SH-V/PHS/502/C-12/19

B.Sc. 5th Semester (Honours) Examination, 2019-20

PHYSICS

Course ID : 52412 **Course Code : SHPHS-502-C-12**

Course Title : Solid State Physics

Time: 1 Hour 15 Minutes **Full Marks: 25**

The figures in the margin indicate full marks.

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

Section-I

1. Answer *any five* questions: 1×5=5

(a) Mention differences between crystalline and amorphous solids.

(b) Explain the significance of area of hysteresis loop of a ferromagnetic material.

(c) What is meissner effect?

(d) Give an example of a crystal that is piezoelectric but not ferroelectric.

(e) What is the number of nearest neighbour in a bcc crystal?

(f) Define effective mass of an electron in a solid.

(g) What are the origins of magnetic moment in an atom?

(h) Obtain the Miller indices of a plane having intercepts of $\frac{a}{2}, \frac{b}{3}, \infty$ on the a, b and c axes, respectively.

Section-II

Answer *any two* questions: 5×2=10

2. (a) The primitive translation vectors of a hexagonal space lattice are,

$$\vec{a} = \left(\frac{\sqrt{3}}{2}a\right)\hat{\imath} + \left(\frac{a}{2}\right)\hat{\jmath}$$

$$\hat{b} = -\left(\frac{\sqrt{3}}{2}a\right)\hat{\imath} + \left(\frac{a}{2}\right)\hat{\jmath}$$

$$\vec{c} = c\hat{k}$$

find the volume of the primitive cell.

(b) Derive the expression for interplanar spacing between two parallel planes with Miller indices (hkl). Show that for cubic crystal of lattice constant 'a' is given by,

$$d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$$ 2+3=5

3. (a) What is Hall effect?

(b) Derive an expression of Hall coefficient of a material. 1+4=5

4. (a) What is meant by induced and orientational polarizability?

(b) Derive the Clausius-Mosotti equation relating to polarizability and dielectric constant of a solid. 1+4=5

5. Explain the concept of BCS Theory and BCS ground state. 5

Section-III

Answer *any one* of the following: 10×1=10

6. (a) Derive the number of vibrational modes of a crystalline solid in the frequency range γ and $\gamma + d\gamma$.

Hence obtain an expression for Debye temperature and explain the significance of Debye cut-off frequency.

(b) Now calculate the specific heat at very low temperature and high temperatures. Interpret the result. 2+2+5+1=10

7. (a) What is paramagnetism? What is the essential difference between the classical and quantum theory of paramagnetism?

(b) Using the quantum theory of paramagnetism derive an expression for paramagnetic susceptibility at ordinary fields and temperatures. 1+1+8=10

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