Homework 2

ECE 5411 – CMOS Analog IC Design (Spring 2011)

Due on Monday, Jan 31, 2011.

Note: Use Cadence schematic capture, layout and Spectre simulation tools, available on the AMS servers for the homework problems.

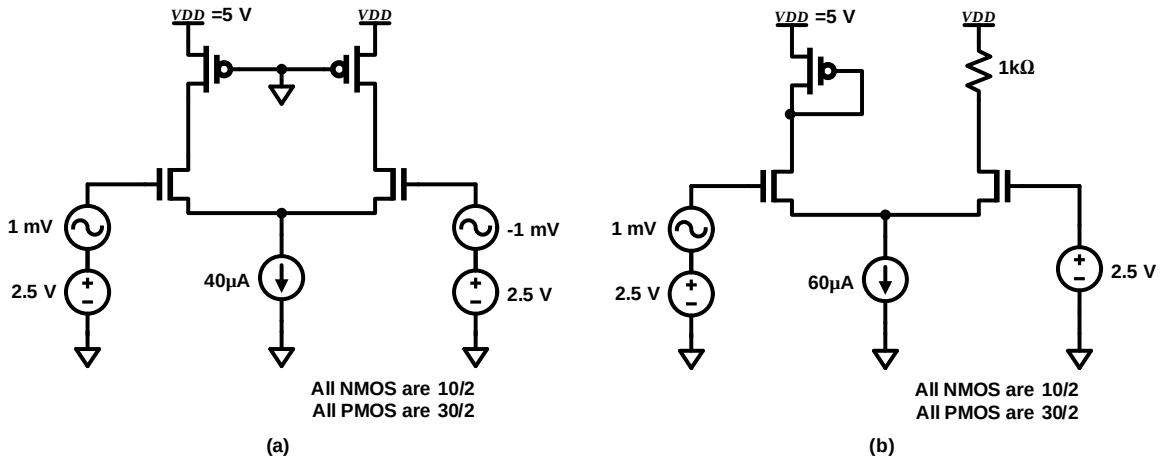
Problems 1-3: Do problems A9.3-A9.5 from the extra problem set available on the textbook website. For A9.4 and A9.5 each, do Spectre simulation for any of the two circuits.

Problem 4: Show that, when the channel length modulation is considered, the transconductance of an NMOS is given by the equation

$$g_m = \beta_n(V_{GS} - V_{THN})(1 + \lambda(V_{DS} - V_{DS,sat}))$$

Comment on this result and plot this g_m as a function of V_{DS}.

Problem 5: Repeat Example 9.5 from the book for the circuits shown below. Clearly show all the hand calculations and compare them with Spectre results.



Problem 6: In this problem, we will further explore the notion of *small-signal*. Consider two non-linear amplifiers with their input output characteristics given by $V_{out} = \frac{V_{in}^2}{V_A}$ and $V_{out} = V_A e^{\frac{V_{in}}{V_A}}$.

a) A small-signal gain ($A_v = \frac{v_{out}}{v_{in}}$) of 10 is desired from both of these amplifiers. Determine the operating points so that this gain can be achieved.

b) Recall that the small-signal approximation is valid only when the higher order terms in the Taylor series expansion can be neglected when compared to the linear term. Compare the second order derivative of the two amplifiers around the operating point. What can you say about the relative magnitudes of the incremental inputs for each of the amplifiers which qualify as small signals ?