Example- At 300 K for Si,find effective density of states # of charge carrier densities.

Constants

$h := 6.62607015 \cdot 10^{-34}$ J-s $\quad m0 := 9.1093837015 \cdot 10^{-31}$ kg $\quad T := 300$ K

$kB\_eV := 8.617333 \cdot 10^{-5}$ eV/K $\quad kB\_eV \cdot T = 0.025852$ eV

$kB := 1.380649 \cdot 10^{-23}$ J/K $\quad kB \cdot T = 4.14195 \times 10^{-21}$ J $\quad Eg\_Si := 1.12$ eV

From Table 4.1, the eff. electron & hole masses for Si $\quad mne := 1.08 \cdot m0 \quad mpe := 0.56 \cdot m0$

Conduction band eff. density of states function (4.10) $\quad Nc := 2 \cdot \left(\frac{2 \cdot \pi \cdot mne \cdot kB \cdot T}{h^2}\right)^{\frac{3}{2}}$

$Nc = 2.816 \times 10^{25}$ #/m3 $\quad \frac{Nc}{100^3} = 2.816 \times 10^{19}$ #/cm3

From Table 4.1, $\boldsymbol{N_c = 2.8 \cdot 10^{19}}$ **#/cm3**

Valence band eff. density of states function (4.18) $\quad Nv := 2 \cdot \left(\frac{2 \cdot \pi \cdot mpe \cdot kB \cdot T}{h^2}\right)^{\frac{3}{2}}$

$Nv = 1.052 \times 10^{25}$ #/m3 $\quad \frac{Nv}{100^3} = 1.052 \times 10^{19}$ #/cm3

From Table 4.1, $\boldsymbol{N_v = 1.04 \cdot 10^{19}}$ **#/cm3**

Assuming $E_c - E_F \sim 0.5E_g$, the number of electrons is (4.11)

$n0 := Nc \cdot e^{-\left(\frac{0.5 \cdot Eg\_Si}{kB\_eV \cdot T}\right)}$ $\quad n0 = 1.102 \times 10^{16}$ #/m3 $\quad \frac{n0}{100^3} = 1.102 \times 10^{10}$ #/cm3

From Table 4.2, $\boldsymbol{n_0 = n_i = 1.5 \cdot 10^{19}}$ **#/cm3**

Assuming $E_F - E_v \sim 0.5E_g$, the number of holes is (4.19)

$p0 := Nv \cdot e^{-\left(\frac{0.5 \cdot Eg\_Si}{kB\_eV \cdot T}\right)}$ $\quad p0 = 4.114 \times 10^{15}$ #/m3 $\quad \frac{p0}{100^3} = 4.114 \times 10^{9}$ #/cm3

From Table 4.2, $\boldsymbol{p_0 = n_i = 1.5 \cdot 10^{19}}$ **#/cm3**