18.4

TM242897X

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, MARCH 2024

2023 ADMISSIONS REGULAR

SEMESTER II - CORE COURSE

PH2C08TM20 - Condensed Matter Physics

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Explain how to confirm whether the sample if FCC or BCC from the XRD results.
2. Discuss the terms point group and space group.
3. Based on Fermi Dirac statistics, explain the nature of the FD function and how it varies with temperature.
4. Show that the wavelength associated with an electron whose energy is equal to the Fermi energy is $2\left(\frac{\pi}{3n}\right)^{1/2}$ where n is the associated quantum number.
5. Estimate the magnitude of energy gap in solids using the modified free electron theory.
6. Give an account of Bloch oscillators.
7. Outline the process of thermal ionization of donors and acceptors.
8. A crystal with monoatomic lattice be called as a low pass filter. Justify this statement.
9. Enumerate the defects of Debye model of specific heat.
10. Briefly discuss Geo and bio magnetism.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Estimate the reciprocal lattice to FCC and BCC systems.
12. Explain degenerate and non degenerate states. Taking the example of particle in a cubical box of side a, obtain first few states and present them graphically.
13. Derive equations for Density of states of 3D, 2D and 1D electron gas systems.
14. If the Fermi energy of electrons in a metal is 7 eV, calculate the Fermi momentum, Fermi velocity and de Broglie wavelength.
15. The intrinsic carrier density at 300 K in Si is $1.5\times10^{16}/m^3$ and the electron and hole mobility are 0.13 and $0.05m^2V^{-1}s^{-1}$ respectively. Calculate the conductivties of intrinsic silicon and that of doped silicon containing 1 donor atom per 10^8 silicon atoms.
16. Discuss the effect of variation of relative masses of the two types of atoms and the wavelength of elastic waves of the forbidden gap foe a linear diatomic lattice.
17. Define thermal conductivity of a solid. Derive an expression for the same in terms of its specific heat capacity.
18. Discuss the thermal excitation of magnons and obtain $T^{3/2}$ law.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Write down the Laue equations and explain their use in analyzing x-ray diffraction results. Explain how Ewald sphere helps in identifying the Bragg reflection conditions in a crystal system.

20. Discuss how Kronig Penney model correctly predicts the presence of band gap in the energy dispersion curve of solids.
21. Discuss the vibrations of a crystal with linear diatomic lattice. Explain the acoustical and optical branches observed in the spectrum of this lattice.
22. Discuss in detail the quantum theory of paramagnetism. Hence explain how the theory account for the behaviour of rare earth ions.