

Exam. Code : 209002

Subject Code : 4810

M.Sc. Physics 2nd Semester (Batch 2021-23)

CONDENSED MATTER PHYSICS—I

Paper : Phy-455

Time Allowed—3 Hours] [Maximum Marks—100

Note :— Attempt **FIVE** questions in all, selecting at least **ONE** question from each section. The fifth question may be attempted from any section. All questions carry equal marks.

SECTION—A

- (i) Define stress and strain. Express both stress and strain as tensors and explain the physical meaning of each component with suitable diagrams. 15

(ii) Prove that elastic constants are symmetrical
i.e. $C_{ij} = C_{ji}$. 5
- Derive wave equation for elastic waves in a cubic crystal. Solve it for longitudinal and transverse waves moving in [0 1] direction and calculate ratio of velocities for two waves. 20

SECTION—B

3. (i) The energy required to remove a pair of ions, Na^+ and Cl^- , from NaCl is $\sim 2\text{eV}$. Calculate the approximate number of Schottky imperfections present in the NaCl crystal at room temperature. 10
- (ii) What are point defects ? Derive an expression for temperature dependence of Frankel defects. 10
4. (i) Distinguish among the direction of the dislocation line, the Burgers vector and the direction of motion for both edge and screw dislocations, differentiating between positive and negative types. 10
- (ii) What are color centers ? How they are produced ? Explain F-center and V-center. What is the opposite to F center ? 10

SECTION—C

5. (i) Explain the variation of electrical conductivity with temperature both at low and high temperature regions. Hence explain the Matthiessen's rule. 10

- (ii) A uniform copper wire whose diameter is 0.16 cm carries a steady current of 10 A. Its density and atomic weight are respectively, 8920 kg/m^3 and 63.5. Calculate the current density and the drift velocity of the electrons in copper. 10
6. What is activation energy ? Derive the expression of activation energy required for formation of defects in ionic crystals. 20

SECTION—D

7. (i) Derive an expression for the local electric field acting at an atom. Explain the terms depolarization field and Lorentz field. 15
- (ii) Find the total polarizability of CO_2 , if its susceptibility is 0.985×10^{-3} . Density of carbon dioxide is 1.977 kg/m^3 . 5
8. (i) Explain the dipole theory of ferroelectricity in detail. 15
- (ii) What is ferroelectricity ? Name two ferroelectric materials and their applications. 5