

Con. 9049-12.

(REVISED COURSE)

KR-3447

(2 Hours)

[Total Marks : 60

N.B. : (1) Question No. 1 is compulsory.

(2) Attempt any **three** questions from remaining questions No. 2 to 6.(3) Assume **suitable** data wherever **required**.(4) **Figures to the right** indicate marks.

1. Attempt any **five** :- 15
- Explain the term lattice parameters of Cubic crystal.
  - What is the probability of an electron being thermally excited to conduction band in silicon at 20°C. The band gap energy is 1.12eV; Boltzmann constant is  $1.38 \times 10^{-23}$  J/k.
  - Mobility of holes is 0.025 m<sup>2</sup>/V-sec. What would be the resistivity of P-type silicon if the Hall coefficient of the sample is  $2.25 \times 10^{-5}$  m<sup>3</sup>/C ?
  - Define dielectrics, electric dipole and polarizability.
  - Differentiate between soft and hard magnetic materials.
  - Define 'Reverberation time'. Write Sabine's formula and explain the terms in it.
  - State the terms : magnetostriction effect; piezo-electric effect.
2. (a) Explain the formation of energy bands in solids. With neat energy band diagrams explain extrinsic semiconductors. 8
- (b) Draw the unit cell of HCP. What is its co-ordination number, atomic radius, and effective number of atoms per unit cell. Also calculate its packing factor. 7
3. (a) What is hysteresis ? Draw a hysteresis loop for ferromagnetic material and explain the various important points on it. What is the technical significance of the area enclosed under it. For a transformer which kind of material will you prefer the one with small hysteresis area or the big one ? 8
- (b) Derive Bragg's law. Calculate the glancing angle on the plane (100) for a crystal of rock salt ( $a = 2.125 \text{ \AA}$ ). Consider the case of 2<sup>nd</sup> order maximum and  $\lambda = 0.592 \text{ \AA}$ . 7
4. (a) Calculate the number of atoms per unit cell of a metal having lattice parameter  $2.9 \text{ \AA}$  and density  $7.87 \text{ gm/cm}^3$ . Atomic weight of metal is 55.85, Avogadro number is  $6.023 \times 10^{23}$ /gm-mole. 5
- (b) Prove that the Fermi level lies exactly at the centre of the forbidden energy gap in case of an intrinsic semiconductor. 5
- (c) Explain ionic polarization and obtain polarizability ( $\alpha_i$ ). 5

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5. (a) With neat diagram of a unit cell, explain the structure of  $\text{BaTiO}_3$ . 5  
(b) What is Hall effect ? Derive expression for Hall voltage. 5  
(c) Explain the absorption coefficient of a hall. Calculate the change in intensity level when the intensity of sound increases 1000 times its original intensity. 5
6. (a) In what sense real crystals differ from ideal crystals ? Explain the point defects in crystals. 5  
(b) Explain construction and working of a solar cell. 5  
(c) Find the natural frequency of vibration of quartz plate of thickness 2mm. Given Young's modulus of quartz  $Y = 8 \times 10^{10} \text{ N/m}^2$ , density of quartz is  $2650 \text{ kg/m}^3$ . Calculate the change in thickness required if the same plate is used to produce ultrasonic waves of frequency 3MHz. 5