

**(Revised Course)**

(2 Hours)

**[ Total Marks : 60**

- N.B. :** (1) Question No.1 is **compulsary**.  
 (2) **Attempt** any **three** questions from Question No. 2 to 6.  
 (2) Use **suited** data wherever **required**.  
 (3) **Figures** to the right indicate **full** marks.

1. Solve any **five** from the following :- **15**
- (a) Define the term space lattice, unit cell and lattice parameter.
  - (b) Find the interplaner spacing between the family of planes (111) in a crystal of lattice constant  $3\text{Å}$ .
  - (c) Represent the following in the cubic unit cell :-  
 $(1\bar{1}2)$ ,  $(002)$ ,  $[121]$
  - (d) Define drift current, diffusion current and mobility of charge carriers.
  - (e) Explain the use of P-N junction as a solar cell.
  - (f) State with neat diagram direct and inverse Piezoelectric effect.
  - (g) What is magnetic circuit ? Explain Ohm's Law in case of magnetic circuit.
2. (a) Explain the Hall effect in metal ? Derive the formulae to determine the density and mobility of the electrons. **8**
- (b) Define ligancy and critical radius ratio in case of ionic solid. Write the conditions for stability of ionic crystal in 3-D ? Determine critical radius ratio for ligancy 6. **7**
3. (a) Explain with neat diagram construction of Bragg's X-ray spectrometer ? Write the procedure to determine crystal structure. Calculate the maximum order of diffraction if X-rays of wavelength  $0.819\text{Å}$  is incident on a crystal of lattice spacing  $0.282\text{ nm}$ . **8**
- (b) Calculate the number of turns required to produce a magnetic flux of  $4 \times 10^5\text{ wb}$ , if an iron rod of length  $50\text{ cm}$  and cross sectional area  $4\text{ cm}^2$  carrying an electric current  $1\text{ A}$  is in the form of ring. (*Permeability of iron is  $65 \times 10^{-4}\text{ H/m}$* ). **7**
4. (a) What is mesomorphic state of matter ? Explain with neat diagram cholesteric phase. **5**
- (b) What is dielectric polarization and dielectric susceptibility ? Find the relation between them ? **5**

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- (c) The resistivity of intrinsic InSb at room temperature is  $2 \times 10^{-4} \Omega \text{ cm}$ . If the mobility of electron is  $6 \text{ m}^2/\text{V-sec}$  and mobility of hole is  $0.2 \text{ m}^2/\text{V-sec}$ . Calculate its intrinsic carrier density. **5**
5. (a) Identify the crystal structure if its density is  $9.6 \times 10^2 \text{ kg/m}^3$ , lattice constant is  $4.3 \text{ \AA}$  and atomic weight is 23. **5**
- (b) Explain the formation of depletion region in P-N junction. **5**
- (c) Define reverberation time? State Sabine's formula and explain the terms involved in it? **5**
6. (a) What are soft and Hard magnetic material? State their properties and applications. **5**
- (b) What is Fermi level in semiconductor? Show that in intrinsic semiconductor Fermi level always at the middle between the forbidden energy gap? **5**
- (c) An Ultrasonic sound wave is used to detect the position of defect in a steel bar of thickness 50 cm. If the echo times are 40 and 90  $\mu\text{-sec}$ . Locate the position of defect. **5**
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