

- N.B. :** (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions from Q. Nos. 2 to 7.  
 (3) Use suitable data wherever required.  
 (4) Figures to the right indicate full marks.  
 (5) Illustrate your answer with sketches wherever necessary.

1. (a) Draw the following for a Simple Cubic Structure :- 3  
 $[2\bar{1}2]$   $[021]$   $(00\bar{2})$
- (b) Find the shortest wavelength of X-ray produced by an X-ray tube operated at 16 kV of potential. 3
- (c) Explain the term "Diamagnetism is the test for Super Conductivity". 3
- (d) Calculate the increase in the acoustic intensity level when the sound intensity is reduced to the half of original intensity. 3
- (e) In phase measurement by Lissajous Pattern ellipse is obtained with major axis of 2 cm and minor axis of 0.8 cm estimate the phase angle. 3
2. (a) Determine the co-ordination number and packing density for a 'Hexagonally Closed Packed' structure. Show that a HCP structure demands an axial ratio of  $\sqrt{8/3}$ . 8
- (b) What is 'Echo-Sounding' ? 7  
 Velocity of Ultrasonics in mild-steel is  $5.9 \times 10^3$  m/s. The velocity of ultrasonic waves in brass measured by an ultrasonic gauge meter calibrated for mild steel is  $4.3 \times 10^3$  m/sec. If thickness of a brass plate measured by the ultrasonic gauge meter is 15 cm what is real thickness ?
3. (a) A sample of semiconductor is placed in uniform magnetic induction 'B' with sample current 'i' and thickness 't' then obtain the expression for (a) Hall voltage (b) Hall coefficient and state. How to identify the type of semiconductor material. 8
- (b) 10 KeV electrons are passed through a thin film of a metal for which atomic spacing is  $5.5 \times 10^{-11}$  m. What is the angle of deviation of the first order diffraction minimum. 7
4. (a) Explain the concept of superconductivity. Explain following terms associated with superconductivity :- 8  
 (i) Critical Temperature  
 (ii) Critical Field  
 (iii) Type-I Super Conductor.
- (b) What is Frankel defect ? How it is developed in a crystal ? Estimate the ratio of vacancies at (i)  $-119^\circ\text{C}$  (ii)  $80^\circ\text{C}$ . Where average energy to create vacancy is 1.8 e.V. 7
5. (a) What is magnetostriction effect ? Draw the diagram of magnetostriction oscillator and explain its working as a 'Ultrasound' generator. 7
- (b) Explain the concept of 'holes' as a majority carriers in P-type. Semiconductors. Explain concept of mobility. Calculate the mobility of electrons in Cu where resistivity of Cu is  $1.72 \times 10^{-8}$  ohm-m and number of electrons per unit volume is  $10.41 \times 10^{28}$  per cubic meter. 8
6. (a) How homogeneous beam of identical charge particles can be prevented from divergence ? Hence deduce the formula of Snell's law for electron optics. 8
- (b) A class room has dimensions  $20 \times 15 \times 5 \text{ m}^3$ . The reverbation time is 3.5 secs. Calculate the total absorption of it's surfaces and average absorption coefficient. 7

7. (a) Explain following terms :-
- (i) Phases of liquid crystal 3
  - (ii) Reverbation time 2
  - (iii) Characteristic X-ray spectrum. 3
- (b) A CRT has anode voltage of 1.6 kV and parallel deflection plates are 1.8 cm long and 4.2 mm apart. The screen is at 2.8 cm from the centre of deflecting plates. Find the input voltage required to deflect the beam by 1.5 cm. The input voltage is applied to the deflection plates through the amplifiers having overall gain of 60. 7