Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
6.012
Microelectronic Devices and Circuits
Spring 2007
February 21, 2007 - Homework #2
Due - February 28, 2007

Problem 1

Fill in the values for the maximum absolute electric field, built in voltage, and depletion width for the following pn junctions. Assume thermal equilibrium.

N_d cm^{-3}	N_a cm^{-3}	x_{no} nm	x_{po} nm	E_o kV/cm	ϕ_{bi} mV
10^{15}	10^{15}				
10^{16}	10^{17}				
10^{16}	10^{18}				

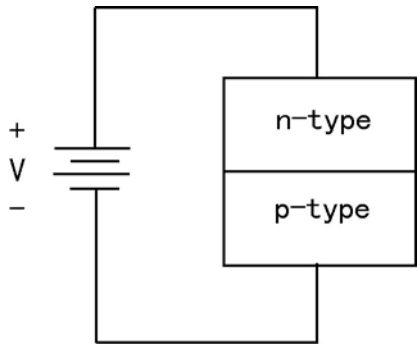
Problem 2

We have a PN junction with the p-type side doped with $N_a = 10^{17}$ cm^{-3} and the n-type side doped with $N_d = 10^{18}$ cm^{-3}. Assume thermal equilibrium.

a) Compute the built in potential ϕ_{bi}.
b) Calculate the depletion width on each side: x_{n0} and x_{p0}.
c) Plot the charge density, electric field, and electric potential across the PN junction. Please follow the graph convention in Howe & Sodini.

Problem 3

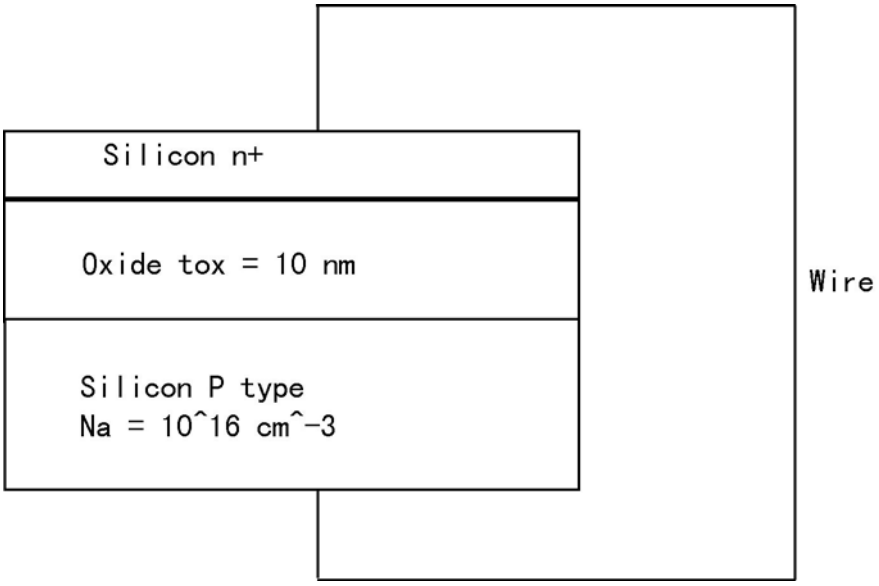
Given $x_{no} = 100$ nm, $\phi_{bi} = 780$ mV, $N_d = 10^{17}$ cm^{-3}. The voltage V varies from 0 to +3 volts.



a) Plot the amount of charge stored on the n-side versus voltage V.
b) What is C_{jo}, the depletion capacitance at zero bias? Plot C_j versus voltage V.

Problem 4

For the given set up:



a) Plot the electric field versus distance. Follow the convention in H&S. Set the oxide and p-type interface as x = 0.
b) Plot the charge density versus distance.