

(2 Hours)

[Total Marks: 60]



1. Q. No.1 is compulsory.
2. Attempt any three from Q.No.2 to Q.No.6.
3. Assume suitable data wherever required.
4. Figures to the right indicate maximum marks.

- Q1. Answer any five from the following questions. (3 marks each) [15]
- a. Draw the following for a cubic unit cell.  $\bar{1}\bar{2}\bar{3}$ ,  $(2\ 0\ 0)$ ,  $(\bar{2}\ \bar{3}\ 0)$
  - b. Show that the Fermi energy level lies at the centre of the band gap in intrinsic semiconductors.
  - c. The mobility of hole is  $0.025\text{m}^2/\text{V.s}$ . What would be the resistivity of p-type Si sample if its Hall coefficient is  $2.25 \times 10^{-5}\text{ m}^3/\text{C}$ ?
  - d. Explain de Broglie's hypothesis of matter waves and deduce the expression for  $\lambda$ .
  - e. Explain reverberation of sound.
  - f. Explain Meissner Effect with the help of diagram.
  - g. Discuss any three applications of Ultrasonic waves.
- Q2. a. Derive Bragg's equation for X-ray diffraction in crystals. Calculate the glancing angle on a plane  $(1\ 0\ 0)$  of rock salt having lattice constant  $2.814\text{\AA}$  corresponding to first order Bragg's diffraction maximum for X-rays of wavelength  $1.541\text{\AA}$ . [8]
- b. What is Hall Effect? Derive an expression for Hall voltage. How can mobility be determined by using Hall Effect? [7]
- Q3. a. Derive the relation between density and lattice constant for a cubic crystal. Calculate the lattice constant, atomic radius and packing factor for Chromium having BCC structure. Given density of Chromium is  $5.98\text{ gm/cc}$  and atomic weight is 50. [8]
- b. Explain the formation of P-N junction in equilibrium with energy band diagram and explain its conduction process in forward bias. [7]
- Q4. a. Differentiate between Type-I & Type-II Superconductors. [5]
- b. Discuss in details any three factors affecting acoustics of a hall with their remedies [5]
- c. Calculate the de Broglie wavelength of alpha particles accelerating through a potential difference of 150 volts. Given mass of Alpha particle is  $6.68 \times 10^{-27}\text{ Kg}$ . [5]
- Q5. a. Find the accuracy in the position of an electron moving with speed  $350\text{ m/sec}$  with uncertainty of 0.01%. [5]
- b. A quartz crystal of thickness  $1\text{mm}$  is vibrating at resonance. Calculate its fundamental frequency. (Assume that for quartz,  $Y=7.9 \times 10^{10}\text{N/m}^2$  and  $\rho=2.650\text{gm/cc}$ ). [5]
- c. Calculate electron & hole concentration in intrinsic Si at room temperature if its electrical conductivity is  $4 \times 10^{-4}\text{ mho/m}$ . Given that mobility of electron =  $0.14\text{m}^2/\text{V-sec}$  and mobility of holes= $0.04\text{ m}^2/\text{V-sec}$ . [5]
- Q6. Write short notes on the following (any three) [15]
- a. Davisson- Germer Experiment
  - b. Maglev
  - c. Bragg's spectrometer
  - d. Crystal defects