Homework #2 assigned 2/16/05  due 2/23/05

HW2.1  Consider a p-MOS inverter consisting of a p-MOS driver transistor with W/L = 6 and a p-MOS load device with W/L = 1. The power supply voltage, V_{DD}, is -10 V and the gate of the load device is connected to V_{DD}. Calculate and plot the transfer characteristic (output voltage versus input voltage) of this inverter for an input voltage varying from 0 V to -10 V. The p-MOS devices are made on a n-type, 2 x 10^{15} cm^{-3} doped substrate, have an aluminum gate, $\Phi_M = 3.94$ V, $\chi = 4.05$ V, and a 0.08 $\mu$m thick gate oxide. Use the table in the back of the book for the physical constants and use a hole mobility of 450 cm$^2$/Vs.

HW2.2  Assume a silicon metal gate CMOS process where the gate metal is aluminum ($\Phi_M = 3.94$ V, $\chi = 4.05$ V) and the gate oxide is 0.1 $\mu$m thick.

a) Find the n and p-type doping concentrations for the substrate and the well for which the threshold voltages of the n-MOS and p-MOS transistor are $V_{Tn} = 1$ Volt and $V_{Tp} = -1$ Volt. Solve this problem graphically by plotting $V_{Tn}$ and $V_{Tp}$ versus doping concentration. Make sure that your solution is within 10% of the exact solution by scaling the graph appropriately. Provide the graph with your solution.

b) Is a p-type well or an n-type well required to satisfy the above threshold voltage requirement? Explain. Compare this situation to the discussion in Jaeger 9.3.