ECSE-2210 Microelectronics Technology
Class Activity 30

1. a. Find the threshold voltage for a Si n-channel MOS transistor with $N_A = 10^{17}$ cm^{-3}, $\Phi_{ms} = -0.95$ eV, $Q_i = 10^{11}\ q/\text{cm}^2$, and a SiO_2 thickness $d = 200$ Å. ***Hint***: First calculate V_{FB}. Add this to V_T' (= threshold value for the ideal case) to get the actual V_T.

   b. Repeat the above for a p-channel device ($N_D = 10^{17}$ cm^{-3}) with the same material parameters, except Φ_{ms}. Φ_{ms} for this case can be calculated from the change in E_F compared to that of part (a).

   c. Plot qualitatively the *C*-*V* curves for the above two MOS capacitors at high frequency. Mark important points in the curves. Specifically, show the effect of V_{FB}. (Ignore the presence of source and drain for this problem).

d. Find the dose of boron (ions/cm^2) required to change the threshold voltage of the above n-channel device to + 1 V. Assume that the implanted boron resides just below the Si surface and all impurities are ionized. Is this an enhancement mode device or a depletion mode device?

e. Find the dose of (**boron or phosphorus: choose one**) required to change the threshold voltage of the above p-channel device to – 1 V. Assume that the implanted ions reside just below the Si surface. Is this an enhancement mode device or a depletion mode device?