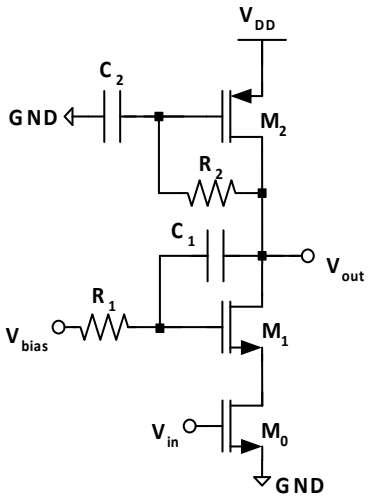
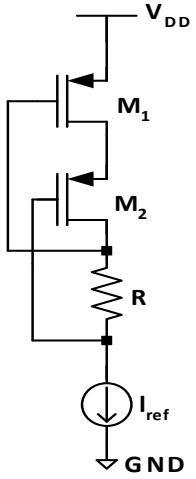
EECE488 Analog CMOS Integrated Circuit Design
Assignment 3
Due: Thursday March 8th, 2012 at 9:30am

1. Calculate the gain of the following circuit at very low and very high frequencies. Neglect all other capacitances that are not shown in the circuit and assume $\lambda = \gamma = 0$.



2. In the following cascode circuit (typically referred to as self-biased cascode circuit) the resistor R is used to maintain a proper voltage to allow both M_1 and M_2 remain in saturation.



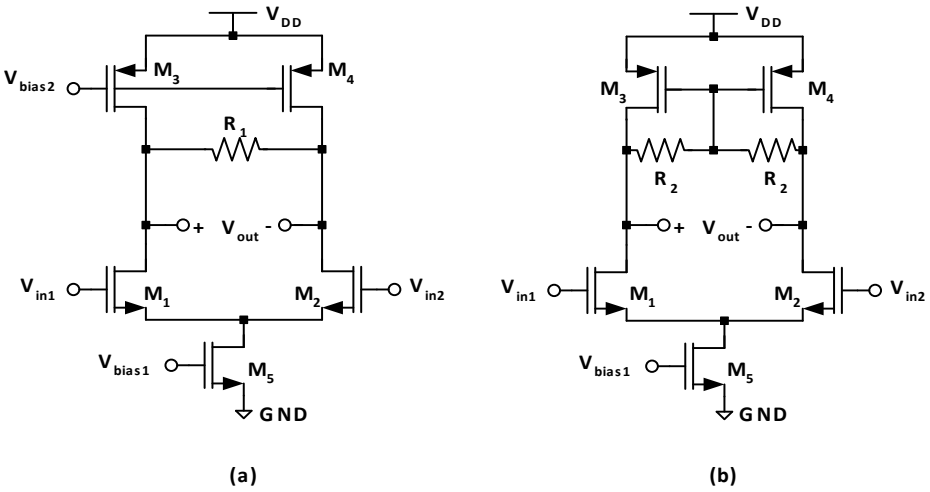
Assume both M_1 and M_2 have the same size W/L. Ignoring the channel length modulation and the body effect, show that for M_1 and M_2 to remain in the saturation region we should have:

$$\frac{2}{\mu_p C_{ox}\left(\frac{W}{L}\right)R^2} \le I_{ref} \le \frac{|V_{tp}|}{R}$$

3. Assuming the following two circuits are symmetric and $\gamma = 0$: and $\lambda \neq 0$:

a) Find the expressions for the small-signal differential voltage gain of each circuit.

b) Assuming that the corresponding transistors of each of the circuits are identical and the two circuits have the same small-signal differential voltage gain, find the relationship between R_1 and R_2.



4. Assuming all the transistors in the following symmetric circuits are in saturation, $\lambda \neq 0$ (for the circuit on the right assume $\lambda = 0$) and $\gamma = 0$, calculate the small-signal differential voltage gain of each circuit.