Arab Academy for Science & Technology & Maritime Transport
(AASTMT – Cairo Branch)
College of Engineering & technology
Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210

Sheet #4

TextBook
'Principles of Electronic Materials and Devices', Third Edition, S.O. Kasap © McGraw-Hill, 2006

Constants:

$\varepsilon_o = 8.85\times10^{-12}\,\mathrm{Fm}^{-1}$

Charge of electron $(q) = 1.6\times10^{-19}\,\mathrm{C}$

Mass of electron $(m_e) = 9.1\times10^{-31}\,\mathrm{kg}$

Plank's Constant $(h) = 6.63\times10^{-34}\,\mathrm{Js}$

Solve the following problems

[1] Find the resistivity of intrinsic Germanium (Ge) at 300K where = 3800 cm^2/V.sec, =1800 cm^2 /V.sec and intrinsic concentration 1.6*10^{13} cm^{-3}.

[2] For intrinsic silicon at room temperature, given that the intrinsic concentration is 1x10^{10} cm^{-3}, the mean time between scatterings is 2x10^{-13} sec for electrons, and1x10^{-13} sec for holes, the conductivity effective mass for electrons is 0.26m_o, and 0.386m_o for holes, where m_o is the rest mass for the electrons.
Find:

a. Electron and hole mobilities
b. Total conductivity.
c. The current density if the silicon has a length of 1um, and an applied voltage of 10V.
d. The total current if the cross section area is 100um^2.

Hint: use MKS system

[3] Example 5.3 p.392.

[4] An intrinsic semiconductor with L=10μm. The potential V(x) applied is given as: $\frac{-2}{10\times10^{-6}}x + 2$. Plot both V(x) and the potential energy versus x.

[5] For an electron mobility of 500 cm^2/Vsec, calculate the time between collisions, for an electric field of 100 V/cm, calculate also the distance traveled by an electron between collisions. Take m* = m in this calculation.

[6] For a p-type silicon slice doped with Boron (Acceptor, N_A). The doping gradient have a linear dependence on distance, with N_A(at x=0um) = 5x10^{16} cm^{-3}, and N_A(at x= 100um) =$10^{17}$$cm^{-3}$. Given that the cross section area = 10 um^2, length= 100um, mobility = 600 $cm^2V^{-1}sec^{-1}$, temperature = 27°C, find the total diffusion current.
Note: Use k= 1.3806488×10^{-23} $J.K^{-1}$.