

M. Sc. DEGREE END SEMESTER EXAMINATION - JULY 2021**SEMESTER 2 : PHYSICS****COURSE : 16P2PHYT07 : CONDENSED MATTER PHYSICS***(For Regular - 2020 Admission and Supplementary - 2019/2018/2017/2016 Admissions)*

Time : Three Hours

Max. Marks: 75

PART A**Answer All (1 mark each)**

- Which of the following is hcp crystal structure?
a) NaCl b) CsCl c) Zn d) RbCl.
- Which type of silicates involve sharing of two oxygen atoms between silicon atoms? I. single chain silicate II. ring silicate III. sheet silicate IV. double chain silicate
a) I, III b) I, II c) II, IV d) III, IV.
- In a N-type semiconductor, the position of Fermi-level
a) Is lower than the center of energy gap b) Is at the center of energy gap
c) Is higher than the center of energy gap d) Can be any where
- In a metal
a) The electrical conduction is by electrons and holes
b) The conductivity decreases with the rise in temperature
c) The conduction band is empty
d) None of the above
- Which of the following is the ferroelectric material ?
a) Rochelle salt. b) Potassium dihydrogen phosphate.
c) Barium titanate. d) All of the above.

(1 x 5 = 5)**PART B****Answer any 7 (2 marks each)**

- Obtain the reciprocal lattice to a sc lattice.
- Write a note on electrical resistivity of metals?
- State Bloch theorem?
- With the help of suitable diagram, explain the concept of reciprocal lattice.
- Briefly explain the minority carrier life time
- What is umklapp scattering process of a phonon?
- Give dispersion relation for one dimensional monoatomic lattice
- What is Curie-Weiss law in ferro electricity?
- Discuss the domain theory in the case of ferromagnets?
- What are Fullerenes?

(2 x 7 = 14)**PART C****Answer any 4 (5 marks each)**

- Show that volume of the unit cell of the reciprocal lattice is inversely proportional to that of the corresponding direct lattice.
- Calculate the energy of an electron in the energy state immediately above the lowest energy level in a cubic box of side 1 \AA .
- 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 $0.05 \text{ m}^2 V^{-1} s^{-1}$, respectively. Calculate the conductivity of (a) intrinsic silicon and (b) silicon containing 1 donor impurity atom per 10^9 silicon atoms.

19. 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.
20. The penetration depth of mercury at 3.5 K is about 750 \AA . Estimate the penetration depth at 0 K.
21. A magnetizing field of 1200 A/m produces a magnetic flux of 10 web in a bar of iron of cross section of 0.2 m^2 . Calculate the permeability and susceptibility of the material? **(5 x 4 = 20)**

PART D

Answer any 3 (12 marks each)

- 22.1. Obtain expression for wave function and energy eigen values for electrons confined to a line of length L. Derive expression for Fermi energy and density of states
OR
 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.
2. 23.1. Derive an expression for the specific heat of a solid on the Einstein's model and show that at low temperatures it drops exponentially with decreasing temperature.
OR
 Write a note on quantization of lattice vibrations. Discuss the energy and momentum conservation law for neutron inelastically scattered by phonons.
2. 24.1. Discuss in detail about the BCS theory of superconductivity.
OR
 2. Briefly explain (i) Domain theory of ferromagnetism (ii) Explain magnetic hysteresis in the case of ferromagnets?

(12 x 3 = 36)