MS – 284

VI Semester B.Sc. Examination, May/June 2013
(Semester Scheme)
PHYSICS – VII
Statistical Physics and Solid State Physics

Time : 3 Hours Max. Marks : 60

Instructions : *1) Part – **A** : Answer **any five** of the following **(5×6=30)**.*
*2) Part – **B** : Answer **any four** of the following **(4×5=20)**.*
*3) Part – **C** : Answer **any five** of the following **(5×2=10)**.*

PART – A

Answer **any five** of the following : **(5×6=30)**

1. Arrive at Maxwell-Boltzmann distribution function. **6**

2. Obtain an expression for the electrical conductivity of metals based on free electron theory. **6**

3. a) What are nano materials ?

   b) Mention any three properties and applications of nano materials. **(1+5)**

4. a) Give the theory of Compton effect.

   b) Under what condition the Compton shift is maximum ? **(5+1)**

5. a) Distinguish between continuous X-rays and characteristic X-rays.

   b) State Moseley's law. How is the periodic table modified using the Moseley's law ? **(3+3)**

6. Discuss the classification of liquid crystals with necessary diagram. **6**

7. a) State and explain Bloch Theorem.

   b) Distinguish between type 1 and type 2 superconductors. **(3+3)**

8. a) What is Meissner effect ? Show that the magnetic susceptibility of a super conductor is – 1.

   b) Explain the concept of persistence of current. **(4+2)**

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PART – B

Answer **any four** of the following. Use the following data **wherever** necessary. **(4×5=20)**

$N = 6.66\times10^{26}$ kg-mole $e = 1.6\times10^{-19}$ C

$h = 6.63 \times 10^{-34}$ Js $me = 9.1\times10^{-31}$ kg

1 amu = 1.66×10^{-27} kg

9. Sodium has 2.5×10^{28} free electrons per.cm^3. Calculate the Fermi energy. Effective mass of electron = 1.2 me.

10. A copper wire of cross sectional area 4×10^{-6} m^2 carries a steady current of 40 A. Assuming one free electron per atom, calculate
    i) The density of free electrons and
    ii) The drift velocity of the electron.

    Given density of copper = 8.92×10^3 kg m^{-3} and atomic weight of copper = 63.5 amu.

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

12. If the plane cuts the crystallographic axes at 1a, 2b and 3c, what are the Miller indices of the plane ?

13. Calculate the Hall voltage developed in a crystal of thickness 0.6 mm when a magnetic field of 0.8 Tesla is applied. The current density is 200 Amperes/m^2 and electron density is 2×10^{23} m^{-3}.

14. A specimen of pure germanium at 300 k has a charge carrier density of 2.5×10^{19}m^{-3}. It is doped with donor impurity at the rate of one impurity atom for every 10^6 atoms of germanium. All the impurity atoms may be assumed to be ionized . The density of germanium atoms is 4.2×10^{28} atoms m^{-3}. Find the resistivity of the doped germanium if the electron mobility is 0.36 m^2/volt-second.

PART – C

Answer **any five** of the following : **(5×2=10)**

15. a) Is electron a Boson ? Explain.

b) Do gold particles of all sizes look yellow ? Justify.

c) Miller indices represent not a single plane but a set of parallel planes. Why ?

d) Is water an anisotropic phase ?

e) Why semiconductors are tetravalent ? Explain.

f) X-ray production is the converse of photoelectronic phenomenon. Explain.

g) What is meant by potential barrier across a p-n junction ?

h) If the current is passed through a superconductor does it remain for ever ? Explain.