বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2021
(Under CBCS Pattern)
Semester - V
Subject: PHYSICS
Paper: C12T & C12P
(Solid State Physics)

Full Marks : 60
Time : 3 Hours

Candiates are required to give their answer in their own words as far as practicable.
The figures in the margin indicate full marks.

Group - A

THEORY (Marks : 40)

Answer any ***two*** from the following questions : 2×20

1. Answer any ***five*** : 5×4=20

   (a) Calculate the wavelength of an X-ray beam incident at 120 for the first order reflection from calcite crystal if the grating constant of the crystal is 3.035 Å (sin120=0.2079)

   (b) What is the basic difference between a crystalline solid and amorphous solid.

(c) Calculate the effective number of lattice points in a bcc lattice.

(d) Show that the reciprocal lattice of a bcc lattice is fcc lattice.

(e) What do you mean by Miller indices ? A plane makes intercepts of 1Å on the crystallographic axis of an orthorhombic crystal with a : b : c = 3 : 2: 1. Determine the miller indices of this plane.

(f) Copper (fcc) has density of 8960 kg/m^3. Calculate the unit cell dimension and the radius of Cu atom, given the atomic mass of Cu as 63.54. amu.

2. (a) What do you mean by ‘‘effective mass’’ of an electron in a lattice ? Argue that the effective mass of the hole is opposite to that of an electron.

(b) The result of Kronig-Prenney model is given below —

$$P\frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka$$

Where $P = \frac{mV_0 ab}{\hbar}$ and $\alpha^2 = \frac{2mE}{\hbar^2}$, other symbols have their usual meaning. Plot the cruve of the left hand Side as P, function of αa and draw the Conclusions.

(c) Discuss the quantum theory of paramagnetism and obtain an expression for paramagnetic Susceptibility for normal field strength and ordinary temperature. Explain why the theoritical results do not agree with the modified expression for Susceptibility for th e ions of the iron group.

(d) Derive Curie-weiss law of feromagnetic Susceptibility. Compare the temperature dependence of magnetisation obtained from it with expreimental results. 4+3+5+8

3. (a) Write the difference between Type-I and Type-II superconductor. What do you mean by Meissner effect.

(b) What is coherence length ?

(c) What do you mean by critical temperature of a superconductor ?

(d) What is Hall effect ? Find Hall coefficient in a metal. Why is the Hall co-efficient positive in some metals ?

(e) Obtain Clausius-Mossotti equation relating macroscopic dielectric constant with microscopic polarizability. 5+2+3+5+5

4. (a) Derive the dispersion relation for a 1D chain of diatomic lattice. Write the difference between optical and acoustical branches.

(b) What is phonon ?

(c) Write Dulong and Petit's law. Explain its limitation.

(d) Explain the Einstien's theory of Lattice heat capacity. How is it different from the classical theory ?

(e) What is Debye temperature ? What is its significance ? (6+2)+2+3+5+2

Group - B

PRACTICAL (Marks : 20)

Write down the theory/working principle, circuit diagram/schematic diagram, procedure of data collection, expected naturem of curve and analysis for any one of the experiments given below :

Answer any ***one*** from the following questions : 1×20

1. Measure susceptinililty of paramagnetic solution (Quinck's Tube Method)
2. Measure the Magnetic susceptibility of Solids.
3. Determine the refractive index of a dielectric layer using SPR.
4. Draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
5. Measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and determine its band gap.

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