Reg. No ..... Name **18P232**

M Sc DEGREE END SEMESTER EXAMINATION - APRIL 2018

SEMESTER 2 : PHYSICS

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

(For Regular - 2017 Admission)

Time : Three Hours Max. Marks: 75

Section A
Answer any 5 (1 marks each)

1. When electrons are trapped in the crystal lattice in place of anion vacancy, the defect in the crystal is known as
   A. Frenkel defect
   B. Schottky defect
   C. F-centre
   D. Dislocations.
2. 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%.
3. Impurities like boron, aluminum, gallium or indium are added to intrinsic semiconductor to form
   A. N-type doped semiconductor
   B. P-type doped semiconductor
   C. A junction diode
   D. All of these
4. For silicon, the energy gap at 300 K is
   A. 1.1 W
   B. 1.1 J s
   C. 1.1 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. Show that the reciprocal of the reciprocal lattice is a direct lattice?
7. Explain Widemann-Franz-Lorentz law?
8. Explain the term ‘donors’ ?
9. Explain the term ‘traps’ in the case of semiconductors?

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11. Explain the Diffusion current in the case of semiconductors
12. What is Curie-Weiss law in ferro electricity?
13. Discuss the domain theory in the case of ferroelectrics?
14. How are cooper pairs formed?
15. What are Fullerenes?

(2 x 7 = 14)

Section C
Answer any 4 (5 marks each)

16. A beam of X-rays incident on a sodium chloride crystal (lattice spacing 0.282 nm), the first order Bragg reflection is observed at a glancing angle of 8°35'. What is the wavelength of X-rays? At what angles would be the third order Bragg's reflections occur?
17. A uniform silver wire has a resistivity of 1.54×10^{-8} ohm.meter 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.
18. Find the resistance of an intrinsic germanium rod which is 1 cm long, 1 mm wide and 1 mm thick at 300 K. The intrinsic carrier density at 300 K is $2.5 \times 10^{19}/m^3$ and the mobilities of electron and hole are 0.39 and $0.19\ m^2V^{-1}s^{-1}$, respectively.
19. The intrinsic carrier density at 300 K in silicon is $3.5 \times 10^{16}/m^3$. If the electron and hole mobilities are 0.13 and $0.05\ m^2V^{-1}s^{-1}$, respectively. Calculate the conductivity of (a) intrinsic silicon and (b) silicon containing 1 donor impurity atom per 10^9 silicon atoms.
20. Calculate the intrinsic concentration of charge carriers at 300 K. Given that $m_e^* = 0.12m_0, m_h^* = 0.28m_0$ and the energy gap of germanium at 300 K is 0.67 eV.
21. A magnetizing field 100 A/m produces a flux density $4\pi \times 10^{-3}$ T in a bar of material Calculate the relative permeability and susceptibility of the material ?

(5 x 4 = 20)

Section D
Answer any 3 (12 marks each)

22. A particle is moving a one dimensional potential, given by $V(x) = 0$ for $x < 0$ and $v(x) = V(0)$, for $x >= 0$. Write down the Schrodinger wave equation for the particle and solve it.

OR

23. 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?

24. Define geometrical structure factor. Obtain the structure factors for fcc, bcc and scc structure and explain it in context of missing of reflection planes in crystals.

OR

25. Discuss how the specific heat of solid was explained in 'classical model'. What are its limitations? Explain how Einstein explain the specific heat capacity using quantum mechanics. Also give the draw backs of Einstein's model.

26. Explain the vibrations of crystals with monatomic basis. Obtain the dispersion relation and discuss first brillouin zone, long wavelength limit and phase and group velocities.

OR

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

(12 x 3 = 36)

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