Assignment 5 (Semiconductor Physics)

1. Assume that E_F is 0.3 eV below Ec. Determine the temperature at which the probability of an electron occupying an energy state at E =Ec + 0.025 eV is 8x 10^{-6}.

2. Assume that the Fermi energy level is 0.35 eV above the valence band energy. Let T 300 K. (a) Determine the probability of a state being empty of an electron at E = Ev -(1/2)kT. (b) Repeat part (a) for an energy state at E = Ev – (3/2)kT.

3. Calculate the energy, in terms of *kT* and *EF*, at which the difference between the Boltzmann approximation and the Fermi–Dirac function is 5 percent of the Fermi function.

4. Two possible conduction bands are shown in the *E* versus *k* diagram given in Figure P3.13. State which band will result in the heavier electron effective mass; state why.

5. Two possible valence bands are shown in the *E* versus *k* diagram given in Figure P3.14. State which band will result in the heavier hole effective mass; state why.

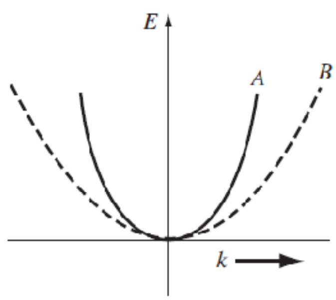

Figure P3.13 | Conduction bands for Problem 3.13.

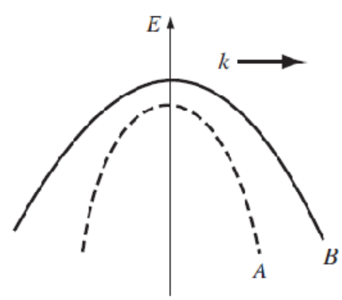

Figure P3.14 | Valence bands for Problem 3.14.

6. Determine the total number (/cm3) of energy states in silicon between Ec and $Ec + 2kT$ at (*i*) T = 300 K and (*ii*) T =400 K.
7. (a) Consider the energy levels shown in Figure P3.42. Let T=300 K. (*a*) If $E_1 - E_F$= 0.30 eV, determine the probability that an energy state at $E = E_1$ is occupied by an electron and the probability that an energy state at $E = E_2$ is empty. (*b*) Repeat part (a) if $E_F - E_2 = 0.40$ eV.

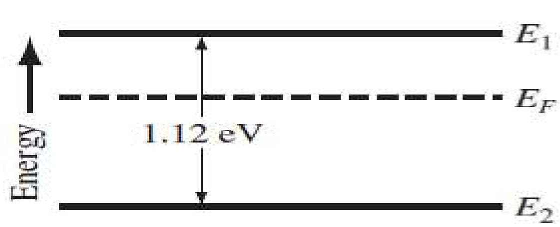

Figure P3.42 | Energy levels for Problem 3.42.

(Note: You may refer the book: Semiconductor Physics and Devices Basic Principles (4th edition) by Donald A. Neamen)