K17P 1350

Reg. No. : ....

Name : ....

Third Semester M.Sc. Degree (Reg./Suppl./Imp.)
Examination, November 2017
PHYSICS
PHY 3C11 : Solid State Physics
(2014 Admn. Onwards)

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**) :

1. a) Obtain the dispersion relation for elastic waves in a linear monoatomic chain with nearest neighbour interactions. Show that group velocity vanishes at zone boundaries.

   OR

   b) Describe Kronig-Penny model for the motion of an electron in a periodic potential.

2. a) Obtain an expression for intrinsic carrier concentration in an intrinsic semiconductor. Under what conditions will the Fermi level be in the middle of forbidden gap ?

   OR

   b) With suitable examples explain paramagnetic and ferromagnetic materials. Discuss quantum theory of paramagnetism.　　　　　(2×12=24)

SECTION – B

Answer **any four** (1 mark for Part (**a**), 3 marks for Part (**b**) and 5 marks for Part (**c**)) :

3. a) What are quasi crystals ?

   b) Derive Bragg's law in X-ray diffraction.

c) The wavelength of K_{α} line of Ag is 0.0563 nm. The radiation from Ag target is analysed using Bragg spectrometer using a calcite crystal (a simple cube of lattice constant 0.3029 nm). Determine the angle of reflection for the first order. What is the highest order for which this line may be observed ?

4. a) What is Fermi energy ?

   b) Explain the concept of effective mass.

   c) The energy E (k) of electrons of wave vector k in a solid is given by, $E(k) = Ak^2 + Bk^4$, where A and B are constants. Find the effective mass of electrons at $|k| = k_0$.

5. a) What is Hall effect ?

   b) Account for thermal conductivity in metals and hence derive an expression for Lorentz number.

   c) Find an expression for the minimum conductivity of a semiconducting sample.

6. a) Define superconductivity.

   b) What is Meissner effect ?

   c) The London penetration depths for Pb at 3 K and 7.1 K are 39.6 and 173 nm respectively. Calculate its transition temperature as well as the depth at 0 K.

7. a) What are ferroelectric crystals ?

   b) Write a note on atomic theory of magnetism.

   c) Given that Curie temperature of a ferromagnet is 727°C, what is the order of magnitude of exchange integral ? Form this value, estimate the internal field. (Given, $\mu_B = 9.3 \times 10^{-21}$ erg/Gauss).

8. a) What are Cooper pairs ?

   b) Calculate the critical current density for 1 mm diameter wire of lead at 7 K. A parabolic dependence of H_c upon T may be assumed. Given T_c for lead is 7.18 K and H_o for lead is 6.5×10^4 A/m.

   c) Explain BCS theory of superconductivity. (4×9=36)