

M.Sc.(Physics) (CBCS Pattern) Semester - IV  
**PSCPHYT14 - Paper-XIV (Core-XII) : Solid State Physics**

P. Pages : 2

Time : Three Hours



**GUG/S/23/11413**

Max. Marks : 80

**Either:**

1. a) State and prove Bloch theorem. Discuss its importance in the band theory. 8
- b) Using Kronig-Penny model, show that  $P \ll 1$ , the energy of lowest energy band is 8  
 $E = \hbar^2 p^2 / ma^2$

**OR**

- e) Obtain an expression for paramagnetic susceptibility of electron on the basis of Langevin's classical theory and show how Pauli modified it. 8
- f) Give an account for the quantum theory of paramagnetism and discuss the low and high temperature cases. 8

**Either:**

2. a) Explain Dulong Petit law. 8
- b) What is Brillouin zone, explain. 8

**OR**

- e) Write on magnetism of Iron group and rare earth ions. 8
- f) Explain Weiss theory of Ferromagnetism. 8

**Either:**

3. a) Write on Mossbauer effect and its application. 8
- b) Explain resonance phenomenon in electron spins in solids. 8

**OR**

- e) What is an extrinsic semiconductor? Discuss the variation of the fermi level with temperature for an n-type semiconductor? 8
- f) What is Hall effect? State the importance of Hall effect? Derive the expression for hall coefficient and mobility of charge carrier. 8

**Either:**

4. a) Discuss BCS theory of superconductor. 8
- b) What is Meissner effect? Obtain expression for the London penetration depth of Magnetic field for superconductor. 8

**OR**

- e) What is Isotope effect? Describe superconducting coherence length? **8**
- f) Discuss DC and AC Josephson effect. **8**

**5.** Answer of **all** the following.

- a) Derive an expression for the effective mass of the electron in a crystal and explain the physical basis of it. **4**
- b) The Debye temperature for diamond is 2230K. Calculate the highest possible vibrational frequency and the molar heat capacity of diamond at 10K. **4**
- c) The intrinsic carrier density at room temperature in germanium is  $2.37 \times 10^{19} / \text{m}^3$ . If the electron and hole mobilities are 0.38 and  $0.18 \text{m}^2 \text{v}^{-1} \text{s}^{-1}$ , respectively, Calculate the resistivity of the intrinsic germanium. **4**
- d) State any four applications of superconductivity. **4**

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