Homework Assignment No. 5

Due Monday, February 14, 2005 in class (because of Exam 1, you may turn in by 2/16)

Problem 1 - (10 points - Problem 6.2-8 of A&H)

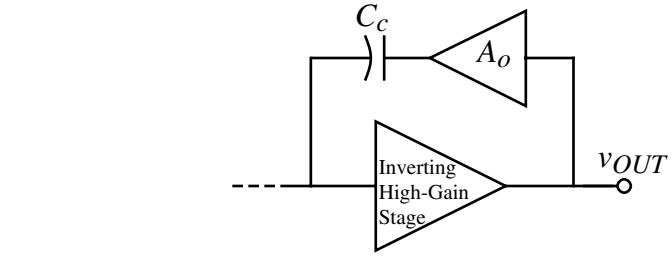
A two-stage, Miller-compensated CMOS op amp has a RHP zero at 20*GB*, a dominant pole due to the Miller compensation, a second pole at p_2 and a mirror pole at -3*GB*. (a) If *GB* is 1MHz, find the location of p_2 corresponding to a 45° phase margin. (b) Assume that in part (a) that $|p_2| = 2GB$ and a nulling resistor is used to cancel p_2. What is the new phase margin assuming that *GB* = 1MHz? (c) Using the conditions of (b), what is the phase margin if C_L is increased by a factor of 4?

Problem 2 – (10 points - Problem 6.2-10 of A&H)

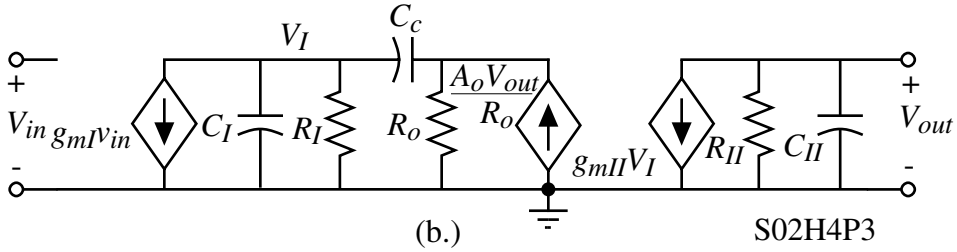
For the two-stage op amp of Fig. 6.2-8, find W_1/L_1, W_6/L_6, and C_c if *GB* = 1 MHz, $|p_2|$ = 5 *GB*, z = 3 *GB* and $C_L = C_2$ = 20 pF. Use the parameter values of Table 3.1-2 and consider only the two-pole model of the op amp. The bias current in M5 is 40 μA and in M7 is 320 μA.

Problem 3 – (10 points – Problem 6.2-11 of A&H)

In the figure shown, assume that R_I = 150 kΩ, R_{II} = 100 kΩ, g_{mII} = 500 μS, C_I = 1 pF, C_{II} = 5 pF, and C_c = 30 pF. Find the value of R_z and the locations of all roots for (a) the case where the zero is moved to infinity and (b) the case where the zero cancels the highest pole.



(a.)



(b.)

S02H4P3

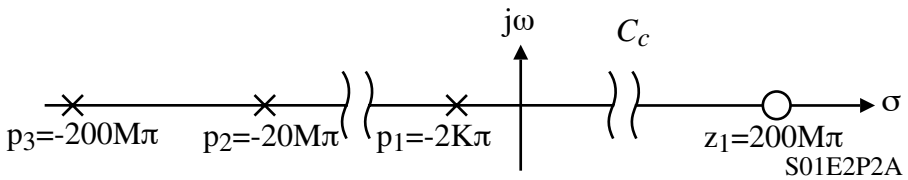
Problem 4 – (10 points)

The poles and zeros of a Miller compensated, two-stage op amp are shown below.

(a.) If the influence of p_3 and z_1 are ignored, what is the *GB* in MHz of this op amp for 60° phase margin?

(b.) What is the value of $A_v(0)$? What is the value of C_c if $g_{m1}=g_{m2}=500\mu S$?

(c.) If p_2 is moved to p_3, what is the new *GB* in MHz for 60° phase margin? What is the new C_c if the input transconductances are the same as in (b.)?



S01E2P2A

Problem 5 – (10 points)

A self-compensated op amp has three higher order poles grouped closely around $-1x10^9$ radians/sec. What should be the *GB* of this op amp in Hz to achieve a 60° phase margin? If the low frequency gain of the op amp is 80dB, where is the location of the dominant pole, p_1? If the output resistance of this amplifier is 10MΩ, what is the value of C_L that will give this location for p_1? (Ignore any other capacitance at the output for this part of the problem).