Numericals

1.Find the temperature at which there is 1% probability that a state with energy 0.5 eV above Fermi energy.

2.Find the relaxation time of conduction electrons in a metal of resistivity 1.54 × 10-8 Ω-m, if the metal has 5.8 × 1028 conduction electrons/m3.

3.A uniform silver wire has a resistivity of 1.54 × 10-8 Ω–m at a temperature 300 K. For an electric field along the wire of 1 V/cm. Calculate:

a) drift velocity

b)the mobility and relaxation time of electrons assuming that there are 5.8 × 10 28 conduction electrons per m3of the material

4.Find the resistivity of an intrinsic semiconductor with intrinsic concentration of 2.5 × 1019 per m3. The mobilities of electrons and holes are 0.40 m2/ V-s and 0.20 m2/ V-s.

5. 1.Calculate the intrinsic concentration of charge carriers at 300 K given that m \*e =0.12m o ,m \*h =0.28mo and the value of brand gap = 0.67 eV.

6.The intrinsic carrier density is 1.5 × 1016 m–3. If the mobility of electron and hole are 0.13 and 0.05 m2 V–1 s–1, calculate the conductivity.

7. The Hall coefficient of certain silicon specimen was found to be –7.35 × 10–5 m3 C–1 from 100 to 400 K. Determine the nature of the semiconductor. If the conductivity was found to be 200 –1 m–1. Calculate the density and mobility of the charge carrier.

8. In a P-type germanium, ni = 2.1 × 1019 m–3density of boran 4.5 × 1023 atoms /m3. The electron and hole mobility are 0.4 and 0.2 m2 v–1 s–1 respectively. What is its conductivity before and after addition of boron atoms.

9. For an intrinsic Semiconductor with a band gap of 0.7 eV, determine the position of EF at T = 300 K if m\*h = 6m\*e.

10. Find the resistance of an intrinsic germanium rod 1 cm long, 1mm wide and 1mm thick at 300 K. the intrinsic carrier density is 2.5 × 1019 / m–3 at 300 K and the mobility of electron and hole are 0.39 and 0.19 m2 V–1 S–1. (Ans: 4.31 × 103)

11.Calculate the position of Fermi level EF and the conductivity at 300 K for germanium crystal containing 5 × 1022 arsenic atoms / m3. Also calculate the conductivity if the mobility of the electron is 0.39 m2 V–1 S–1.

 (Ans : EF is 0.16 eV below Ec   = 3210 –1m–1)

12.In a Hall experiment a current of 25 A is passed through a long foil of silver which is 0.1mm thick and 3cm wide. If the magnetic field of flux density 0.14 Wb/m2 is applied perpendicular to the foil, calculate the Hall voltage development and estimate the mobility of electrons in silver. The conductivity the Hall coefficient is (–8.4 × 10–11)m3 / coulomb. (Ans : 29.4 V and 57.7 × 10–4 m2 V–1)

13.The intrinsic carrier density at room temperature in Ge is 2.37 × 1019 m3. If the electron and hole motilities are 0.38 and 0.18 m2 V1 S1 respectively, calculate the resistivity.(Ans : 0471   m)

14. For silicon semiconductor with band gap1.12 eV, determine the position of the Fermi level at 300 K, if m\*e 0.12m0 and m\*h 0.28m0 (Ans : 0.576 eV)

15.For an intrinsic semiconductor with gap width Eg = 0.7 eV, calculate the concentration of intrinsic charge carriers at 300 K assuming that m\*e m\*h m0 .

(Ans : 33.49 × 1018 / m3)

16.A silicon plate of thickness 1mm, breadth 10mm, and length 100mm is placed magnetic field of 0.5 wb/m2 acting perpendicular to its thickness. If A 10–2 current flows along its length, calculate the Hall voltage developed if the Hall coefficient is 3.66 × 10–4 m3 / coulomb. (Ans : 3.7 × 106 C–1 m3)

  17.A N-type semiconductor has Hall coefficient = 4.16 × 10–4 C–1 m3. The conductivity is 108 ohm–1 m–1. Calculate its charge carrier density and electron mobility at room temperature.    (Ans : 0.038 m2 V–1 S– )