

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2024
(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. Obtain vector form of Bragg's law using the concept of reciprocal lattice.
2. What are Miller indices? What is their importance?
3. Plot the dispersion curves for lattice vibrations of a crystal with one and two atoms in the primitive cell.
4. Explain Hall effect. Give the expression for Hall coefficient.
5. Elaborate on the origin of diamagnetism.
6. Briefly explain spin waves.
7. What are ferro electric domains?
8. Write a note on high T_c super conductors.

(8 × 1 = 8 weightage)

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

9. Discuss the Debye model of lattice heat capacity and derive an expression for it. How does the Einstein model differ from it?
10. Derive London equations and derive an expression for London penetration depth.
11. Explain how bands are formed in solids. Discuss the essential features of the behavior of electrons in a periodic potential using Kronig Penney model.
12. Derive Curie-Weiss law for ferromagnetism.

(2 × 5 = 10 weightage)

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

13. Show that the reciprocal lattice of a BCC lattice is FCC lattice.
14. Copper has an FCC structure and the atomic radius is 0.1278 nm. Calculate the interplanar spacing for (111) planes.
15. The atomic radius of Sodium is $1.86\text{\AA}$. Calculate the Fermi energy of Sodium at absolute zero.

(P.T.O.)

16. Estimate the Curie constant for Fe. Given $N = 9 \times 10^{28} \text{ m}^{-3}$ and $\mu_B = 9.27 \times 10^{-24} \text{ JT}^{-1}$.
17. Calculate the critical current for a wire of lead having a diameter of 1 mm at 4.2 K. The critical temperature for lead is 7.18 K and $H_c(0) = 6.5 \times 10^4 \text{ A/m}$.
18. A uniform silver wire has a resistivity of $1.54 \times 10^{-8} \Omega\text{m}$ at room temperature. For an electric field along the wire of 1 V/cm, compute the average drift velocity of the electrons, assuming that there are 5.8×10^{28} conduction electrons/ m^3 . Also calculate the mobility and the relaxation time of the electron.
19. A magnetic material has a magnetization of 3200 A/m and flux density of 0.0045 Wb/ m^2 . Determine the magnetic field and the relative permeability of the material.

(4 × 3 = 12 weightage)