Exam. Code : 209003
Subject Code : 3765

M.Sc. Physics 3rd Semester

PHY-503 CONDENSED MATTER PHYSICS–I

Time Allowed—3 Hours] [Maximum Marks—100

Note :— Attempt **all** the questions from Section-A and attempt one question from each of the Sections B,C,D and E.

SECTION—A

1. (i) Define tensor and discuss its significance in finding elastic constants.

   (ii) Write an expression for specific heat of metals and discuss the parameters which can affect it.

   (iii) Express Hooke's law in tensor form.

   (iv) Write the factors on which the dislocation density depends.

   (v) What is role of defects in a crystal ?

   (vi) Differentiate low angle grain boundaries from large angle grain boundaries.

   (vii) Discuss the significance of Boltzmann transport equation.

   (viii) What are the assumptions made by Drude and Lorentz in explaining the behavior of free electrons in metals ?

(ix) What is dielectric loss and dielectric breakdown?

(x) Define dielectric relaxation. 2×10=20

SECTION—B

2. (i) How the shortcomings of Einstein model were overcome by Debye model of specific heat ? 5

(ii) What is elastic stress and strain ? Express them in terms of tensor notations. 15

3. (i) Derive Debye's equation for molar lattice specific heat both at lower and higher temperatures. Discuss its agreement with experimental results. 15

(ii) Show that elastic constants are symmetrical, i.e. $C_{ij}=C_{ji}$. 5

SECTION—C

4. (i) Explain the formation of V-centres in a crystal. What are the applications of presence of V-centres in a crystal ? 10

(ii) Explain the process of self diffusion in metals qualitatively. 10

5. (i) Define Burgers vector and how it can be helpful in explaining the concept of grain boundaries. 10

(ii) Determine the concentration of Frenkel defect in a crystal in equilibrium state at a given temperature. 10

SECTION—D

6. State and derive the Boltzmann transport equation. Also describe its physical significance. 20

7. (i) What is activation energy and find its expression for the formation of defects in ionic crystals. 10

(ii) Discuss the process of ionic conductivity in pure alkali halides qualitatively. 10

SECTION—E

8. (i) At what frequency the real and imaginary parts of the polarizability become dominant and why ? 10

(ii) Explain electronic and orientational polarization in dielectrics. 10

9. (i) Consider a system of two neutral atoms separated by a fixed distance **a**, each atom having a polarizability α. Find the relation between **a** and α, for such a system to be ferroelectric. 10

(ii) State why the simple dipole theory fails to explain the ferroelectricity. Suggest a theory which can explain the ferroelectric nature of Barium Titanate. 10