VE311 Electronic Circuit HW9
Due: **Aug 3rd 11:59 p.m.**

Note

1. Please use A4 size paper or page.
2. Please clearly state your final result for each question.
3. This is your last assignment:)
   Congratulations on surviving this course.

Problem 1

Here M_3 and M_5 double cascode the current source M_2. Transistors M_1-M_5 are identical having width W and length L. Both M_6 and M_7 also have width W. This problem concerns the lengths of M_6 and M_7. Assume M4 is in saturation. Ignore the body effect. What are the minimum lengths for transistors M6 and M_7 so that the cascode transistors have the appropriate bias voltages?

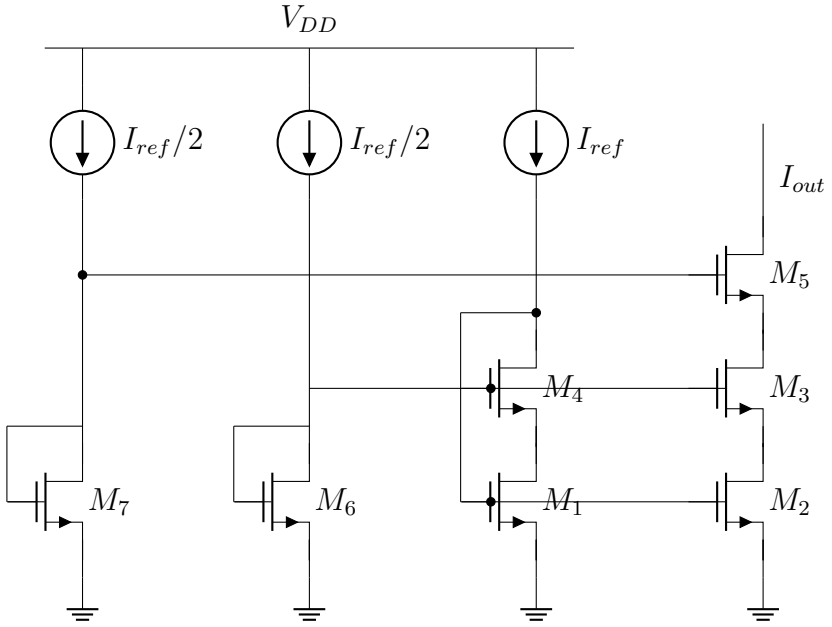

Figure 1: circuit for problem 1

Problem 2

Assume $\lambda = 0$ and both M_1 and M_2 are in saturation. M_1 and M_2 are identical. Ignore the body effect.
a) Write an expression for the low-frequency small-signal differential gain.
b) Write an expression for the low-frequency small-signal common mode gain

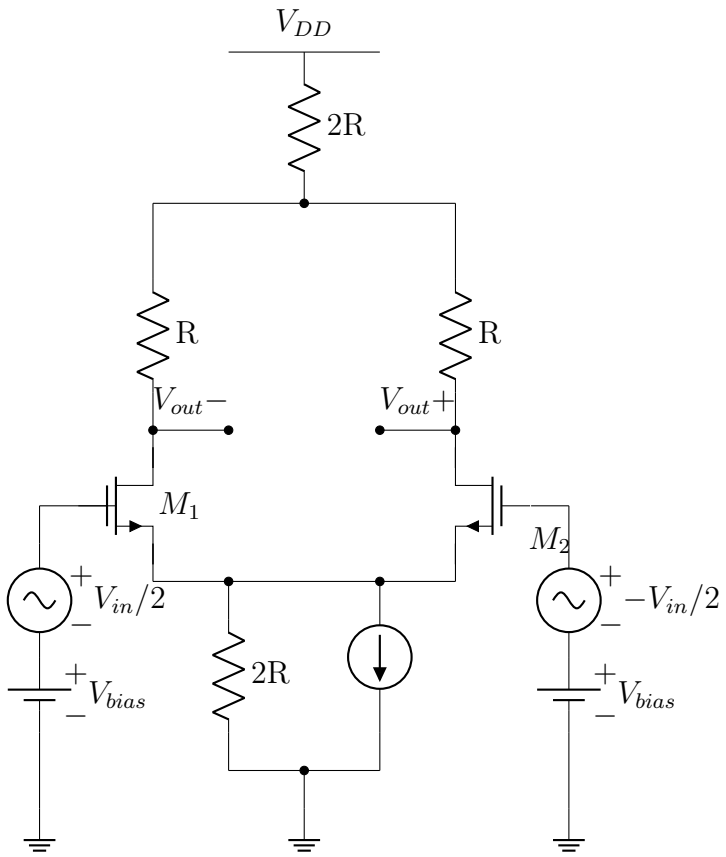

Figure 2: circuit for problem 2

Problem 3 (Not Graded)

