Subject Code: 02PY0503

Subject Name: Solid State Physics

M.Sc. Year-II, Sem-III

Objective: To examine the crystal structures and crystal systems and to learn the theories of various properties of the materials.

Credits Earned: 4 Credits

Course Outcomes: After completion of this course, post graduate will be able to

- Identify the importance of crystal physics to analyze the materials properties.
- Apply knowledge of physical phenomena taking place which are responsible for the particular characteristics of the materials.
- Apply knowledge of physics to become successful in national level examinations like NET, SLAT, GATE etc.
- Useful for the understanding of the properties of advanced materials in research and apply to understand the characteristics of the advanced materials.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva (V)	Term work (TW)	
4	0	0	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Geometry of Lattice:** Introduction to crystal structure, Reciprocal lattice and Brillouin zone, Lattice vibrations, Phonons, Thermal properties, Diffraction, Bragg and Laue formulation of X - ray diffraction by a crystal, Atomic and crystal structure factor, London theory of Van Der Waal forces	**12**
2	**Crystal Defect and Non-Stoichiometry** Perfect and imperfect crystal, types of defect, Schottky defect, frenkel defect, Thermodynamics of Schottky and frenkel defect formation, Colour centres, Vacancies and interstitial in non-stoichiometry crystal, Defect clusters or aggregates, Dislocation and Grain boundaries	**12**
3	**Dielectric Behavior of Solids** Dielectric properties, ferroelectrics, Piezoelectrics, Electromagnetic waves in solids, Frequency dependent polarizabilities, Dielectric loss and relaxation, Electronic polarizability, Free carrier effects, Ionic polarizability.	**12**
4	**Low temperature Physics** Fundamental properties, Penetration depth, Arbitrary shape, Coherence length, The nature of the surface energy, Magnetic properties -type II, HTSC, Magnetization curve, Microscopic structure of the mixed state, Magnetic field effect on HTSC, Pinning energy.	**12**
5	**Magnetism** Types of magnetic material and magnetism, Effect of Temperature (Curie and Curie-Weiss laws) Hund's rules, Coupling of electrons in atoms to an external field, free spin (curie or Langevin) paramagnetism, Larmor diamagnetism, (Spontaneous) magnetic order, Superexchange, Breaking symmetry, Ising model, Disorder and domain walls, Disorder pinning, The Bloch/N´eel wall.	**12**
	Total Hours	**60**

References:

1. Material Characterization, ASME Handbook, 3rd addition. ASM International (1992)
2. Semiconductor Material and Device Characterization, 3rd Edition, D. K. Schroder, Wiley-IEEE Press (2006).
3. Solid State Chemistry and its Applications Anthony R. West (John Wiley & Sons), 1987.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	20%	25%	25%	10%	10%

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.