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

Homework #11 - due Friday, 6 May 2011, in class

1. The emitter current of a p-n-p transistor with $\alpha_N = \alpha_I$ is 0.5 mA when the emitter-base junction is forward biased and the collector is left open. (hint: use Ebers-Moll equation to obtain equation when $I_C = 0$). When the collector is shorted to the base, the emitter current rises to 25 mA. Use this expression to obtain the α. Calculate h_{FE} and the base-width (W_B) of the transistor assuming a minority carrier diffusion length of 20 μm in the base and the emitter efficiency to be unity (1).

2. Problem 6.14 (a) in chapter 6 of Muller & Kamins, p. 322 in 3rd edition. Hint: use a simplified Ebers Moll model in which a current generator qG is in parallel with the current generator: ($\alpha_F \times I_F$).

3. Problem 7.1 in chapter 7 of Muller & Kamins, p. 375 in 3rd edition. Hint: for an npn transistor, use Eqns. 7.1.1 with *constant* base doping, and 7.1.3, and 7.1.4 (simplifies with constant base doping and low level injection).

4. Consider a Si double-gate n-channel JFET with the following parameters: $N_A = 3 \times 10^{18} cm^{-3}$, $N_D = 10^{15} cm^{-3}$, a = 2 μm, L = 20 μm, and Z/L = 5. Assume $\mu_n = 1000\ cm^2/V\text{-sec}$ and T = 300K. (a) Calculate the built-in voltage, the pinch-off voltage, and the value of the open channel conductance.

5. Problem 8.1 in chapter 8 of Muller & Kamins, p. 422 in 3rd edition.

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.