

**Q. P. Code: 26572**

**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  $2650 \text{kg/m}^3$ .
  - 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

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- 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  $150 \text{ m}^2$  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 piezoelectric 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

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