**23P308** (Pages: 2) Name: .....

Reg.No: .....

**THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2024**

(CBCSS - PG)

(Regular/Supplementary/Improvement)

**CC19P PHY3 C11 - SOLID STATE PHYSICS**

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

**Section A**

Answer ***all*** questions. Each question carries 1 weightage.

1. Explain the crystal structure of diamond.
2. Define acoustic and optical phonons.
3. What is Wiedmann-Franz law and explain its significance.
4. Distinguish between direct band gap and indirect band gap semiconductors.
5. Write a short note on ionic polarisability.
6. Explain polarization catastrophe.
7. Explain first order phase transition based on Landeau theory.
8. What are cooper pairs? How are they formed?

**(8 × 1 = 8 Weightage)**

**Section B**

Answer any ***two*** questions. Each question carries 5 weightage.

9. What is meant by Madelung interaction? Discuss the nature of cohesion and obtain expression of cohesive energy in ionic crystals.
10. Derive the expression for specific heat using Debye model.
11. What is meant by Bloch function? Discuss the formation of allowed and forbidden energy band on the basis of Kronig-Penny model.
12. Give an account of d.c Josephson effect effect with relevant theory.

**(2 × 5 = 10 Weightage)**

**Section C**

Answer any ***four*** questions. Each question carries 3 weightage.

13. An orthorhombic crystal has a ratio a: b: C = 0.429:1:0.377. Find the miller indices of the faces whose intercepts are (i) 0.214: 1: 0.188 and (ii) 0.429: α : 0.126

14. In a tetragonal lattice a = b = 2.5 AU. and c = 1.8 AU. Determine the lattice spacing between (111) planes.

15. Show that the wavelength of a moving electron having an energy equal to the Fermi energy at absolute zero is given by $(2\pi)/(3\pi 2)(-1/3)$

16. In an intrinsic semiconductor the effective mass of the electron is 0.07 me and that of the hole is 0.4 me, where me is the rest mass of the electron equaling 9.1 x 10-31 Kg. Calculate the intrinsic concentration of charge carriers at 300K. Given: Eg = 0.7 eV.

17. Sodium metal with fcc structure has 4 atoms per unit cell. The radius of the sodium atom is 10A and the lattice parameter is 3.6080A . Calculate its diamagnetic susceptibility.

18. A typical magnetic field achievable with an electromagnet with iron core is about 1 Tesla. Compare the magnetic interaction energy,$\mu BB$ of an electron spin magnetic dipole moment with kBT at room temperature(300 K) and show that at this temperature the approximation $kBT/ \mu BB>>1$ is valid.

19. The critical temperature Tc, for mercury with isotopic mass 199.5 is 4.185 K. Calculate the critical temperature when its isotopic mass changes to 203.4.

**(4 × 3 = 12 Weightage)**

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