GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY

SUBJECT NAME: ELECTRICAL AND OPTICAL PROPERTIES OF NANOMATERIALS

SUBJECT CODE: 2173905

B.E. VII SEMESTER

Type of course: material science and Nanotechnology.

Prerequisite: Elements of Material science, Physics of Nano Materials, Nanopolymers and Nano-composites.

Rationale: To make students understand the use of nanotechnology-based devices in the industries, the challenges to prepare nanotechnology-based device for industries.

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		
3	0	2	5	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; OEP-Open Ended problem; AL-Active learning;

Learning Objectives:

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Electrical Transport properties of Nano Materials:** Introduction to electrical transport properties and their applications. Electrical transport properties of Nanostructured Thin film and it's applications. Electrical Transport properties of Nanomaterial and it's sensitivity.	12	20%
2	**Electrical Conductivity of Nano Materials:** The introduction to AC and DC conductivity of Materials, AC conductivity of oxide materials, AC conductivity of Nanostructured Oxide materials. Temperature effect on AC conductivity of Nanostructured Oxide materials.	11	20%
3	**Microstructural effects on Electrical Properties of nanomaterials:** Grain and grain size effect on transport properties of nanomaterials, Microstructure effect on the transport properties of nano thin film,	8	20%
4	**Optical Properties of Nanomaterials and it's applications - I:** UV-visible properties of Nanomaterials, the Photocatalytic effect of Oxide and nanostructured oxide materials and it's applications, optical properties of nano thin film and their applications.	9	20%
5	**Optical Properties of Nanomaterials and it's applications - I:** Particle Size effect on optical properties of nanostructured materials, Temperature effect on optical properties of Nanostructured materials.	8	20%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	**Understanding U Level**	**Application A Level**	**Analyse N Level**	**Evaluate E Level**
7	**21**	**28**	**7**	**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. Transport in Multilayered Nanostructures. The Dynamical Mean-Field Theory Approach, Imperial College Press. James K Fredericks, 2006.
2. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
3. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
4. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.

Course Outcome:

1. After learning the course the students should be able to understand:
2. The device Characteristics and transport properties of nanostructured materials.
3. The electrical conductivity behaviour of nanostructured materials and their response to various frequency ranges.
4. The microstructure effect on the properties of nanostructured materials.
5. The photocatalytic properties of nanostructured materials.

List of Experiments:

1. Prepare Semiconducting nanoparticles.
2. Determine the optical energy band gap of semiconducting nanoparticles using UV-Visible spectroscopy.
3. Determine nano size effect on energy band gap on nano materials.
4. Study transport properties of nanomaterials.
5. Measure the dielectric properties of nanomaterials at various frequencies.
6. Study electrical conductivity of nanomaterials.
7. Study morphology effects on electrical properties of nanomaterials.

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.

Examples

1. Make nanogenerator using nano-ZnO.
2. Make memristor nanodevices.

Major Equipment:

1. UV-Visible Spectrometer.
2. Voltage supplier and current measurement.
3. Distil Water Unit.
4. PH Meter.
5. LCR meter.
6. Necessary Chemicals and glassware for sol-gel and chemical synthesis

List of Open Source Software/learning website:

1. www.virtual.itg.uiuc.edu
2. http://ocw.mit.edu/courses/chemical-engineering/10-467-polymer-science-laboratory-fall-2005/labs/
3. Macrogalleria (http://pslc.ws/macrog/index.htm)
4. POLYED (http://www.uwsp.edu/chemistry/polyed/)
5. Carnegie Mellon Education Website - Macromolecular products http://gelfand.web.cmu.edu/scimodules/)
6. https://en.wikipedia.org/wiki/Nanomedicine
7. http://www.nanotechproject.org/inventories/medicine/
8. http://www.nanomedjournal.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.