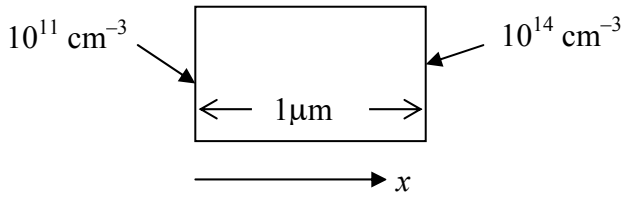
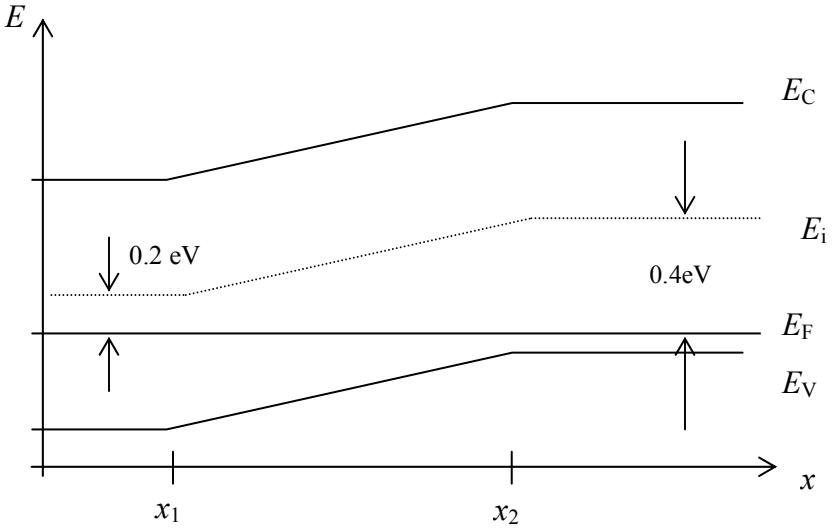
ECSE-2210 Microelectronics Technology
Fall 2005
Class Activity 7

1) A silicon piece of 1 μm thick is shown below. By some magic, we maintain an electron concentration linearly varying from 10^{11} cm^{-3} to 10^{14} cm^{-3} inside the sample. Calculate the electron diffusion current density $J_{N|\ diff}$ in A/cm^2 and its direction. Repeat if carriers were holes. Assume $D_n = 25$ cm^2/s and $D_p = 10$ cm^2/s.



2) A silicon sample maintained in equilibrium at 300 K is characterized by the energy band diagram in the figure. Answer the questions below. Also write down (on the side) the general equations that you used to get the answer.



$x_2 - x_1 = 1\mu m$

(a) Sketch the electric field $\mathcal{E}$ inside the semiconductor as a function of x. Find the numerical value for the $\mathcal{E}$-field in units of V/cm.

(b) Sketch the potential inside as a function of x. What is the potential difference between the two ends?

(c) Roughly sketch p versus x. Find p at the two ends and plot qualitatively in between.

(d) Make a rough sketch (qualitatively) of the hole drift-current density ($J_{P|\,drift}$) as a function of x. (Assume $\mu_p = 400\ cm^2/(Vs)$ if you want to calculate numerical answer).

(e) What will be the hole diffusion current density ($J_{P|\,diff}$) based on the result of question (d)?