ENEE 302 Homework Set 2   Due Tu 03/09/04

for all these problems use the mnmosis and mpmosis transistors with (unless otherwise specified) L=W=10u, Vdd=5V=-Vss.

#1. 25 points (design of current sources)

Give analytic design (that is, use equations) of current sources to give 1.2mA via the following circuits:

a). A current "sink" with the current determined by a resistor R (attached to Vdd) and the left and right NMOS transistors identical with the sources and bulks tied to Vss.

b). A current "source" with the current determined by a resistor R (attached to Vss) and the left and right PMOS transistors identical with sources and bulks tied to Vdd.

c). Replace the resistor R by a PMOS for a) and an NMOS for b) and repeat parts a) and b) except now allow the W/L of the sink or source transistor to vary as needed.

#2. 25 points (Spice check of current source designs)

a) Run Spice to check all of the results of problem #1 above. Explain any differences between the simulation versus the analytic results. For this use a load that is ground.

b) For the "sink" current source of problem #1c) make a Spice plot showing the NMOS curve with the PMOS curve for a load line. From that find the voltage at the Q point for the left side of the circuit. Calculate this Q point voltage analytically and discuss any differences.

#3. 25 points (CMOS switches)

Setup the following circuit in Spice plot Vin, Voutp, and Voutn for 0<t<20ns. Zoom into 0<t<0.3ns. Write equations justifying the non-transient behavior and discuss the transient behavior and why it is to be expected.
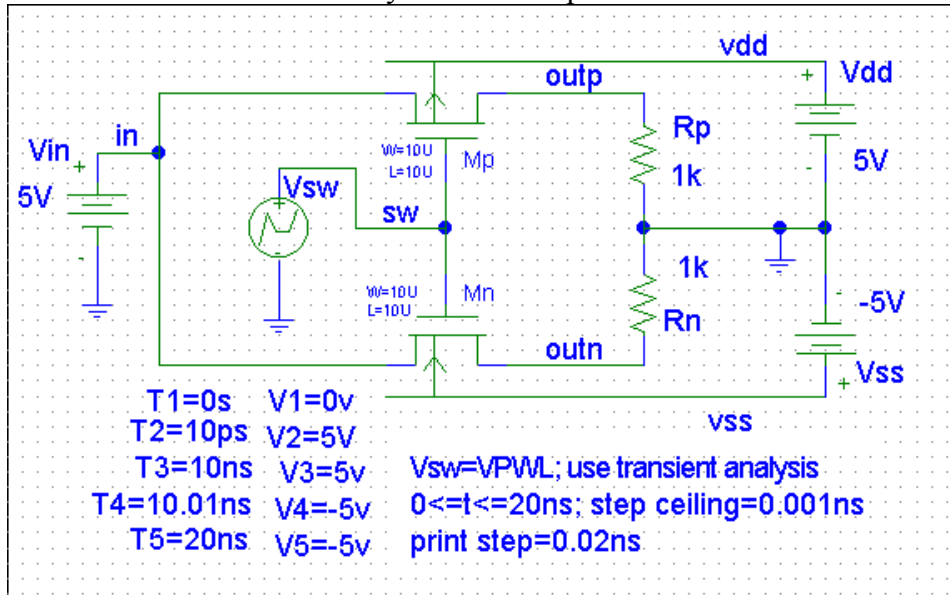
#4. 25 points (switches for pass transistor logic)

Set up and run the pass transistor logic circuit of Figure 10.30, p. 990, [= Figure 13.30 p. 1088 of fourth edition] of the text. Check that it gives the designated logic function.