MS – 300

VI Semester B.Sc. Examination, May 2016
(OS) (Prior to 2013-14)
PHYSICS – VII
Statistical and Solid State Physics

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***any five*** *questions from Part* ***A***, ***four*** *problems from Part* ***B*** *and* ***five*** *questions from Part* ***C***.

PART – A

Answer **any five** of the following. **Each** question carries **six** marks. **(5×6=30)**

1. Obtain an expression for Bose-Einstein distribution function. **6**
2. Obtain an expression for the electrical conductivity of metals based on free electron theory. **6**
3. Explain briefly :
   a) any three applications of nanotechnology and
   b) any three properties of smart materials. **(3+3)**
4. Explain with theory the powder method of X-ray diffraction. **6**
5. What are liquid crystals ? Explain with diagram the different lyotropic liquid crystal phases. **(1+5)**
6. a) State Bloch theorem.
   b) Distinguish between conductors, insulators and semiconductors on the basis of band theory of solids. **(2+4)**
7. Derive an expression for electron concentration in an intrinsic semiconductor. **6**
8. a) What is Hall effect ?
   b) Write a note on type-I and type-II superconductors. **(2+4)**

PART – B

Answer **any four** of the following. **Each** problem carries **five** marks. **(4×5=20)**

$h = 6.63 \times 10^{-34}$ Js
$e = 1.6 \times 10^{-19}$ C
$m_e = 9.1 \times 10^{-31}$ kg
$C = 3 \times 10^{8}$ ms^{-1}
$K = 1.38 \times 10^{-23}$ JK^{-1}

9. Consider a two particle system each of which exist in three quantum states. What are the possible states if the particles are
   1) Bosons and 2) Fermions **5**

10. The fermi energy for silver is 5.5 eV. Calculate the fermi temperature and fermi velocity.

11. An X-ray photon of wavelength 0.1 Å is reflected at angle of 90° with its original direction after collision with an electron at rest. Find the energy it losses on collision.

12. Calculate the glancing angle on the plane (110) of a cube rock salt (a = 0.281 nm) corresponding to second order diffraction maximum for the X-rays of wavelength 0.071 nm.

13. Find the mobility of electrons in copper assuming that each atom contribute one free electron for conduction.

    Given : Resistivity of copper = 1.7×10^{-8} ohm–m

    Atomic weight of copper = 63.54

    Density of copper = 8.96×10^{3} kg m^{-3} and

    Avogadro's number = 6.025×10^{26} kg–mole.

14. Calculate the Hall coefficient of sodium as a free electron model given that sodium has a (bcc) structure of cell side 4.28 Å.

PART – C

Answer **any five** of the following. **Each** question carries **two** marks. **(5×2=10)**

15. a) Can Fermi-Dirac statistics be applied to heavily doped semiconductors ? Explain.
    b) Does the Fermi energy depend on the density of electron gas ? Explain.
    c) When the potential difference between the electrode of an X-ray tube is increased what happens to its short wavelength. Give the relation.
    d) Does Compton shift depend on the nature of the scattering material ? Explain.
    e) Do Miller indices represent a set of parallel planes ? Explain.
    f) With increasing energy what happens the bands in Kronig-Penny Model ? Explain.
    g) Is solar cell a photovoltaic device ? Explain.
    h) Does a paramagnetic substance have a net magnetization in the absence of external field ? Explain.