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MSCPHY-12 (M.Sc. PHYSICS)

First Year, Examination-2015

PHY-503

Solid State Physics

Time : 3 Hours **Maximum Marks :** 60

Note : This paper is of sixty (60) 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 fifteen (15) marks each. Learners are required to answer any two (02) questions only.

(2×15=30)

1. Solve the schrodinger equation for an electron in a crystal moving in a perfect periodic potential. Explain how energy spectrum of electrons consists of humber of allowed energy and reporated by forbidden enegy region.

2. Describe the lattice dynamics of a diatomic linear chain of atoms.

3. Explain the quantum theory of paramagnetism.

4. What is super conductivity ? Give the BCS theory.

Section - B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short-answer-type questions of five (05) marks each. Learners are required to answer any four (04) questions only. (4×5=20)

1. What is the interplaner distance in a :

   (a) Tetragonal

   (b) Hexagonal close packed and

   (c) Orthorhombic crystal

2. Copper has fcc structure with lattice constant 0.361 hm. calculate the interplaner spacing for (112) and (120) planes. Draw there planes also.

3. Define reciprocal lattice. What is diffraction condition in reciprocal lattice system.

4. Give the geometrical models of an edge dislocation and screw dislocotion diffentiate there two in terms of Burger's vector.

5. Discuss the various drawbacks of classical free electron theory of metals and explain the assumptions made in quantum theory to over come there drawbacks.

6. What is displacement current ? Show that displacement vector D is related to free-charge denisty.

7. Explain the various methods of measurment of dielectric properties.

8. A paramagnetic substance has 10^{28} atom/m^3 each atom has magnetic moment 1.8×10^{-23} Am^2. Determine the paramagnetic susceptibility of at 300.k.

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. Which of the following has least packing fraction ?

   (a) Simple cubic structure

   (b) Body centred cubic structure

   (c) Face centred cubic structure

   (d) Diamond structure

2. The volume of a crystial primitive cell is V the volume of the first brillouin Zone is :

   (a) $\frac{1}{V}$ (b) V

   (c) $(2\pi)^3 V$ (d) $(2\pi)^3 / V$

3. A crystallographic plan has the intercept 1 along a, 2 along b and 3 along C. A. parallel plane will have miller indicas

   (a) (1, 2, 3) (b) (2, 4, 6)

   (c) (3, 2, 1) (d) 6, 3, 2)

4. Phonon is the quantisation of :

   (a) Electromagnotic wave

   (b) Elastic wave

   (c) Polarisation wave

   (d) Magnetization wave

5. For harmonic theory of lattice vibrations :
   (a) There is no thermal expansion
   (b) There is thermal expansion
   (c) Adiabatic and isothermal elastic constant are different
   (d) The heat capacity is not a constant at higher temperature

6. The electronic specific heat at constant volume per electron is proportional to :
   (a) T (b) T^2
   (c) T^3 (d) T^{-3}

7. At absolute zero temperature, all the allowed states of energy above the fermi level will be :
   (a) Empty
   (b) Occupied
   (c) Half occupied and half empty
   (d) Party occupied and partly empty

8. The Hall effect occurs in :
   (a) Metals only
   (b) n type semiconductors only
   (c) Intrinsic semiconductor only
   (d) All of the above

9. The electronic polarizability at moderate temperature is :
   (a) Linearly deplending on temperature
   (b) Independent of temperature
   (c) Inversely depending on temperature
   (d) Inversely depending on square of temperature

10. Which of the following can be type I super conductor ?
   (a) Pb (b) Nb
   (c) Nb_3Sn (d) Nb_3 Ge