M.Sc. Physics 3rd Semester
(2122)
CONDENSED MATTER PHYSICS—I
Paper : PHY-8033

Time Allowed : Three Hours]   **[Maximum Marks : 60**

Note :— Attempt **FIVE** questions in all, including Question No. **9** (Unit-V) which is compulsory and selecting **ONE** question each from Units-I to IV.

UNIT—I

1. (a) Discuss the importance of geometrical structure factor in X-ray diffraction & also explain the reason for some missing planes.   7

   (b) Calculate the cohesive energy per atom (ion) in NaCl, if ionisation potential is 5.14 ev & electron affinity of chlorine is 3.61 ev, Madelung constant A 1.7496 & equilibrium separation Re = 2.81Å.   5

2. (a) Derive an expression for elastic energy density. Explain dilation in crystals also.   7

   (b) Prove the physics of forbidden gap in diatomic linear chain. Sketch the acoustical & optical branches clearly.   5

UNIT—II

3. (a) Explain the concept of pseudo-potential method approach in solving the Schrodinger equation. Also give treatment for nearly free electron model. 8

    (b) How Bloch theorem is an important tool in understanding the band theory of solids ? 4

4. (a) Show the Lorentz number obtained on the basis of quantum theory is equal to $\dfrac{\pi^2}{3}\left(\dfrac{K_b}{e}\right)^2$ where symbols have their usual meaning. Compare this value with one predicted by classical theory. 7

    (b) Explain the meaning of effective mass and how it differs from ordinary mass. Prove your result. 5

UNIT—III

5. (a) Derive an expression for two band magneto resistance model and give its importance also. 6

    (b) Prove thermoelectric effects from transport theory. 6

6. (a) Discuss the minute detail of the following Boltzmann transport equation :

$$\frac{\partial f}{\partial t} + V.\nabla f + F.\nabla_p f = \frac{f - f_0}{\tau}.$$

    7

    (b) Discuss the difference between quantum and classical Hall effect. Derive it from transport theory. 5

UNIT—IV

7. (a) What are the various polarizabilities ? Discuss the classical theory of electronic polarizability and derive the required dispersion relation. 7

   (b) If 10^{27} molecules/m³ of HCl subjected to electric field of 10^6 v/m each with dipole moment 3.46×10^{-30} cm. Show that at this temperature and for corresponding value of high field a is small, (a=pE/KT). 5

8. (a) What is piezoelectric effect ? Explain the origin of the effect & its applications also. 6

   (b) Show that dielectric constant of a ferroelectric should follow the Curie-Weiss law above Curie temperature. 6

UNIT—V

9. Short questions :

   (a) What is the difference between pyroelectric ferrielectric and antiferroelectric substances ?

   (b) Discuss the structure of Brillouin Zones.

   (c) What is the core correction term in pseudo-potential method ?

   (d) Discuss the various symmetries in energy bands.

   (e) Explain atomic scattering factor.

   (f) Discuss the outcome of tight binding approximation.

   $6 \times 2 = 12$