

# PHY-503

## Solid State Physics

M.Sc. Physics (MSCPHY-12/13/16/17)

First Year Examination, 2019 (June)

**Time : 3 Hours]**

**Max. Marks : 80**

**Note :** This paper is of Eighty (80) marks divided into three (03) sections A, B and C. Attempt the questions contained in these sections according to the detailed instructions given therein.

### SECTION-A

#### (Long Answer Type Questions)

**Note :** Section 'A' contains four (04) long answer type questions of Nineteen (19) marks each. Learners are required to answer any two (02) questions only.

(2×19=38)

1. Define seven crystal system. What is hexagonal close packed (HCP) structure ? Draw diagram and explain it.

2. What do you mean by lattice vibrations ? Explain the lattice dynamics of a diatomic linear chain.
3. Following Debye theory, calculate the specific heat for a one dimensional solid and show that at low temperature the specific heat is proportional to temperature.
4. Explain paramagnetism. Give the quantum theory of paramagnetism.

## SECTION-B

### (Short Answer Type Questions)

**Note :** Section 'B' contains eight (08) short answer type questions of eight (08) marks each. Learners are required to answer any four (04) questions only. (4×8=32)

1. What do you mean by reciprocal lattice ? Give the properties of reciprocal lattice.
2. Taking the molecular weight of KCl crystal as 74.45 and density at room temperature as  $1.98 \text{ g/cm}^3$  calculate (i) the distance between adjacent atoms (lattice constant) (ii) spacing between (100) planes, (110) planes and (111) planes.

3. Explain Schottky and Frenkel defects.
4. What do you mean by cohesive energy of a crystal ? Calculate the cohesive energy of NaCl crystal and explain various terms.
5. What is Bloch theorem ? Prove it.
6. Calculate the position of fermi level at  $T = 300\text{k}$  for germanium crystal containing  $5 \times 10^{22}$  As atoms/ $\text{m}^3$ .
7. Classify magnetic materials.
8. Derive Clousius-Mossotti equation.

**SECTION-C**  
**(Objective Type Questions)**

**Note :** Section 'C' contains ten (10) objective type questions of one (01) mark each. All the questions of this section are compulsory. (10×1=10)

1. The atomic radius for (fcc) lattice is
  - (a)  $a/2$
  - (b)  $\sqrt{3} / 4 a$
  - (c)  $\sqrt{2} / 4 a$
  - (d) None of these

2. The diamond has Bravais lattice
- (a) fcc
  - (b) bcc
  - (c) hcp
  - (d) sc
3. The primitive translation vector in reciprocal lattice have dimension of
- (a) length
  - (b)  $(\text{length})^2$
  - (c)  $(\text{length})^{-1}$
  - (d)  $(\text{length})^{-2}$
4. Diamagnetism is explained in term of
- (a) Spin motion of electron
  - (b) Orbital motion of electron
  - (c) Both orbital and spin motion
  - (d) Spin motion of nucleus

5. Ferrites are
- (a) Ferrimagnetic having long electrical conductivity
  - (b) Ferrimagnetic having negligible electric conductivity
  - (c) Diamagnetic having large electrical conductivity
  - (d) Ferromagnetic having negligible electric conductivity
6. Aphonon is emitted or absorbed in
- (a) Elastic scattering of photon by a crystal
  - (b) Inelastic scattering of photon by a crystal
  - (c) Both the elastic and inelastic scattering of a photon by a crystal
7. The average kinetic energy of the electron in the ground state in one dimension is
- (a)  $\frac{1}{3}$  of fermi energy
  - (b)  $\frac{1}{2}$  of fermi energy

- (c)  $\frac{1}{4}$  of fermi energy
- (d) Equal to fermi energy

8. The motion of electrons in the periodic crystal lattice give rise to

- (a) Energy band
- (b) Continuous energy level
- (c) Conduction band only
- (d) None of these

9. Crystal whose natural primitive cells have a non-vanishing dipole moment are called

- (a) Piezoelectric
- (b) Ferroelectric
- (c) Antiferroelectric
- (d) Pyroelectric

**10.** Above the curie temperature

- (a) The ferromagnetic materials become diamagnetic
  - (b) The paramagnetic materials become diamagnetic
  - (c) The ferromagnetic materials become paramagnetic
  - (d) The diamagnetic materials become paramagnetic
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