2023-24

Time - 3 hours

Full Marks - 60

*Answer **all groups** as per instructions.*
Figures in the right hand margin indicate marks.
Candidates are required to answer
in their own words as far as practicable.

GROUP - A

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

    (a) The atomic radius for fcc cubic lattice is _____.

    (b) The primitive translation vectors in the reciprocal lattice have dimensions of _____.

    (c) What do you mean by phonons ?

    (d) The relative permeability of a material is 0.99. What type of substance is it ?

    (e) Define electric susceptibility.

    (f) The population inversion in helium neon laser is produced by _____.

(g) A pure semiconductor behaves as insulator at _____.

(h) Give an example of Type 1 superconductor.

GROUP - B

2. Answer any eight of the following within two or three sentences each. [1½ × 8

(a) What is Wigner Seitz cell ?

(b) Define atomic scattering factor.

(c) State Dulong and Petits law.

(d) What are Ferrimagnets or Ferrites ?

(e) Write down Clausius Mosotti Equation.

(f) What are the main components of a LASER ?

(g) Define Hall effect.

(h) What do you mena by critical temperature in relation to superconductivity ?

(i) What are lattice translation vectors ?

(j) Write the basic assumption in Kronig Penney Model.

GROUP - C

3. Answer any eight of the following within 75 words each. [2 × 8

(a) Find the Miller Indices for the planes with intercept 3a, 2b, 2c.

(b) State Bragg's law of X Ray Diffraction.

(c) Distinguish between Photons and Phonons.

(d) Draw B-H curve for a ferromagnetic substance. Why is it called hysteresis loop ?

(e) What do you mean by population inversion ? How is it achieved ?

(f) Discuss the factors on which conductivity of semiconductor depends.

(g) Discuss the salient features of BCS theory.

(h) Obtain the relation between dielectric constant and electric susceptibility.

(i) What do you mean by reciprocal lattice ?

(j) State Curie's law and define Curie temperature.

GROUP - D

4. Answer any four of the following within 500 words each.

(a) What do you mean by crystal structure ? Define crystal lattice, basis, unit cell, with neat diagrams. [1+2+1+2

(b) What are the assumptions of Einstein's theory of Specific Heat of solids ? Derive expression for Lattice Specific Heat at constant volume. [2 + 4

(c) Discuss in detail of Langevin's theory of paramagnetism and obtain the relation between susceptibility and absolute temperature. [6

(d) Explain the terms spontaneous and stimulated emissions. Obtain the relation for Einstein's A and B coefficients. [1+1+4

(e) Discuss Kronig Penney Model in brief and explain origin of Energy Gap. [6

(f) What is superconductivity ? Discuss Meissner effect. What are type I and type II superconductors ? [1+3+2

(g) Write short notes on <u>any two</u>. [3 × 2

   (i) Reciprocal lattice

   (ii) P and N type semiconductors

   (iii) Electric polarisation

   (iv) Ruby Laser