End Semester Examination, 2022

Semester - V

Physics

PAPER - CC-12T

Full Marks : 40

Time : 2 Hours

The Figures in the right hand margin indicate marks. Candidates are required to give their answers in their own words as far as practicable.

Group - A

1. *Answer any <u>five</u> questions :* **5x2=10**

a) Define primitive and non-primitive unit cell of a crystal.

b) Why are 'γ' rays not used to study crystal structure ?

c) Mention the difference between phonons and photons.

d) The Bragg angle for first order reflection from (111) plane in a crystal is 60^0. Calculate the interatomic spacing if *x*-rays of wavelength $1.8\times10^{-10}m$ are used.

e) Differentiate between diamagnetism and paramagnetism.

f) Define Co-ordination number and Atomic packing factor.

g) Copper has FCC structure and the atomic radius is 0.1278 nm. Calculate the interplanner spacing for (111) and (321) planes.

h) Define polarization of a dielectric material and mention the different types of Polarizability.

Group - B

Answer any four questions : **4x5=20**

2. a) Calculate the volume of the primitive cell, co-ordination number and atomic packing factor for a fcc lattice.

   b) Show that for a crystal of cubic symmetry the direction [h, k, l] is perpendicular to the plane (h k l). 3+2

3. a) Discuss and draw the periodicity character of potential in a crystal.

   b) State and discuss Bloch theorem in this reference. (2+1)+2

4. Find the magnetic moments per ions in the following paramagnetic ions :

   i) Dy^{3+} (having nine electrons in 4f cell)

   ii) $Cu^{2}+$, ($[Ar]3d^{9}$) $2\frac{1}{2}x2=5$

5. Derive an expression for the concentration of electrons in the conduction band and the holes in the valance band of an intrinsic semiconductor.

6. Show that the diamagnetic susceptibility increases with the number of atoms per unit volume but is independent of temperature.

7. a) What is super conductivity ? Explain Meissner effect.

   b) Mention some important applications of super ductivity. (2+2)+1

Group - C

Answer any one question : **1x10=10**

8. a) How does quantum theory of paramagnetism remove the short comings of the Langevin's theory?

   b) Explain the significance of atomic scattering factor to study the crystal structure.

   c) How is atomic scattering factor related to geometrical structure factor ?

   d) Calculate the geometrical structure factor for body centered cubic (bcc) lattices. 4+2+2+2

9. a) Distinguish between electronic, ionic and dipolar polarizability. Derive an expression for dipolar polarizability.

   b) If the potential energy function is expressed as $U(R)=\frac{A}{R^{12}}-\frac{B}{R^{6}}$; find the intermolecular distance for minimum potential energy. Show that the minimum potential energy will be $-\frac{B^{2}}{4A}$ (2+3)+5=10