Condensed Matter Physcis - I
Semester - VI

Time Allowed : Three Hours **Maximum Marks : 40**

Note :- The candidates are required to attempt two questions each from Section A and B carrying 8 marks each, and the entire Section C consisting of 8 short answer type questions carrying 1 marks each.

Section - A

1. What are assumptions made in Debye Theory ? Discuss Debye's model of specific heat of solids. What are its success and failure ? 8
2. What do you mean by lattice vibrations ? Discuss inelastic scattering of photon by phonon. 8

3. Derive dispersion relationship for a one dimensional diatomic crystal and discuss the nature of acoustic and optical modes. Show that the group velocity vanishes at the zone boundary. Give the physical significance of the result. 8

4. Derive an expression for the Fermi energy of a free electron gas in three dimensions. 8

Section-B

5. Discuss Kroneg Penny model for the energy band structure of solids and show it explain the forbidden bands 8

6. (a) What do you mean by Fermi Level ? Discuss the variation of the Fermi level with temperature for an n-type semiconductor. 5

   (b) For a semiconductor of band gap 1.5 eV, calculate the wavelength of radiation emitted when an electron jumps from conduction band to valence band. 3

7. Discuss BCS theory of semiconductor and describe on experimental evidence for the existence of band gap. 8

8. Explain the difference between type I and type II superconductors using Meissner effect. Prove that the Meissner effect and disappearance of resistivity in superconductors are mutually consistent. 8

Section-C

9. Attempt all parts in short :

   (i) What is superconductivity ?

   (ii) Lead in a superconducting state has critical temperature of 6.0K at zero magnetic field and critical field $H_c(0) = 0.064\ mAm^{-1}$ at 0K.

   (iii) Fermi gas

   (iv) Effective mass of electron

   (v) Block theorem

   (vi) Give two limitations of free electron gas.

   (vii) What is Einstein temperature ?

   (viii) Difference between elastic vibrations and e.m. waves. $8 \times 1 = 8$