GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)

Elements of Material Science

SUBJECT CODE: 2143903

B.E. 4th Semester

Type of course: Material Sciences

Prerequisite: For understand Elements of Material Science subject require basic knowledge of inorganic chemistry, Solid State of Physics, and solid state chemistry up to 12th science level.

Rationale: To introduce the students to the basics concept of different Properties of Nano materials

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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION: Structure, composition, processing and properties of materials and their interrelationships	6	10%
2	MECHANICAL AND THERMAL PROPERTIES Mechanical: Stress; Strain; Elastic Deformation; Yielding; Time Dependent Deformation; Fracture; Fatigue Testing Thermal: Heat Capacity; Thermal Expansion; Thermal Conductivity; Thermal Stress; Thermal Shock	7	15%
3	ELECTRICAL ,DIELECTRIC AND PIEZOELECTRIC PROPERTIES Electrical: Metallic Conductivity; Semi conductivity; Ionic Conductivity; Superconductivity Dielectric: Dielectric Dispersion; Dielectric Loss and Strength; Ferro electricity and Piezoelectricity	7	15%
4	OPTICAL: Refraction; Reflection; Transmission and Absorption Factors; Colour; Luminescence; Photoconductivity	7	10%
5	POLYMER OLED MATERIALS	7	15%
6	MAGNETIC MATERIALS-1: Diamagnetism; Para magnetism; Ferromagnetism; Anti-ferromagnetism; Ferrimagnetism	7	15%

7	MAGNETIC MATERIALS-2: Ferrites and garnets – Magnetic bubbles and their applications – Giant Magneto Resistance (GMR) – Colossal Magneto Resistance (CMR).	7	20%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
15	20	30	5	

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. Materials Science and Engineering, William D Calisher Jr.
2. Solid state chemistry, a.k.west
3. Elements Of Material Science And Engineering, 6th edition, Van vlack
4. Elements of materials science and Engineering, I.H.Vanvlach (4th Edition)
5. Materials science and Engineering, V. Raghvan
6. The Science and Engineering of Materials, Donald R.Askeland (Chapman & Hall)
7. Ask eland, Donald R; Pradeep p. Phule (2005). The science & Engineering of Materials, 5th edition, Thomson Engineering.
8. Solid state Physics: Properties of Materials, M.A. Wahab, and Narosa Publishing.
9. Fundamentals of materials Science & Engineering, William F Smith

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. Band gap determination
2. Dielectric constant measurement.
3. Photoconductivity measurement.
4. Determination of Hall coefficient and carrier type for a semiconductor material.
5. To trace the hysteresis loop for a magnetic material
6. Magnetic susceptibility – Quince's method
7. Determination of thermal conductivity – Lee's
8. Resistivity determination for a semiconductor wafer using Four probe method.

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 Nano materials

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.