

- N.B. :** (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions from the remaining questions.  
 (3) Assume suitable data and symbols if required.  
 (4) Figures to the right indicate the full marks.

- Q.1** Answer any five questions:
- Draw the following planes (121), (100), (111) (3)
  - State any three applications of superconductivity (3)
  - How Lissajous figures are used to determine phase difference? (3)
  - What are ultrasonic waves? State magnetostriction effect. (3)
  - State Sabine's formula. (3)
  - Calculate atomic packing factor for FCC crystal structure? (3)
  - Show the position of Fermi level in intrinsic semiconductor, p-type semiconductor and n-type semiconductor. (3)
- Q.2**
- Explain Diamond crystal structure with proper diagram. Calculate the number of atoms per unit cell, atomic radius and atomic packing factor for diamond unit cell. (8)
  - What is cavitation effect? Find the natural frequency of vibration of quartz plate of thickness 2 mm. Given: Young's modulus for quartz is  $8 \times 10^{10}$  N/m<sup>2</sup> and density 2650 Kg/m<sup>3</sup>. Calculate the change in thickness required if the same plate is to be used to produce ultrasonic waves of 3 MHz. (7)
- Q.3**
- Explain reverberation and reverberation time. Explain various methods for design of good acoustics. (8)
  - What are lattice parameters? Aluminium has density 2.7 gm/cm<sup>3</sup>. It has atomic weight 27 and lattice parameter is 4.05 Å. Determine the type of crystal structure followed by Aluminium and calculate the atomic radius. Given Avogadro's number  $N_A = 6.023 \times 10^{23}$  /gm mole. (7)
- Q.4**
- What is superconductivity and critical temperature? Describe type I and type-II superconductor. (8)
  - Define mobility of charge carrier. Find resistivity of germanium at 300 °K. Given density of carriers is  $2.5 \times 10^{19}$  /m<sup>2</sup>. Mobility of electron is 0.39 m<sup>2</sup>/V-Sec and mobility of hole is 0.19 m<sup>2</sup>/V-Sec. Charge of electron is  $1.6 \times 10^{19}$  C. (7)

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- Q.5 a) State Hall effect and what is the significance of hall effect? n-type Ge sample has donor concentration  $10^{21}$  atoms /m<sup>3</sup>. What hall voltage would you expect if current  $1 \times 10^{-3}$  A and if 0.5 T magnetic field is applied across 2 mm thick sample. (8)
- b) What is piezoelectric effect? Explain with neat labeled diagram the construction and working of Piezoelectric oscillator. (7)
- Q.6 a) State and explain terms in Bragg's law of X-ray diffraction. Calculate the glancing angle on cube (100) of rock salt having lattice constant  $2.814 \text{ \AA}$  corresponding to first order diffraction maximum for X-rays of wavelength  $1.541 \text{ \AA}$ . (8)
- b) Explain construction and working of CRO. (7)
- Q.7 Solve/explain any three:
- a) A class room has dimension  $20 \times 15 \times 10 \text{ m}^3$ , the reverberation time is 3 sec. Calculate total absorption of its surfaces and average absorption coefficient. (5)
- b) Liquid crystal and different phases of liquid crystal (5)
- c) Point defects in crystal (5)
- d) Meissner effect (5)

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