ECEn 450, Winter 2010
Homework # 9
Due March 9, 5:00 pm

From the text Semiconductor Devices, Physics and Technology, do the following problems:

Chapter 4, problems 9, 12

Chapter 13, problems 16

Also complete the following problem:

9.1 Consider a p^+n silicon diode at T=300K with doping concentrations of $N_A = 10^{18}$ cm^{-3} and $N_D = 10^{16}$ cm^{-3}. The minority carrier hole diffusion coefficient is $D_P = 12$ cm^2/s and the minority carrier hole lifetime is $\tau_{po} = 10^{-7}$ s. The cross-sectional area is $A = 10^{-4}$ cm^2. Calculate the reverse saturation current and the diode current at a forward-bias voltage of 0.50 V.

9.2 An n^+p silicon diode at T=300K has the following parameters: $N_D = 10^{18}$ cm^{-3}, $N_A = 10^{16}$ cm^{-3}, $D_n = 25$ cm^2/s, $D_p = 10$ cm^2/s, $\tau_{no} = \tau_{po} = 1$ μs, and $A = 10^{-4}$ cm^2. Determine the diode current for (a) a forward-bias voltage of 0.5 V and (b) a reverse-bias voltage of 0.5 V.

9.3 Consider two ideal pn junctions at T=300K, having exactly the same electrical and physical parameters except for the bandgap energy of the semiconductor materials. The first pn junction has a bandgap energy of 0.525 eV and a forward-bias current of 10 mA with $V_A = 0.255$ V. For the second pn junction, "design" the bandgap energy so that a forward-bias voltage of $V_A = 0.32$ V will produce a current of 10 μA.

Homework Helps and Hints:
4.12 $D_n = 21 cm^2/s$, $D_p = 10$ cm^2/s