M.Sc. Semester—II (CBCS Scheme) Examination
PHYSICS
2-PHY-3 Solid State Physics

Time : Three Hours] [Maximum Marks : 80

[Credits : 04

EITHER

1. (a) Show that atomic packing fraction for fcc and hcp metals are same. 6

   (b) What are space groups in three dimensional lattice ? Explain the concept of glide plane and screw axis operation. 4

   (c) What are point groups in 2-dimension ? 6

OR

   (p) Explain the role of inversion symmetry in piezoelectric crystal with example. 4

   (q) What are point groups of orthorhombic system ? 6

   (r) Give the Hermann-Mauguin symbols for point groups with (a) a four-fold rotation axis (b) identity and an inversion axis (c) a four-fold axis and a mirror plane perpendicular to the rotation axis. 6

EITHER

2. (a) Show that in SC structure, diffraction peaks will be available for all possible combinations of (h,k,l). 4

   (b) Explain, why X-ray diffraction spectrum of b.c.c. lattice will not contain lines such as (100), (111) but lines such as (200), (110). 4

   (c) Describe powder photograph method in detail. Explain, why the diameter of a powder camera is 57.3 mm or its multiple ? 8

OR

   (p) State advantages of oscillating crystal method over rotating crystal method. 4

   (q) Derive relation for form factor and show that it can have maximum value equal to the atomic number. 4

   (r) Derive Laue's equations of diffraction of X-rays and obtain Bragg's diffraction condition from them. 8

EITHER

3. (a) Prove that, $2K^{*}G + G^{2} = 0$

   where K is the wave vector along incident X-ray;

   G is reciprocal lattice vector. 8

   (b) Explain how neutron diffraction can explore magnetic structure of the crystal. 8

OR

   (p) Explain graphical method to analyze powder diffraction pattern. 8

   (q) Discuss the preparation of Bernel chart. 8

EITHER

4. (a) Derive dispersion relation for mono-atomic lattice vibrations. 6

(b) Derive the relation for frequency associated with localized lattice vibrations. 6

(c) Explain the process to find Madelung constant for ionic crystal. 4

OR

(p) What are phonons ? 2

(q) Find out possible modes of vibration of linear chain of diatomic lattice 6

(r) Derive dispersion relation for one dimensional diatomic lattice. What is the significance of optical and acoustical branches of lattice vibrations ? 8

EITHER

5. (a) What is Einstein temperature ? State the basic drawbacks of Einstein model of specific heat. 5

(b) Derive an expression for lattice specific heat of solid by considering Einstein's model. 8

(c) Calculate Einstein temperature : given Einstein frequency as 900 GHz. $K_s = 1.38 \times 10^{-23}$ J/K and $h = 6.6 \times 10^{-34}$ Js. 3

OR

(p) Why does Dulong and Petit's law fail at low temperature ? Which discrepancy was removed by Einstein ? 5

(q) Explain assumptions and derive an expression for the lattice specific heat according to Debye model. 8

(r) If the frequencies of vibration of solid are all equal and its Debye temperature is 373° C, calculate molar specific heat of the solid at 773° C. 3