Reg. No ..... Name .....

**M. Sc DEGREE END SEMESTER EXAMINATION - MARCH 2020**

**SEMESTER 2 : PHYSICS**

COURSE : **16P2PHYT07 : CONDENSED MATTER PHYSICS**

***(For Regular - 2019 Admission & Supplementary 2018/2017/2016 Admissions)***

Time : Three Hours Max. Marks: 75

**Section A**
**Answer All the Following (1 mark each)**

1. The percentage of the available space occupied in a hexagonal close packing of spheres in three dimensions is
   a) 26% b) 76% c) 52.4% d) 74%.
2. A simple cubic lattice consists of eight identical spheres of Radius R in contact, placed at the corners of the cube, what fraction of the total volume of cube is actually occupied by the cube?
   a) 74% b) 68% c) 52.4% d) 66%.
3. In an intrinsic semiconductor, the Fermi level
   a) Lies at the center of forbidden energy gap.
   b) Is near the conduction band.
   c) Is near the valence band.
   d) May be anywhere in the forbidden energy gap.
4. The forbidden gap for germanium is
   a) 0.12 eV b) 0.72 eV c) 7.2 eV d) None of these
5. In superconductivity the conductivity of a material becomes
   a) Zero b) Finite c) Infinite d) None of the above

(1 x 5 = 5)

**Section B**
**Answer any 7 (2 marks each)**

6. Explain the geometrical structure factor?
7. Explain Widemann-Franz-Lorentz law?
8. Explain the Ewald construction.
9. What are degenerate levels?
10. Briefly explain the generation and recombination in semiconductors.
11. State Dulong and Petit's law
12. Discuss the effect of temperature on mobility in the case of semi-conductors
13. What is meant by Ferroelectricity?
14. Discuss the application of quantum wires and quantum dots?
15. Derive an expression connecting relative permeability and magnetic susceptibility?

(2 x 7 = 14)

**Section C**
**Answer any 4 (5 marks each)**

16. Prove that the reciprocal lattice of a bcc lattice is an fcc lattice.
17. The density of Zn is $5.13 \times 10^3$ kg/m$^3$ and its atomic weight is 65.4. Calculate the Fermi energy in zinc. Also calculate the mean energy at 0 K. The effective mass of the electron in zinc is 0.85 $m_e$.
18. The intrinsic carrier density at 300 K in silicon is $1.5 \times 10^{16}/m^3$.The electron and hole mobilities are 0.13 and $0.05 m^2 V^{-1} s^{-1}$, respectively. Calculate the conductivity of (a) intrinsic silicon and (b) silicon containing 1 donor impurity atom per $10^8$ silicon atoms.
19. An intrinsic semiconductor material A has an energy gap 0.6 eV while material B has an energy gap 0.12 eV. Compare the intrinsic carrier densities in these two material at 300 K. Assume that the effective masses of all the electrons and holes are equal to the free electron mass.

20. A magnetic induction of $2 \times 10^{-4}$ web/m$^2$ in vacuum produces magnetic flux of $2.4 \times 10^{-8}$ web in a bar of area of cross section $2 \times 10^{-5} m^2$. Calculate (a) magnetizing field (b) magnetic induction in the bar and (c) Intensity of magnetization?

21. A magnetizing field of 600 A/m produces a magnetic flux of 5 web in a bar of iron of cross section of 0.1 m$^2$. Calculate the permeability and susceptibility of the material?

(5 x 4 = 20)

**Section D**
**Answer any 3 (12 marks each)**

22.1. What are density of states in metals? Derive an expression for the density of energy states and hence obtain the Fermi energy of a metal?

**OR**

2. Discuss Kronig Penney model. Using the model show that the energy spectrum of electron consists of a number of allowed energy bands separated by forbidden regions.

23.1. Discuss Debye model of lattice heat capacity. Derive an expression for it.

**OR**

2. Obtain the vibrational spectrum of a linear diatomic lattice and show that the spectrum consists of two branches.

24.1. What is meant by spontaneous magnetic moment of a ferromagnet? Obtain an expression for susceptibility in terms of Curie point.

**OR**

2. Explain the properties of Metallic Nano clusters?

(12 x 3 = 36)