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Total No. of Pages : 02

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M.Sc.(Physics) (2015 to 2017) (Sem.–2)

SOLID STATE PHYSICS

Subject Code : MPH-203

Paper ID : [A2817]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTION TO CANDIDATES :

Attempt FIVE questions in all including the compulsory question No.-9.

Q1. a) Work out the coordination number and nearest neighbour distance for bcc and hcp structures. Describe the principal symmetry operations applicable to three-dimensional lattices. Show that the fivefold rotational axis is not permissible in case of lattices. (4+6+2=12)

b) Find the Miller indices of a plane that makes an intercept of 3Å, 4Å and 5Å on the coordinate axes of an orthorhombic crystal with a: b: c=l:2:5 (8)

Q2. a) What is Bragg's condition of diffraction? Obtain the vector form of Bragg's law using the concept of reciprocal lattice. (4+8=12)

b) Prove that reciprocal lattice of FCC is BCC lattice. (8)

Q3 a) What is meant by crystal imperfection? Classify them in the order of their geometry. Discuss with neat diagram tilt and twin boundaries defects in crystal. (3+3+6=12)

b) Obtain an expression for the equilibrium concentrations of vacancies at a given temperature in a metallic crystal. (8)

Q4 a) Explain the various mechanism by which the diffusion of atoms in solid take place. (12)

b) Show that the diffusion coefficient is temperature dependent. (8)

Q5 a) Briefly describe Drude's free electron theory of metals. Obtain an expression for the energy for the electron in a one-dimensional potential box and derive important conclusions from it. (3+9=12)

b) How free electron gas model help in explaining the lattice heat capacity of metals? (8)

Q6 a) What are density of states? Derive an expression for density of energy states and hence obtain Fermi energy of the metal. (2+10= 12)

b) Briefly cite the main difference between ionic, covalent and metallic bonding. (8)

Q7 a) Derive the vibrational modes of a diatomic linear chain of atoms. What is the difference between the two branches? Why are they named so? (8+2+2= 12)

b) How would the group and phase velocity vary in the first Brillouin zone? (8)

Q8 a) Derive an expression for specific heat of solids on the basis of Einstein's model. Discuss the successes and failures of this model. (8+4=12)

b) Show that in long wavelength limit, the velocity of sound is independent of the frequency. (8)

Q9 Answer briefly :

a) How many atoms are there in unit cell of diamond lattice?

b) What is Bravais lattice?

c) Explain edge dislocation.

d) What are colour centres?

e) Explain Kirkendal law.

f) What do you mean by long wavelength limit?

g) What are Brillouin zone?

h) What is the physical significance of wave function Ψ? (8×2.5=20)