

ELEG 646; ELEG 446 - Nanoelectronic Device Principles – Spring 2007

Homework #11 (revised) - due Tuesday, 8 May 2007, in class

1. Problem 7.2 in chapter 7 of Muller & Kamins, p. 375 in 3rd edition. Hint: this is an *npn* transistor, so use Eqns 7.1.4 with constant base doping. For the depletion width on the base side, use an equation similar to (4.2.11) that has been adjusted to yield x_p (portion of depletion width on the p side only).
2. Problem 8.1 in chapter 8 of Muller & Kamins, p.422 in 3rd edition.
3. Derive an expression for the depletion width x_d of an MOS capacitor that is valid for the depletion condition: $V_{FB} < V_{GS} < V_T$. Express x_d in terms of V_{GS} , and oxide parameters such as d_{ox} , ϵ_{ox} , etc. The suggested approach is to set up the MOS charging equation: $V_{ox} + \Psi_s = V_{GS} - V_{FB}$, where $V_{ox} = -Q_{dep}/C_{ox}$, which depends linearly on x_d , and $\Psi_s = qN_A x_d^2/2\epsilon_s$, which of course depends quadratically on x_d . Solve the resulting equation for x_d . Note that this result for x_d can be used to yield the semiconductor contribution ($C_s = \epsilon_s/x_d$) to the total gate capacitance in this region, by putting in series with C_{ox} .

Homework assignments will appear on the web at:
<http://www.ece.udel.edu/~kolodzey/courses/eleg646s07.html>

Note: On each homework and report submission, please give your name, the due date, assignment number and the course number. For full credit - include units/dimensions for all numerical quantities