JUST
Dep. Of Electrical Engineering

Electronics (1) EE 220 First Exam 3/30/04

Time:1hr

Answer all of the following questions

Q1: (5 points)

Given a uniformly doped semiconductor having donor doping of $10^{15}cm^{-3}$ and if $n_i = 4.88\times10^{15}\times T^{3/2}e^{-E_g/(2kT)}$.

a) Calculate the electron and hole concentrations and the resistivity of the sample if T=450 °K, E_g=1.02eV, μ_n=400 $cm^2/V.s$, μ_p =150 $cm^2/V.s$, and $k = 8.62\times10^{-5}$ eV/K

b) If an electric field of (10^4 V/cm) is applied on the sample, calculate the velocity of the electrons and holes.

Q2: (10 points)

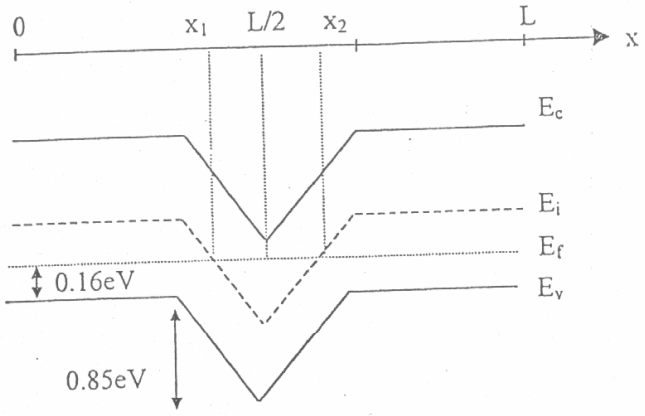
For a PN silicon diode has $N_A=3\times10^{17}$ cm^{-3} and $N_D=1\times10^{18}$ cm^{-3}. Assume the following parameters for Silicon: $n_i=10^{10}$ cm^{-3}, $\varepsilon_0=8.85\times10^{-14}$F/cm, ε_R=Ks=11.8, q=1.6×10^{-19}, KT/q=26mV, KT=26meV

Calculate

1) The built-in voltage (V_{bi})
2) Majority and minority carrier concentrations in each side of the junction
3) Depletion region width (W) and (x_n)
4) Maximum electric field (ε_0)
5) Find the depletion region width (W) for reverse bias of −1V.
6) Explain why the diode reverse bias current is much less than the forward bias current?

Q3: (10 points)

Given the following energy band diagram for Silicon where $n_i=10^{10}$ cm^{-3} and E_g=1.15eV



1) Find n and p at x=0, x1, L/2, x2 and L
2) What is the type of the material at x=0, x1, L/2, x2 and L
3) Plot electric field ε(x) and potential V(x)
4) Find the total current at x=L/2 and explain your answer briefly.