2023

Time - 3 hours

Full Marks - 60

Answer **all groups** as per instructions.

Figures in the right hand margin indicate marks.

GROUP – A

1. Answer all questions and fill in the blanks as required.   [1 × 8

(a) Which magnetic substance can have positive permeability and negative susceptibility ?

(b) At lower temperature, the lattice specific heat varies as _____.

(c) The reciprocal lattice for Hexagonal space lattice is _____ lattice.

(d) The Miller indices of the plane parallel to the x and y axes are _____.

(e) Induced dipole moment per unit electric field is known as _____.

(f) The process of achieving population inversion is known as _____.

(g) Quantum of lattice vibrational energy _____.

(h) A super conductor is perfect _____ substance.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each.

[1½ × 8

(a) What are copper pairs ?

(b) Why population inversion is essential for stimulated emission ?

(c) Assuming there are 5×10^{28} atoms / m^3 in copper, find the Hall coefficient.

(d) What is a phonon ?

(e) Define packing factor.

(f) Write Einstein's theory of specific heat of solids.

(g) What is gyromagnetic orbital ratio ?

(h) What is atomic polarizability ?

(i) Write the physical significance of Clausius-Mossotti relation.

(j) State Bragg's law.

GROUP – C

3. Answer any eight of the following questions within 75 words each.

[2 × 8

(a) Distinguish between Ruby laser and He–Ne laser.

(b) Give idea of BCS theory.

(c) Explain Bloch theorem.

(d) Define ionic and orientation polarisation.

(e) Write the importance of Hall effect.

(f) Mention two important features of Miller indices.

(g) Distinguish between atomic factor and geometrical factor.

(h) Discuss about Brillouin zones.

(i) Discuss about the domain theory of ferromagnetism.

(j) Calculate the value of Bohr's magneton. Given

$e = 1.6 \times 10^{-19}$ c , $h = 6.64 \times 10^{-34}$ Js, $m = 9.1 \times 10^{-31}$ kg.

GROUP – D

Answer all questions within 500 words each.

4. Explain geometric structure factor with fundamental mathematical expression.

[6

OR

Explain space lattice and unit cell of a crystal. Discuss Bravais lattice for two dimensions.

5. Explain Linear monoatomic chain. Describe the wave motion of one dimensional lattice. [6

OR

Describe the Weiss theory of ferromagnetism.

6. Explain three level laser system giving the necessary theory. [6

OR

Define local field at an atom. Derive the relation between local field and polarisation of a dielectric.

7. State and explain Meissner effect. Derive the expression for London penetration depth. [6

OR

What is Hall effect ? Briefly discuss the physical origin of Hall effect. Measure Hall co-efficient experimentally.