In the circuit of Fig below, the voltage amplifier is ideal (i.e., it has an infinite input resistance and a zero output resistance).
(a) Use the Miller approach to find an expression for the input capacitance C_{in} in terms of A and C.
(b) Use the expression forC_{in} to obtain the transfer function $V_o(s)/V_{sig}(s)$.
(c)If $R_{sig} = 1$ kΩ, and the gain $V_o(s)/V_{sig}(s)$ is to have a dc value of 40 dB and a 3-dB frequency of 100 kHz, find the values required for A and C.

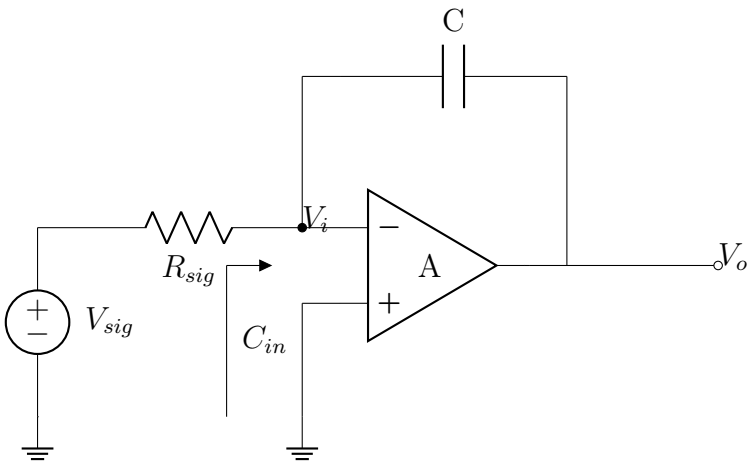

Figure 3: circuit for problem 3

Problem 4 (Not Graded)

Assume that the amplifier is operating in FAR. Ignore all capacitances except those shown. Ignore r_o.
(a) Draw the small-signal model of the given circuit.
(b) Write an expression for the low-frequency small-signal gain, v_o/v_i.
(c) Next, write an expression for the frequency-dependent small-signal gain v_o/v_i. What are the pole/zero frequencies? (Consider only the capacitors shown in the figure. Use open-circuit short circuit time consatnt method)

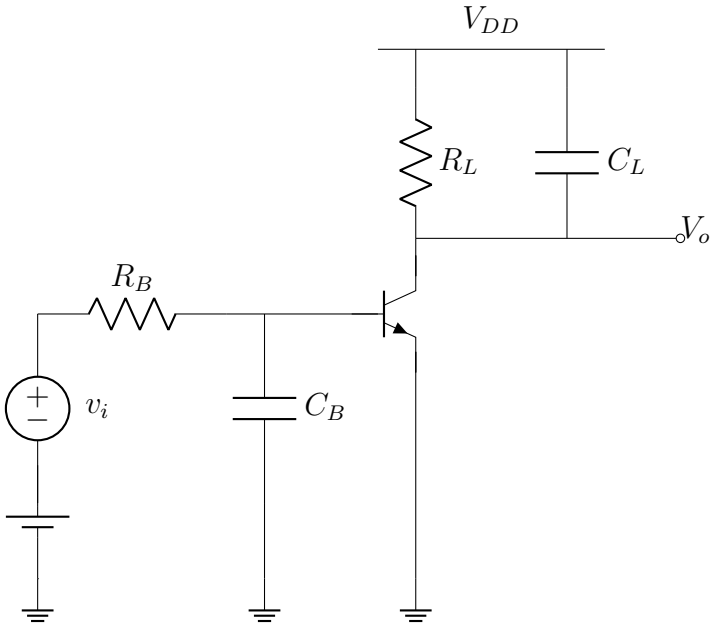

Figure 4: circuit for problem 4