



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3163909

## STRUCTURAL ANALYSIS OF NANOMATERIALS

B.E. 6<sup>th</sup> SEMESTER

**Type of course:** Material Science, Chemistry, Physics

**Prerequisite:** Fundamental of Chemistry, Synthesis of Nano materials, Physics of Nano materials

**Rationale:** The purpose of this course is to provide a review of timely concepts in the rapidly emerging field of material technology and its perspectives. Structural analysis of nanomaterials is an important part of Materials Science and Nanoscience & Nanotechnology which deals with the study of crystal structure of materials and their defects.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

### Content:

Sr. No.	Content	Total Hrs.	% Weig
1	<b>STRUCTURE OF MATERIALS</b> Introduction: Fundamental concepts of atomic structure and interatomic bonding, Structure of materials, Defects in structure of materials, Phase diagram: Determination of phases, Transformation of phases.	10	20%
2	<b>BASIC PROPERTIES:</b> Metals, Basic properties: Ceramics, Basic properties: Polymers, Selection of nanomaterials, Structure property relationship of advanced nanomaterials.	10	20%
3	<b>INTRODUCTION TO X-RAY SPECTROSCOPY-1</b> Diffraction direction and methods of XRD, Determination of crystal structures by XRD Pattern, Precise parameter measurements, Orientation of single crystals.	10	20%
4	<b>INTRODUCTION TO X-RAY SPECTROSCOPY-2</b> Qualitative analysis by diffraction, Quantitative analysis by diffraction,	10	20%



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3163909

	Microscopic structural analysis of Nanomaterials		
<b>5</b>	<b>TRANSMISSION ELECTRON MICROSCOPY</b> Instrumentation Electron Sources Electromagnetic Lenses Specimen Stage Specimen Preparation Pre-Thinning Final Thinning Image Modes Mass-Density Contrast Diffraction Contrast Phase Contrast	<b>10</b>	<b>20%</b>

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>				
<b>Remembrance R Level</b>	<b>Understanding U Level</b>	<b>Application A Level</b>	<b>Analyze N Level</b>	<b>Evaluate E Level</b>
25	30	25	20	-

**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

## TEXT BOOKS AND REFERENCES

1. Cullity, B.D., Stock, S.R. and Stock, S, Elements of X-Ray diffraction, Prentice Hall, 3rd Edition, New Jersey.
2. Phillips, R., Crystal defects and microstructures Cambridge university press, Cambridge, UK.
3. Wang, Z.L., Characterization of nanophase materials, Wiley-VCH, Weinheim, Germany
4. Allen, S.M., Thomas, E.L., The structure of materials, John Wiley & Sons, US.

## Course Outcome:

After a successful completion of the course, students should be able to

1. Describe underlying principles associated with structure, phase and defect of material.



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3163909**

2. Describe underlying principles of signal generation and analysis in X-Ray Spectroscopy.
3. Describe underlying principles of signal generation and analysis in Transmission Electron Microscopy.
4. Interpret analysis results from XRD and TEM