

PHY-503

Solid State Physics

M. Sc. PHYSICS (MSCPHY-12/13/16)

First Year, Examination, 2017

Time : 3 Hours

Max. Marks : 80

Note : This paper is of **eighty (80)** marks containing **three (03)** Sections A, B and C. Learners are required to 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 *two* (02) questions only.

1. Find out the separation between lattice planes in a cubic crystal.
2. (a) What is meant by point defects in crystal lattice ?
What are the different types of point defects ?
(b) Discuss a method of investigating the structure of a single crystal using X rays.
3. Discuss the problem of an electron moving in a periodic potential. Explain the occurrence of energy gap in a semiconductor.

4. Show that the electronic specific heat of a conductor is very small compared to the lattice specific heat at room. Give example also.

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 *four* (04) questions only.

1. Show that for a simple cubic lattice

$$d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$$

2. The primitive translation vectors of a lattice are $a = 2i + j$, $b = 2j$ and $c = k$.

Determine the primitive translation vectors of its reciprocal lattice system.

3. Differentiate between optical and acoustical branches of diatomic lattice. Why are these branches named so ?
4. Explain the term susceptibility and permeability in magnetism. Give some examples and uses of high permeability materials.
5. Obtain an expression for the carrier density of a intrinsic semiconductor.
6. What is meant by polarization mechanism in dielectrics ? Discuss the different polarization mechanism in dielectrics and explain their temperature dependence.
7. Explain the working and application of semiconductor laser.

8. What is Hall Effect ? With the help of a relevant theory explain how Hall Effect experiment is used to distinguish between n -type and p -type semiconductor.

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.

- The co-ordinate number is the case of simple cubic structure is :
 - 12
 - 6
 - 2
 - 1
- If (3, 2, 6) are the Miller indices of the plane, the intercepts made by the plane on the three crystallographic axes are :
 - (2a, 3b, c)
 - (a, b, c)
 - (a, 2b, 3c)
 - None of these
- Einstein theory concludes that at lower temperature the specific heat :
 - drops linearly with increase in temperature
 - drops linearly with decrease in temperature

- (c) drops exponentially with decrease in temperature
 - (d) remains constant
4. Mobility of electrons is :
- (a) Flow of electron per unit electric field
 - (b) Reciprocal of conductivity
 - (c) Average electron drift velocity per unit electric field
 - (d) None of these
5. A superconducting material on being subjected to the critical field changes to :
- (a) Critical conductivity
 - (b) Superconducting which is independent of temperature
 - (c) Normal state
 - (d) Remains uninfluenced
6. Magnetic susceptibility is equal to :
- (a) dipole moment per unit volume
 - (b) magnetization per unit magnetic field
 - (c) torque per unit area
 - (d) None of these
7. Which of the following materials does not have permanent magnetic dipoles ?
- (a) diamagnetic
 - (b) paramagnetic
 - (c) ferromagnetic
 - (d) anti-ferromagnetic

8. The temperature below which certain materials are antiferromagnetic and above which they are paramagnetic is called :
- (a) Curie temperature
 - (b) Neel temperature
 - (c) Transition temperature
 - (d) Weiss temperature
9. Intrinsic concentration of charge carriers in a semiconductor varies as :
- (a) T
 - (b) T^2
 - (c) $T^{3/2}$
 - (d) $\frac{1}{T}$
10. The forbidden energy gap of carbon in diamond structure of :
- (a) 0.7 eV
 - (b) 1 eV
 - (c) 0.01 eV
 - (d) None of these

