

Roll No. [REDACTED]

Exam Code : M-24

Subject Code—61432

B.Sc. EXAMINATION

(Main/Reappear)

(Batch 2019 Onwards)

(Sixth Semester)

PHYSICS

CPL-601 (Course III)

Solid State Physics

Time : 3 Hours

Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) What are reciprocal lattice vectors ? 2
- (b) What is Curie's law ? 2

- (c) Explain the significance of group velocity at zone boundary. 2
- (d) What is crystal plane ? 2
- (e) What is isotopic effect ? 2
- (f) Discuss applications of superconductivity. 3
- (g) What are ferromagnetic domains ? 3

Unit I

2. (a) Discuss the following crystal structures : 10
- (i) Zinc Sulphide
- (ii) Diamond.
- (b) Show that (hkl) plane is perpendicular to the $[hkl]$ direction in a cubic lattice. 6

3. (a) Show analytically that five fold rotation axis does not exist in a crystal lattice. 6
- (b) Derive an expression for interplanar spacing of the lattice planes for a cubic lattice. Find the interplanar spacing for the lattice planes of Miller indices (321) , (210) and (111) for a cubic lattice with $a = 5.62$ angstrom. 10

Unit II

4. (a) Derive the phonon dispersion relation for monoatomic lattice. 8
- (b) Discuss the following terms : 8
- (i) Bragg's law
- (ii) Dulong and Petti's law.
5. (a) Discuss the Einstein theory for specific heat of solids and its variation with temperature. 8

- (b) What is physical significance of reciprocal lattice ? Discuss reciprocal lattice to fcc lattice. 8

Unit III

6. (a) Differentiate in between metals, semiconductors and insulators based on band theory. 8
(b) Discuss classical Langevin theory of diamagnetic materials. 8
7. (a) Describe the nearly free electron model for determining the electron energy bands in metal. 8
(b) Obtain an expression for paramagnetic susceptibility of free electrons on the basis of classical laws. Discuss its shortcomings. 8

Unit IV

8. (a) What is Josephson effect ? Discuss ac Josephson effect. 8
(b) What is London penetration depth ? Obtain an expression for the London penetration depth of magnetic field for a superconductor. 8
9. (a) Derive London equations and discuss how do they help in explaining the superconducting state. 12
(b) The critical temperature for mercury with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 203.4. 4