Homework #6 - EE 482

due 11/20/02

1. A MOS capacitor is made with a silicon substrate doped with $N_a = 5 \times 10^{17}\text{cm}^{-3}$ of boron, 50 Å of silicon dioxide, and an n^+ polysilicon gate doped such that $E_f - E_c = 0.05\,\text{eV}$. Assume there are no significant oxide charges. Determine the charge on the gate, the voltage dropped across the oxide and the voltage dropped across the silicon with the following voltages applied between the gate and the substrate:
   (a) $V_{gb} = -1\,\text{V}$; (b) $V_{gb} = 0.0\,\text{V}$; (c) $V_{gb} = 2\,\text{V}$
   Sketch the charge densities, electric fields and energy band diagrams in each case. What are the capacitances at low and high frequencies in each of the above cases?

2. An MOS capacitor is made on n-type silicon with an oxide thickness of 50 Å, a positive interface charge of $Q'_{ss}/q = 5 \times 10^{10}\,\text{cm}^{-2}$ and a uniform positive oxide charge density of $\rho_{ox}/q = 2 \times 10^{16}\,\text{cm}^{-3}$ throughout the oxide. The substrate is doped with $N_d = 10^{17}\,\text{cm}^{-3}$ and the gate is polysilicon doped with boron just to the edge of degeneracy (p^+ poly, $E_f = E_v$).

   (a) Calculate the flat-band voltage V_{FB} and the threshold voltage V_T.

   (b) Sketch the charge density, electric field and energy-band diagram at flat-band and at the edge of strong inversion.

3. Additional problem(s) to be added. Check back Sunday or Monday.