ELEG 646; **ELEG 446 - Nanoelectronic Device Principles – Spring 2011**

Homework #5 - due Friday, 18 March 2011, in class

1. Calculate: (a) the minority carrier diffusion current density and (b) the majority carrier drift current density along one-dimension in a sample of n-type silicon. This sample is 100 μm long, with uniform donor doping with $N_D = 1 \times 10^{18}$ cm^{-3}. Assume that the minority carrier concentration profile is maintained as a linear variation (by illumination and injection), from equilibrium p_{no} (calculate this value) at the left side (x=0), to $p_n(x=100\ \mu m) = p_{no} + 10^{15}$ cm^{-3} at the right hand side. The applied bias is −2 volts at x=0 and the right side is grounded.

2. Problem 4.1 in chapter 4, Muller & Kamins, p. 222 in 3rd edition.

3. Problem 4.4 in chapter 4, Muller & Kamins, p. 222 in 3rd edition. (Hints: the example referred to is in Section 4.1 on page 180, not section 4.2.)

4. Problem 4.6 (a) only in chapter 4, Muller & Kamins, p. 222 in 3rd edition. Hint: assume that the depletion thickness is known and that the depletion edges lie at $\pm x_{d0}/2$; find n and p in terms of n_i and E_i at these two points, and thus determine the two values of $E_i - E_F$. Find φ from the difference in these.

5. Problem 5.6 in chapter 5, Muller & Kamins, p. 275 in 3rd edition. (Hint: start with Eqn. 5.3.10, and for short base diode, recombination in the bulk can be neglected.)

Homework assignments will appear on the web at:
http://www.ece.udel.edu/~kolodzey/courses/eleg646s11.html

Include your name, due date, assignment number, and course number on each submission.