Exam. Code : 103205
Subject Code : 1405

B.A./B.Sc. Semester—V
PHYSICS PAPER–A (Condensed Matter Physics)

Time Allowed—3 Hours]   [Maximum Marks—35

Note :— There are **FIVE** Sections. Section A consists of **SEVEN** short answer type questions and is compulsory. Sections B, C, D and E consist of **TWO** questions each. The candidates are required to attempt **ONE** question from each Section.

SECTION–A

1. How does *hcp* structure differ from *bcc* structure ? 2

2. What are the various symmetry operations that are present in a crystal ?   2

3. What do you mean by Geometrical structure factor ?

    2

4. What is forbidden energy gap ? Why a solid whose energy bands are filled cannot be a metal ?   2

5. Explain the significance of Brillouin Zones with particular reference to any Cubic Lattice.   2

6. What is Fermi Momentum ? What is its value in the Sommerfeld's free electron theory of metals ?   2

7. Show that at lower temperatures C_v varies directly as T^3.

    3

SECTION–B

1. Describe the face centred cubic and hexagonal close packed structures. Prove that the close packing of atoms in the *hcp* structure demands an axial ratio, $c/a = \sqrt{\left(\dfrac{8}{3}\right)}$. 5

OR

2. What are the differences and similarities of Primitive cells and unit cells ? What are Miller Indices and give their significances ? How are they determined ? What form of notation is used for Miller indices ? 5

SECTION–C

1. Discuss Ewald construction and derive Bragg's diffraction condition in terms of the reciprocal lattice vector. 5

OR

2. What is the reciprocal lattice and why is it named so ? Derive the relationships for the primitive translation vectors of the reciprocal lattice in terms of those of the direct lattice. 5

SECTION–D

1. Describe inelastic scattering of photons by phonons. Obtain an expression for the frequency of phonons generated when a photon is scattered inelastically at an angle Θ.

   5

OR

2. How does the Debye model differ from the Einstein model of lattice heat capacity ? Discuss the consequences of this difference explaining the low temperature behaviour of specific heat in each case. 5

273(2116)/RRA-8064 2 (Contd.)

SECTION–E

1. What is meant by the effective mass of an electron ? What is its significance ? Show that the effective mass of electron in a crystal is inversely proportional to the second derivative of the E-k curve. Discuss the conditions when the effective mass of an electron becomes positive, negative and infinity. 5

OR

2. Obtain expressions for the Fermi energy, the total energy and the density of states for a free electron gas in one dimension. Show the variation of density of states with energy. 5