Electronic Devices

Tutorial-1: Semiconductors under Thermal Equilibrium Conditions

Q. 1

Find the intrinsic carrier concentration of an intrinsic silicon sample at 500K. Compare the result to its value at 300K. What do you infer from the results.

$1.78x10^{14}\ cm^{-3}$

Q. 2

What is the probability of finding a hole in the valence band edge at T = 0K and T = 300K in an intrinsic silicon sample? Consider the bandgap of Si as 1.12 eV

At T=0K, **0**

At T=300K, **4.1 X 10^{-10}**

Q. 3

Find the fermi energy level with respect to the valence band edge in an n-type silicon sample with a doping concentration of 10^{15} cm^{-3}. Assume T = 300K and $N_c = 10^{19}$ cm^{-3}. Also find the minority carrier concentration. Can the intrinsic temperature of this semiconductor be found using the given data?

$$p_0 = 2.25 \, x \, 10^5 \, cm^{-3}$$

$$E_F - Ev = 1.12 - 0.239 \approx 0.881 \, eV$$

Q. 4

An intrinsic semiconductor sample of germanium is doped with a trivalent impurity concentration of 4.8×10^{15} cm $^{-3}$. Find the shift in the position of the fermi level w.r.t the intrinsic fermi level at 300K. Draw the Energy band diagram before and after doping. Mark the energy difference on the diagram. It is given for germanium, $n_i = 2.4 \times 10^{13}$ cm^{-3} and $E_g = 0.67$ eV