

(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 λ .
 - 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 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 m/sec with uncertainty of 0.01% . [5]
- b. A quartz crystal of thickness 1 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