Reg. No ..... Name **26U613-S**

B. Sc. DEGREE END SEMESTER (SPECIAL) EXAMINATION - MAY 2026

SEMESTER 6 : PHYSICS

COURSE : **19U6CRPHY12 : SOLID STATE PHYSICS**

(For Supplementary (Special) 2023 Admission)

Time : Three Hours Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. What is an extrinsic semiconductor? Write example.
2. Contrast the terms 'Curie temperature' and 'Neel temperature'.
3. Write the equation showing Clausius - Mossotti relation.
4. Define a primitive cell?
5. Explain the working principle of a photodiode.
6. Compare holes vis-a-vis electrons in semiconductors .
7. Compare the main properties of high-Tc superconductors with those of conventional superconductors.
8. Comment on the charge carriers accountable for flow of current in a semiconductor?
9. Find the ratio between spacing between (110) and (111) planes?
10. Discuss the Laue method of X-ray diffraction?

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. A rod of magnetic material, 0.5 m in length has a coil of 200 turns wound over uniformly. If a current of 2 A is sent through it, calculate (i) the magnetizing field H (ii) intensity of magnetization M (iii) magnetic induction B (iv) relative permeability of the material. Given $\chi = 6 \times 10^{-3}$
12. For a superconducting specimen, the critical fields at 13 K and 14 K are 4.2×10^5 amp/metre and 1.4×10^5 amp/metre respectively. Determine the transition temperature and critical field at 0K.
13. In a cubic unit cell, find the ratio of inter-planar spacing between the planes (111) and (121).
14. The critical temperature of a superconductor at zero magnetic field is T_c. Determine the temperature at which the critical field becomes half of its value at 0 K.
15. An electric field of 100 V/m is applied to a sample of n-type semiconductor whose Hall co-efficient is -0.0125 m^3/coulomb. Determine the current density. Given, the electron mobility is 0.36 m^2/V-s.
16. In intrinsic GaAs, the electron and hole mobilities are 0.85 and 0.04 m^2/V-s respectively and the corresponding effective masses are $0.068m_e$ and 0.5 m_e respectively, where m_e is the rest mass of the electron. Given the band gap of GaAs at 300 K as 1.43eV. Determine the intrinsic carrier.
17. An intrinsic sample of gallium arsenide has a hole density of 10^{13} per cm^3 at room temperature. When doped with bismuth, the hole density decreases to 10^{11} per cm^3 at the same temperature. What is the majority carrier density?
18. Determine the relationships between the lattice parameter a and the atomic radius r for monoatomic Sc, bcc and fcc structures.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. Write a note on the origin of (a) Covalent bonding (b) Metallic bonding (c) hydrogen bonding and (d) Van der Walls bonding?

20. Derive an expression for density of free electrons and holes in an intrinsic semiconductor show that the Fermi level lies half way between the valence band and the conduction band.

21. Give a quantitative description of the BCS theory. How does it account for the superconductivity state.

22. (a) Why X-rays are used in structure studies? Derive Bragg's law of X-ray diffraction in crystals? (b) Find the smallest glancing angle at which K-alpha radiation of copper of wavelength 3 A^0 will be reflected from Calcium crystal of spacing 6.072 A^0. At what angle will the third order reflection take place?

(10 x 2 = 20)