONS AND PERSPECTIVES",
C.M. Niemeyer and C. A. Mirkin, WILEY-VCH, 2004.
4. NANOTECHNOLOGY - MOLECULARLY DESIGNED MATERIALS,
G. M. Chow and K. E. Gonsalves American chemical society Symposium series 622, 1996.
5. PHYSICS OF SEMICONDUCTOR NANOSTRUCTURES", K. P. Jain Narosa Publishers, 1997

Course Outcome:

1.After learning the course the students should be able to:

2.Understand bulk and Nanostructured materials.

3.Understand preparation of Gas sensor, properties of gas sensor and application of gas sensor.

4.Understand Basic of Biosensor, and application of Bio sensor.

5. Understand semiconductor based Nano device, their properties and application of nanomaterial in semiconductor devices.

List of Experiments:

Experiment-1
Verification of Lambert Beer's law and determination of concentration of unknown solution by UV-Vis spectrophotometer.

Experiment-2
Determination of the band gap of semiconductor nanoparticle.

Experiment-3
Experiment on optical properties of metal oxide nanoparticle.

Experiment-4
Experiment on environmental effect on metal oxide particle.

Experiment-5
Experiment on UV –Vis spectroscopy of semiconductor Nanoparticle.

Experiment-6
Experiment on absorption spectra of TiO_2 Nanoparticles.

Experiment-7
Experiment on Preparation of Nano composite.

Experiment-8
Experiment of absorptions spectra of Nano composite.

Major Equipment:

1. UV-Visible Spectrometer
2. Spin coater
3. Distil Water Unit
4. PH Meter
5. Solar cell testing kit
6. Necessary Chemicals and glassware for sol-gel and chemical synthesis

List of Open Source Software/learning website:

www.virtual.itg.uiuc.edu