U.G. 5th Semester Examination - 2020

PHYSICS

[HONOURS]

Course Code : PHY-H-CC-T-12

(Solid State Physics)

Full Marks : 40   Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **five** questions: 2×5=10

   a) What is Bravais Lattice?

   b) What do you understand by Meissner effect?

   c) What is Neel temperature?

   d) State Dulong and Petit's Law.

   e) What is Bragg's law?

   f) What is umclapp scattering process of a photon?

   g) Discuss the significance of Brillouin zone?

   h) What is Piezoelectricity?

2. Answer any **two** questions: 5×2=10

   a) What do you understand by Type-I and Type-II superconductors? Explain the concept of BCS ground state.   2+3

   b) Prove that 5-fold rotation axis cannot exist in crystal structure? What is space group and point group?   3+2

   c) What are phonons? Describe the characteristic of acoustical and optical phonons with reference to dispersion curves of linear diatomic lattice?   1+4

   d) Obtain the Lorentz relation for local field at a point inside a dielectric. How is local field different from Maxwell field?   3+2

3. Answer any **two** question: 10×2=20

   a) Discuss the failure of classical theory in explaining the observed temperature dependence of specific heat of solid. Give the modification incorporated by Debye and derive T^3-law. Calculate the vibrational frequency of carbon whose Debye temperature is 1650K. Given $h=6.6\times10^{-14}$ Js, $k_B = 1.38\times10^{-23}$ J/K.   2+(3+3)+2

[Turn over]

b) What is the origin of magnetic properties of a material? Distinguish between dia, para-, ferro-, antiferro- magnetic materials on the basis of susceptibility. What is hysteresis? Discuss its occurrence on basis of domain concept. What is spontaneous magnetization?

$$2+2+(2+2)+2$$

c) State Bloch theorem. Obtain the energy spectrum of an electron in a one-dimensional periodic potential. Discuss the symmetry properties of the energy spectrum as obtained from the reduced zone scheme.　　2+5+3

d) What is reciprocal Lattice? Show that the reciprocal lattice of a BCC lattice is a FCC lattice. Explain how the planes of the crystal are specified. Prove for an orthorhombic system the interplanar distance is:

$$d_{hkl} = \frac{1}{\left(\dfrac{h^2}{a^2} + \dfrac{k^2}{b^2} + \dfrac{l^2}{c^2} \right)^{\frac{1}{2}}}$$

Find the value of d_{210} for a cubic crystal with side 'a'.　　　　　　　　2+3+2+3

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