Module 2 Unit 1

SEMICONDUCTORS – NUMERICAL PROBLEMS

1. Determine the resistivity of intrinsic Ge. Given electron and hole mobility in Ge μ_n and μ_p to be 3700 cm^2/V-s and 1900 cm^2/V-s respectively. n_i for Ge = 1.47 x 10^{13}/cm^3. q = 1.6 x 10^{-19} C.
2. Determine the probability that an electron is present in CB and a hole is present in VB in intrinsic Ge at R.T. E_g for Ge = 0.66 eV, take kT = 0.025 eV.
3. Estimate the drift current density for the sample having holes concentration 5 x 10^{15}/cc is subjected to an electric field of 5 V/cm. Given mobility of holes in Ge = 1900 cm^2/V-s Take q = 1.6 x 10^{-19} C.
4. What could be the concentration gradient present if drift current in previous example is balanced by diffusion current at room temp Given mobility of holes in Ge = 1900 cm^2/V-s Take q = 1.6 x 10^{-19} C.

5. The relation between energy and wave vector for a semiconductor is given by $E = \frac{3}{2a}k^2$ where, "a" is some proportionality constant = 1.2 x 10^{38}. Determine the effective mass of this particle in terms of electron rest mass. Given reduced Planck's constant ħ = 1.05 x 10^{-34} J-s and electron rest mass = 9.1 x 10^{-31} kg.
6. An impurity of 0.01 ppm is added in to silicon .The semiconductor has a resistivity of 0.25ohm.m at 300 k .Calculate the hole concentration and its mobility .Also comment on the result .Given: Atomic wt of Si =28.1 and density if Si=2.4x10^3 kg/m^3
7. In a solid the energy level lying 0.012 eV below Fermilevel.What is the probability of this level not being occupied by an electron.Given T=300 K and k=1.38x10^{-38} J/K.
8. Ge is doped with 10^{15} In atoms per cc. What is the electron and hole concentration (n and p)? Take n_i = 1.47 x 10^{13}/cc.

9. Determine shift in Fermi level position in eV (E_i – E_{Fp}) in earlier example. Take kT = 0.025 eV at RT and E_g = 0.66 eV for Ge.

10. Calculate intrinsic concentration for Ge. Given N_C, N_V for Ge to be 1.05 x 10^{19}/cc and 6 x 10^{18}/cc respectively. E_g for Ge = 0.66 eV and kT = 0.025 eV.
11. Calculate the resistivity if we dope Ge in earlier example (no 1) with 10^{16}/cm^3 phosphorous atoms