ECE115B **Final Exam** **Winter 2020**

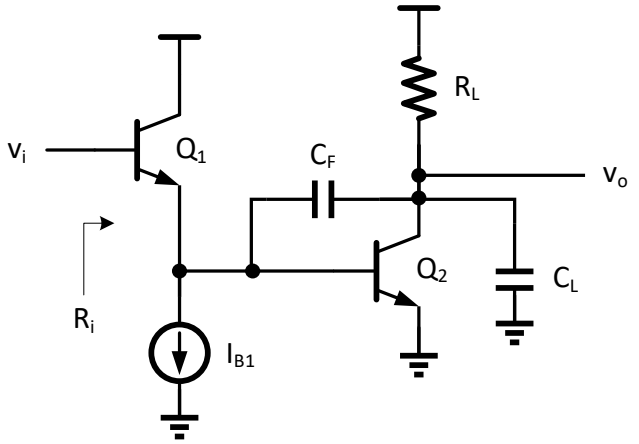
Name: _____

UID: _____

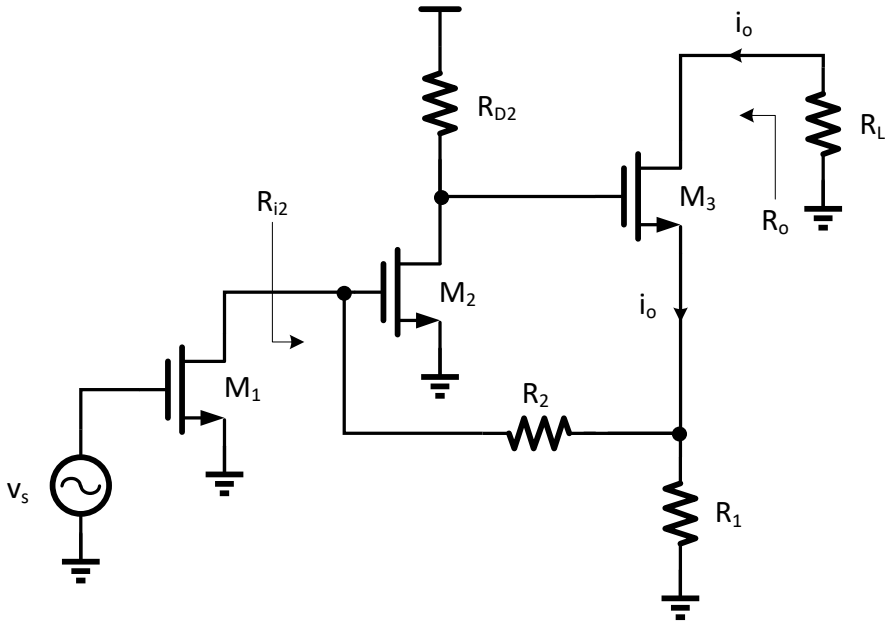
Total of 3 questions, 3 hours.

P1 (30)	
P2 (40)	
P3 (30)	
Total (100)	

1. In the amplifier below, $V_A = \infty$ for both transistors, and ignore all the internal capacitances. Assume that both transistors are in forward active mode, with identical bias currents (all the bias details not shown).
   a. Find the low frequency gain and input impedance.
   b. Determine the number of poles and zeros.
   c. Find the location of zero(s) intuitively
   d. Using Miller approximation, determine the location of the poles. Does the amplifier have a dominant pole? Is Miller approximation valid in this case? Assume C_F and C_L are comparable.
   e. Find the exact transfer function.



2. In the feedback amplifier below, assume that all the transistors are in saturation, and ignore r_o for all transistors (except for part c). Using feedback techniques:
   a. Calculate the loop gain, and consequently the low frequency transconductance gain ($\frac{i_o}{v_s}$).
   b. Find the resistance looking into the gate of M_2 (R_{i2}).
   c. Find the output resistance R_o at the drain of M_3 as shown. Do not ignore the r_o of M_3, but you can still use the loop gain from part a.



3. Consider the amplifier shown below, where $\beta = 100mA/V^2$, and $\lambda = 0.2V^{-1}$ for all the transistors. Assume all the transistors are in saturation.
   a. Calculate the DC current and small signal parameters of the transistors.
   b. Estimate the low frequency gain ($\frac{v_o}{v_i}$) of the circuit.
   c. Find the poles of amplifier assuming that $C_1 = 5pF$, and $C_2 = 0.5pF$ are the only capacitors in the circuit.
   d. Draw the Bode plots of the amplifier gain and phase.
   e. Find the phase margin of the amplifier if it were to be used in a unity feedback.
   f. Calculate C_1 required to guarantee a phase margin of 45° for the amplifier with unity feedback.