**D3APH2403** **(2 Pages)** **Name.....**
**Reg.No.....**

**THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2025**
**(Regular/Improvement/Supplementary)**

**PHYSICS**
**FPHY3C11-SOLID STATE PHYSICS**

**Time: 3 Hours** **Maximum Weightage: 30**

**Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.**

1. Explain the concept of reciprocal lattice.
2. What are the different models explaining the lattice heat capacity of solids?
3. Distinguish between acoustic and optical phonons.
4. What are Bloch functions?
5. Explain Hall effect.
6. What is susceptibility? How is atomic susceptibility calculated?
7. Distinguish between paramagnetic and ferromagnetic materials.
8. Briefly explain the origin of ferrimagnetic moments.

**(8 × 1 = 8 weightage)**

**Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.**

9. Discuss the bonding in ionic crystals, obtain the expression for lattice energy of a crystal in terms of Madelung energy.
10. Obtain the expression for the carrier concentration in intrinsic semiconductors.
11. Derive Curie-Weiss law for ferromagnetism.
12. Derive London equations and hence obtain an expression for London penetration depth.

**(2 × 5 = 10 weightage)**

**Part C: Problems. Answer any *four* questions. Each carries *three* weightage.**

13. Calculate the density of atoms in (1 0 0), (1 1 1) planes of BCC Barium whose lattice parameter is 5.02 Å.
14. Find the cut-off frequency for a one-dimensional monoatomic chain given that the interatomic spacing is 3Å and velocity of sound 3000 m/s.
15. The energy near the valence band edge of a crystal is given by $E= -Ak^2$, $A= 10^{-39}\ Jm^2$. An electron with wave vector $k= 10^{10}\ k_x\ m^{-1}$ is removed from an orbital in the completely filled valance band. Determine the effective mass, velocity, momentum and energy of the hole.

**(P.T.O.)**

16. Find the Fermi velocity of the electrons if the number density of electrons in sodium is $2.52\times10^{28}$ $m^{-3}$ at room temperature.

17. Derive the Clausius – Mossotti relation by considering the local field effects.

18. Calculate the Pauli's paramagnetic susceptibility from the following data: a paramagnetic substance contains $6.02 \times 10^{28}$ atoms/$m^3$ and its fermi energy is 11.63 eV.

19. A superconducting material has a transition temperature of 3.7 K at zero magnetic field and a critical field of $3\times10^5$ A/m at 0 K. Find the critical field at 2K.

**(4 × 3 = 12 weightage)**