Exam. Code : 103205
Subject Code : 1411

B.A./B.Sc. 5th Semester

PHYSICS

(Condensed Matter Physics)

Paper—A

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. Prove that the crystals cannot have five-fold symmetry. 2

2. Show that the c/a ratio for an ideal *hcp* lattice is $\sqrt{\left(\frac{8}{3}\right)}$. 3

3. What do you mean by atomic form factor ? 2

4. What do you understand by Fermi Gas ? What is the significance of the Fermi distribution function ? 2

5. What is Debye's T^3 law ? How far is it satisfied by solids ? 2

6. What is an intrinsic semiconductor ? Give examples. 2

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

SECTION—B

1. What are symmetry operations ? Describe the principal symmetry operations applicable to a three-dimensional lattice. Show that the five-fold rotational axis is not permissible in case of lattices. 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 are Brillouin zones ? Determine the reciprocal lattice vectors, which define the Brillouin zones of bcc and fcc lattices. 5

SECTION—D

1. What are the assumptions of the Debye model of lattice specific heat ? Discuss its predictions and limitations as compared with Einstein model. 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

SECTION—E

1. Discuss the formation of allowed and forbidden energy bands on the basis of the Kronig-Penney model. Discuss the extreme conditions when energy levels are either discrete or continuous. What is the effect of changing the binding energy of electron on the energy bands ? 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