Homework 8

ECE 5411 – CMOS Analog IC Design (Spring 2012)

Due on Monday, Apr 2, 2011.

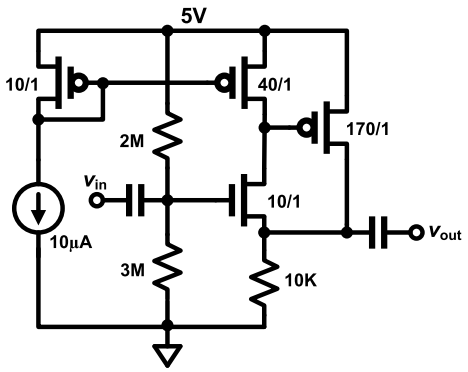
Note: Use Cadence schematic capture, layout and Spectre simulation tools, available on the AMS servers for the homework problems.

Problems A1: Understand examples 21.6-21.10 in the textbook. Do problems A21.19 and A21.20. Simulate them using Spectre. Use the provided MATLAB script (*CommonSourceFreqResp1.m*) to generate frequency and pole-zero plots to augment your understanding.

Problems A2: Do problems A21.21 and A21.23. Simulate them using Spectre. Use the provided MATLAB script to generate frequency and pole-zero plots.

Problems A3: Using the method used in class, show that the zero location in a common-source amplifier is given by $\omega_z = \frac{g_{m2}}{C_c}$. Similarly, derive the expression for the zero location when a zero-nulling resistor R_z is added in series with C_c. Modify the MATLAB file *CommonSource-FreqResp1*, to account for R_z and demonstrate zero-nulling and LHP zero creation with this script.

Problem B1: For the amplifier shown in the figure below:



$V_{THN} = 0.7V,$ and $KP_n = 200\frac{\mu A}{V^2}$

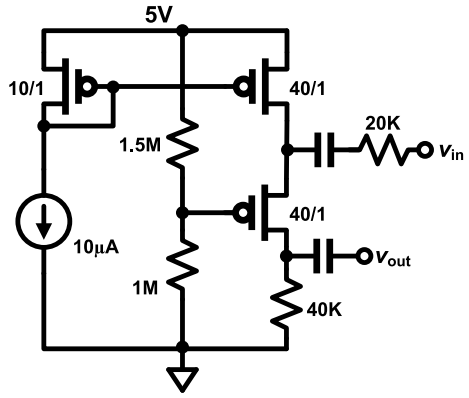
$V_{THP} = 0.8V,$ and $KP_p = 50\frac{\mu A}{V^2}$

$\gamma = 0$

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 determine the small signal gain ($\frac{v_{out}}{v_{in}}$). Also determine the input and output resistances of the amplifier (Perform low-frequency analysis only).

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 $\lambda = 0$