

# GUJARAT TECHNOLOGICAL UNIVERSITY

## NANO TECHNOLOGY (39)

### FUNDAMENTALS OF SOLID STATE TECHNOLOGY

SUBJECT CODE: 2130401

B.E. 3<sup>RD</sup> SEMESTER

**Type of course:** Material Science and Technology

**Prerequisite:** Solid state physic, crystal physics, mathematics (differentiation and integration), material chemistry (inorganic chemistry) and some physical properties of materials from 12<sup>th</sup> science level syllabus.

**Rationale:** The purpose of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials and its basic knowledge for specific engineering applications.

#### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	0	3	70	20	10	0	0	0	100

#### Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	CRYSTALPHYSICS: Periodic array of atoms, Translation vectors, Unit cell, Space lattice, Miller indices, Simple Crystal Structures, Bonds in solids. Nano Crystalline Solids, Physical properties of Nanomaterials, Melting points and Lattice Phonons	7	20
2	STRUCTURAL PROPERTIES: Defects in Solids, Mechanical properties X-ray diffraction methods and their applications in identification of crystal structures, Geometric factor reciprocal lattice.	6	20
3	LATTICE VIBRATIONS AND THERMAL PROPERTIES OF SOLIDS: Concept of lattice vibrations and thermal heat capacity, classical, Einstein and Debye theories of molar heat capacity and their limitations, Concept of phonons.	7	20
4	SOLID STATE SEMICONDUCTING MATERIAL: Intrinsic semiconductors, doping and extrinsic semiconductors, Simple models for semiconductors, Donor and acceptor levels, p-n junction and rectification, tunneling and resonant tunneling, Hall effect in semiconductors	7	20
5	DIELECTRIC AND MAGNETIC MATERIALS: Dielectric properties of solids, Magnetic materials and its	7	20

	properties. Ferrites & Nano-Magnets. Optical and thermal properties of semiconductors. Structures of Ceramics, Polymers & Composites.		
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### Reference Books:

1. Introduction to Solid State Physics C. Kittel
2. Solid State Physics: A.J. Decker
3. Solid State Physics: S.O. Pillai
4. Nanostructures and Nano materials Guozhong Cao, Imperial College Press, 2006
5. S.O. Kasap, "Principles of Electronic Materials and Devices", Tata McGraw Hill Edition, New Delhi, 2002.
6. Van Vlack, L.H., "Material Science for Engineers", 6th edition, Addison Wesley, 1985.
7. Thiruvadigal, J. D., Ponnusamy, S. and Vasuhi.P. S., "Materials Science", 5th edition, Vibrant Publications, Chennai, 2007.
8. Rolf E. Hummel, "Electronic Properties of materials", Narosa Publishing House, New Delhi, 1994.
9. Raghavan.V., "Materials Science & Engineering – A First Course", 5th edition, Prentice Hall of India, New Delhi, 2005.
10. Khanna. O. P., "A Text Book of Material Science & Metallurgy", Revised edition, Dhanpat Rai Publications, New Delhi, 2006.
11. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st edition, Overseas Press, New Delhi, 2005.

### Course Outcome:

At the end of the semester, the student will be able to:

1. Understand crystal and physical properties of materials,
2. Understand the properties and applications of semi conducting materials,
3. Understand general properties and applications of magnetic and dielectric materials,
4. Understand general properties and application Ferrites & Nano-Magnets.
5. Understand Optical and thermal properties of semiconductors

**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.