Sheet 1: Semiconductor Basics

1- Show that the resistivity of the intrinsic germanium at 300°K is 45 $\Omega.cm$, and also find the resistivity of intrinsic silicon at 300°K.

2- Sample of silicon is 5 cm long and has square cross section 3x3 mm the current is due to electrons whose mobility is 1400 cm^2 /V.s. Two volts applied across the bar results in a current of 8mA. Calculate:

(a) Concentration of free electrons (n).

(b) Drift velocity (v_d).

3- (a) Determine the concentration of free electrons (n) and holes (p) in a sample of germanium at 300°K which has a concentration of donor atoms (N_D) equal to $3x10^{14}$ atoms/cm^3 and a concentration of acceptor atoms (N_A) equal to $4x10^{14}$ atoms/cm^3. Is this p- or n-type germanium?

(b) Repeat part (a) for equal donor and acceptor concentration of 10^{16} atoms/cm^3. Is this p- or n-type germanium?

(c) Repeat part (a) for donor concentration of 10^{17} atoms/cm^3 and acceptor concentration of 10^{14} atoms/cm^3

4- Sample of germanium is doped to the extent of $4x10^{14}$ donor atoms/cm^3 and $5x10^{14}$ acceptor atoms/cm^3. At the temperature of the sample the resistivity of pure (intrinsic) germanium is 60 Ω-cm. Assume that the value of the mobility of holes and electrons is approximately the same as at 300°K (μ_p=1800 cm^2/V.s and μ_n=3800 cm^2/V.s). If the applied electric field intensity is 4 V/cm, find the total current density (J).