(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 0.025m^2/V.s. What would be the resistivity of p-type Si sample if its Hall coefficient is 2.25x10^{-5} m^3/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 2.814A˚ corresponding to first order Bragg's diffraction maximum for X-rays of wavelength 1.541A˚. **[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 6.68x10^{-27} 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 1mm is vibrating at resonance. Calculate its fundamental frequency. (Assume that for quartz, Y=7.9x10^{10}N/m^2 and ρ=2.650gm/cc.). **[5]**

c. Calculate electron & hole concentration in intrinsic Si at room temperature if its electrical conductivity is 4x10^{-4} mho/m. Given that mobility of electron = 0.14m^2/V-sec and mobility of holes=0.04 m^2/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
