Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Department

Solid State Electronic Devices
3rd Term – Level 1 / Credit H
Sheet 02 - (Fall 2017)

[1] (a) If $E_F = E_C$, find the probability of a state being occupied at $E = E_C + kT$. (b) If $E_F = EV$, find the probability of a state being empty at $E = E_V - kT$.

[2] (a) Determine for what energy above E_F (in terms of kT) the Fermi-Dirac probability function is within 1 percent of the Boltzmann approximation. (b) Give the value of the probability function at this energy.

[3] The Fermi energy level for a particular material at T = 300 K is 6.25 eV. The electrons in this material follow the Fermi-Dirac distribution function. (a) Find the probability of an energy level at 6.50 eV being occupied by an electron. (b) Repeat part (a) if the temperature is increased to T = 950 K. (Assume that E_F is a constant.) (c) Calculate the temperature at which there is a 1 percent probability that a state 0.30 eV below the Fermi level will be empty of an electron.

[4] Assume the Fermi energy level is exactly in the centre of the bandgap energy of a semiconductor at T = 300 K. (a) Calculate the probability that an energy state in the bottom of the conduction band is occupied by an electron for Si, Ge, and GaAs. (b) Calculate the probability that an energy state in the top of the valence band is empty for Si, Ge, and GaAs. (Ge: E_g = 0.66 eV, GaAs: E_g = 1.42 eV)

[5] Calculate the temperature at which there is a 10-6 probability that an energy state 0.55 eV above the Fermi energy level is occupied by an electron.