ECSE-2210 Microelectronics Technology
Homework 9

Reading list: Chapter 16

1. An ideal MOS-capacitor has x_{ox}= 0.1 μm, $N_D = 10^{15}$ cm^{-3}, and an area $A = 10^{-3}$ cm^2.
   a. Calculate ϕ_F in units of kT/q and in Volts.
   b. Calculate W when $\phi_S = 2\phi_F$.
   c. Calculate $\mathcal{E}_S$ when $\phi_S = 2\phi_F$.
   d. Calculate $V_G = V_T$ when $\phi_S = 2\phi_F$.
   e. Sketch the general shape (qualitative) of the high frequency $C_G - V_G$ characteristic to be expected from this device.
   f. Defining C_{max} to be the maximum high-frequency capacitance, determine C_{max}.
   g. Defining C_{min} to be the minimum high-frequency capacitance, determine C_{min}.
   h. Suppose the gate bias is such that $\phi_S = 3\phi_F / 2$. Draw the MOS-capacitor energy band diagram corresponding to the specified gate bias. (Be sure to include the diagrams for all three components of the MOS-capacitor, show the proper band bending in both the oxide and the semiconductor, and properly position the Fermi level in the metal and the semiconductor.)
   i. The *C-V* characteristic of the device is measured as the dc bias is **rapidly** swept from accumulation into inversion. Using a dashed line, sketch the expected form of the resulting *C-V* characteristic on the same set of coordinates as in the part (e) answer.