

Time: 2 hours

Marks: 60

- N. B. 1) Question no 1 is **compulsory**
 2) Attempt any **three** questions from Q.2 to Q.6
 3) Assume suitable data wherever required
 4) Figures on the **right** indicates **marks**

- 1 Attempt **any five** 15
- a 'Crystal act as three dimensional grating for X-rays', explain.
- b Calculate the frequency and wavelength of photon whose energy is 75eV.
- c Draw the energy band diagram of p-n junction diode in forward and reverse bias condition.
- d "Superconductor is a perfect diamagnetic", Explain.
- e What is reverberation time? How is it important? Write the factors affecting reverberation time.
- f A quartz crystal of thickness 1.5mm is vibrating with resonance. Calculate it's fundamental frequency if the Young's modulus of quartz crystal is $7.9 \times 10^{10} \text{N/m}^2$ and density is 2650kg/m^3 .
- g Mobility's of electron and hole in a sample of Ge at room temperature are $0.36 \text{ m}^2/\text{V-sec}$ and $0.17 \text{ m}^2/\text{V-sec}$ respectively. If electron and hole densities are equal and it is $2.5 \times 10^{13}/\text{cm}^3$, calculate its conductivity.
- 2 a With Heisenberg's uncertainty principle prove that electron cannot survive in nucleus. An electron has a speed of 300m/sec. with uncertainty of 0.01%. Find the accuracy in its position. 4
- b Show that Fermi energy level in intrinsic semiconductor is at the Centre of forbidden energy gap. 4
- What is the probability of an electron being thermally excited to the conduction band in Si at 30°C . The band gap energy is 1.12eV. 7
- 3 a With neat diagram of unit cell, explain the structure of HCP crystal and calculate the no. of ions per unit cell, coordination no. , lattice constant and packing factor of the structure. 8
- b State the Hall effect. Derive the expression for Hall voltage and Hall coefficient with neat diagram. 7

- 4 a What is working principle of Maglev? Explain how it can acquire high speed? 5
b A hall of dimensions $25 \times 18 \times 12 \text{m}^3$ has an average absorption coefficient 0.2. Find the reverberation time. If a curtain cloth of area 150m^2 is suspended at the Centre of hall with coefficient of absorption 0.75, What will be the reverberation time? 5
c State the piezoelectric effect. With neat circuit diagram explain the principle and working of piezoectric oscillator. 5
- 5 a With energy band diagram, explain the variation of Fermi energy level with temperature in extrinsic semiconductor. 5
b Explain with example how to determine crystal structure by Bragg's X-ray spectrometer. 5
c Obtain one dimensional time dependent Schrodinger equation. 5
- 6 a Define ligancy and critical radius ratio. Calculate critical radius ratio for ligancy 6. 5
b What is the significance of wave function? Derive the expression for energy Eigen values for free particle in one dimensional potential well. 5
c What is photovoltaic effect? Explain the principle and working of Solar cell. 5
