

Time : 2 Hours

Marks : 60



1. Question number 1 is compulsory
2. Attempt any three from remaining
3. Use suitable data wherever required
4. Figures to right indicate full marks.

Q.1) Solve any five from following

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1. Draw the following with reference to a cubic unit cell:  $(1\bar{0}\bar{2})$ ,  $[211]$ ,  $[1\bar{1}1]$
2. Define space lattice Basis & coordination number
3. Define Fermi energy level. Explain Fermi Dirac distribution function.
4. Write Sabine's formula explaining each term. Explain how this formula can be used for the determination of absorption coefficient of a given material.
5. Calculate the electronic polarizability of Ar. Given number of Ar atoms at NTP =  $2.7 \times 10^{25}/\text{m}^3$  and dielectric constant of Ar = 1.0024.
6. Explain the statement "crystal act as three dimensional grating with x-rays".
7. In a magnetic material the field strength is found to be  $10^6$  A/m. If the magnetic susceptibility of the material is  $0.5 \times 10^{-5}$ . Calculate intensity of magnetization and flux density in the material.

Q.2) (a) With a neat labelled diagram explain the principle, construction and working of a piezoelectric oscillator.

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(b) Molecular weight of silver bromide is 187.77. Its density is  $6.473 \text{ gm/cm}^3$ . It has NaCl type structure. Calculate the distance between adjacent atoms.

Avogadro's No. =  $6.023 \times 10^{23}/\text{gm. mole}$ .

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Q.3) (a). Draw the unit cell of HCP. Derive the number of atoms/unit cell, the c/a ratio and the packing fraction.

Estimate the number of Frenkel defects per  $\text{mm}^3$  in AgCl if energy of formation of Frenkel defects is 1.5 eV at  $700^\circ\text{K}$ . The molecular weight of AgCl is 0.143 kg/mol and specific density is 5.56.

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(b) Explain Hall effect & its significance. With a neat diagram derive the expression for the Hall voltage & Hall coefficient.

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Q.4) (a) For an intrinsic semiconductor show that the Fermi level lies in the centre of the forbidden energy gap 5

(b) Two ships are anchored at certain distance between them. An ultrasonic signal of 50 KHz is sent from one ship to another via 2 routes. First through water and second through atmosphere. The difference between the time intervals for receiving the signals at the other ship is 2 seconds. If the velocity of sound in atmosphere and seawater are 348 m/s and 1392 m/s respectively, find the distance between the Ships. Also find the time taken by the signal to travel through water. 5

(C) Explain the determination of the crystal structure using Braggs spectrometer. 5

Q. 5) (a) Explain in brief the different phases of liquid crystals. 5

(b) Two parallel plate capacitors having equal and opposite charges are separated by a dielectric slab of thickness 2 cm. If the electric field inside is  $10^6$  V and dielectric constant is 3, calculate the polarization and displacement density. 5

(c) Calculate the critical radius ratio of an ionic crystal for ligancy 6. 5

Q.6) (a). The volume of a room is  $600 \text{ m}^3$ , the wall area, floor area and ceiling area respectively are  $220 \text{ m}^2$ ,  $120 \text{ m}^2$  and  $120 \text{ m}^2$ . The average sound absorption coefficient for the walls, floor and ceiling are 0.03, 0.06 and 0.8 respectively. Find the average sound absorption coefficient and the reverberation time. 5

(b) Explain principle construction & working of a LED. 5

(c) Prove that in a ferromagnetic material, power loss per unit volume in a hysteresis cycle is equal to the area under hysteresis loop. 5