CONDENSED MATTER PHYSICS

Paper-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. Discuss a diatomic linear lattice. Obtain the dispersion relation and give difference between the Optical and Acoustic branches.   8

2. Explain the Einstein model of specific heat of solids.   8

3. Derive expression for Fermi energy and density of state for a free electron gas in one dimension.   8

4. (a) The atomic radius of sodium is 1.8 Å. Calculate Fermi energy of sodium at 0 K. Unit cell of sodium is B.C.C.   5

    (b) What is difference between Phonon and Photon ? Discuss momentum of Phonon. 3

SECTION-B

5. Discuss the formation of allowed and forbidden energy bands on the basis of Kroning-Penny model. What is effect of changing the binding energy of electron on the energy bands ?   8

6. What is an extrinsic semiconductors ? Discuss the variation of the Fermi level with temperature of an n-type semiconductor.   8

7. Discuss the BCS theory. How does it account for superconducting state ?   8

8. (a) Lead in superconducting state has critical temperature is 6.0 K at zero magnetic field and a critical field 0.060MA m^{-1} at 0 K. Determine the crtitical field at 3.0 K.
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(b)   Discuss conductivity of intrinsic semiconductor.   ·   4

SECTION–C

9.   Attempt all parts :

(i)   Give name of theories on based these theories the conductivity of conductor and insulator are explained.

(ii)   What is Meissner effect ?

(iii)   What is Dulong Petit's law ?

(iv)   Give the momentum of Photon.

(v)   Define the mobility of a Charge carrier.

(vi)   What is the Debye temperature ?

(vii)   What is Umclapp scattering process of a Photon ?

(viii)   How many atoms are present in 1 cm^3 of a solid approximately ? $8 \times 1 = 8$