Homework 8

ECE 5411 − CMOS Analog IC Design (Spring 2011)

Due on Monday, Mar 28, 2011.

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

Problems A1: Understand examples 21.6-21.10 in the textbook. Do problems A21.19 and A21.20. Simulate **any one** of the problems in Spectre. You may use the provided MATLAB scripts to generate frequency and pole-zero plots and augment your understanding.

Problems A2: Do problems A21.21 and A21.23. Simulate **any one** of the problems in Spectre. You may use the provided MATLAB scripts to generate frequency and pole-zero plots and augment your understanding.

**Problem B1:** For the amplifier shown in the figure below:
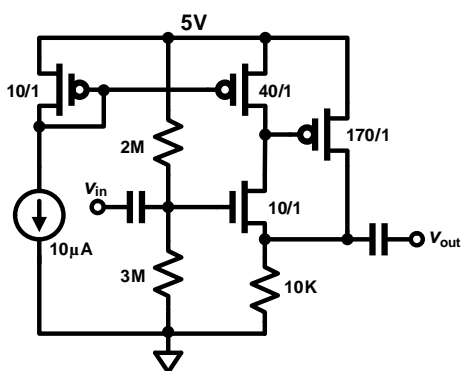
$V_{THN} = 0.7V$, and $KP_n = 200\frac{\mu A}{V^2}$

$V_{THP} = 0.8V$, and $KP_p = 50\frac{\mu A}{V^2}$

$\gamma = 0$

a) Determine the operating points of all the devices in the circuit. For this part, neglect channel length modulation ($\lambda = 0$).

b) All transistors in the circuit have finite r_o, such that for any transistor $g_m r_o = 100$. Draw the small signal equivalent circuit of the amplifier, and determing the small signal gain $\left(\frac{v_{out}}{v_{in}}\right)$. Also determine the input and output resistances of the amplifier (Perform low-frequency analysis only).

c) Determine the amplitude of the largest sinusoid that can be applied to the input so that there is no clipping at the output. Assume that the coupling capacitors are infinite.

Problem B2: Repeat problem B1 for the amplifier shown in the figure below.
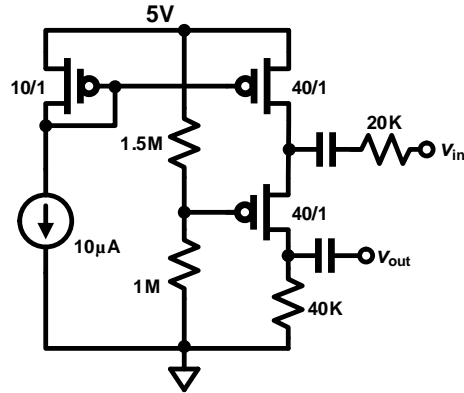
Problem B3: Estimate the poles of each circuit shown in the figure below (symbolic answers). Assume that the current sources are ideal. For part (a) use $\lambda \neq 0$, and for part (b) assume $\lambda = 0$

(a)   **(b)**
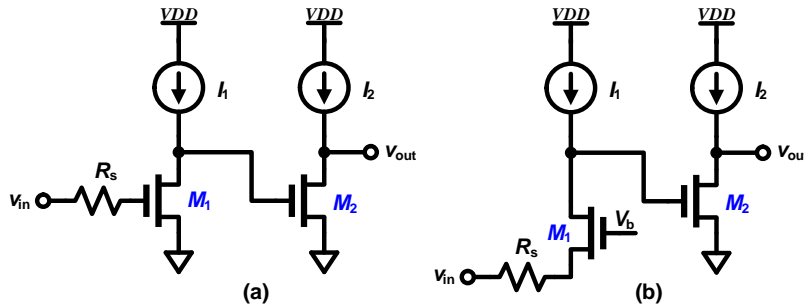
Problem B4: Calculate the input impedance and the small-signal transfer function for each of the circuits shown below (symbolic answers). For both the parts assume $\lambda = \gamma = 0$.

(a)   **(b)**