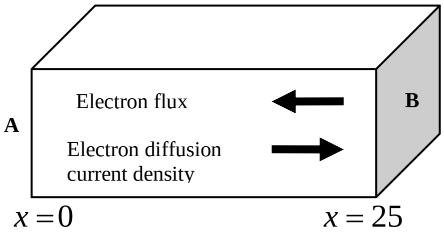
Tutorial questions – 02

ME4252 Nanomaterial for Energy Engineering

1. Figure shows the directions of electron diffusion flux and current densities in a rectangular bar of Silicon and x is measured in μm. The electron concentration varies linearly from 1×10^{17} to 7×10^{16} cm^{-3} between the two ends at T = 300 K. Calculate the diffusion current density, if the electron mobility is, μ_n =9.62×10^{3} $cm^{2}\,V^{-1}sec^{-1}$



2. The intrinsic carrier density at 300 K in silicon is 1.5×10^{16} m^{-3}. If the electron and hole motilities are 0.13 and 0.05 $m^{2}V^{-1}s^{-1}$, respectively, calculate the conductivity of (a) intrinsic silicon and (b) silicon containing 1 donor impurity atom per 10^{8} silicon atoms. The atomic weight of Si is 28.09 *g/mole* and its density = 2.33×10^{3} kg/m^{3}.

3. The intrinsic carrier concentration in *Si* is found to be no greater than 1×10^{12} cm^{-3}. Assume E_g = 1.12 *eV*. Determine the maximum temperature allowed for Si.
   Given: $N_C \approx 2.8\times10^{19} cm^{-3}$ and $N_V = 1.04\times10^{19}$ cm^{-3}.

4. Germanium has the same crystal structure as silicon but its band gap is 0.67 *eV*. If the total density of states in the conduction band (N_c) and in the valence band (N_v) are the same as they are for silicon, what value of n_i would you expect for *Ge* at 300*K*?
   Assume $n_i = 10^{10}/cm^{3}$ and E_g = 1.12eV.
