IMPORTANT: Besides your calculator and the sheets you use for calculations you are only allowed to have an A4 sized "copy sheet" during this exam. Notes, problems and alike are not permitted. Please submit your "copy sheet" along with your solutions. You may get your "copy sheet" back after your solutions have been graded. **Do not forget to write down units!**

ELE222E INTRODUCTION TO ELECTRONICS (21403)
Final Exam ✎ 30 May 2007 ⏰ 13.00-15.00 - 5305
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1. What is a semiconductor? How does a semiconductor differ from a conductor? Explain within two sentences. (5 points)

2. What are some of the similarities and differences between MOSFET and BJT transistors. Provide at least 2 of each. (5 points)

3. As your term project you built a power supply. Explain how the full wave rectifying diode bridge operates. That is, consider 30 V rms from the secondary wiring of a transformer (input to the primary wiring is 220 V rms) and ground as the <u>three inputs</u> to your full wave rectifying diode bridge.

   a. Draw the bridge circuit, indicate inputs and outputs. (5 points)

   b. Explain how it functions for each alternance of the waveform (30 V rms). (5 points)

   c. Sketch the output waveform to scale. (5 points)

4. Design an OPAMP circuit to realize $v_o = 2v_1 - 3v_2 + v_3$. Please use <u>meaningful</u> resistor values. (15 points)

5. Assume you have a 1 mA <u>ideal</u> current mirror feeding the first stage of the 3-stage amplifier shown below.

a. Find R_1, R_3, I_{C3} and I_{C4}, such that, waveform distortion at the output V_o is minimum and symmetrical with $r_o = 50\Omega$. (20 points)

   Note, $h_{FE} = h_{fe} = 250$, $V_T = 25$ mV,
 $|V_{BE}| = 0{,}6$ V, $h_{oe} = h_{re} = 0$.

b. Do the AC analysis and find the total voltage gain, CMRR, and the differential input resistance. (20 points)

   If you could not find the collector currents correctly in (a), use the following values and do the AC analysis:
   $R_1 = R_3 = 4k$; $I_{C3} = I_{C4} = 1$ mA.
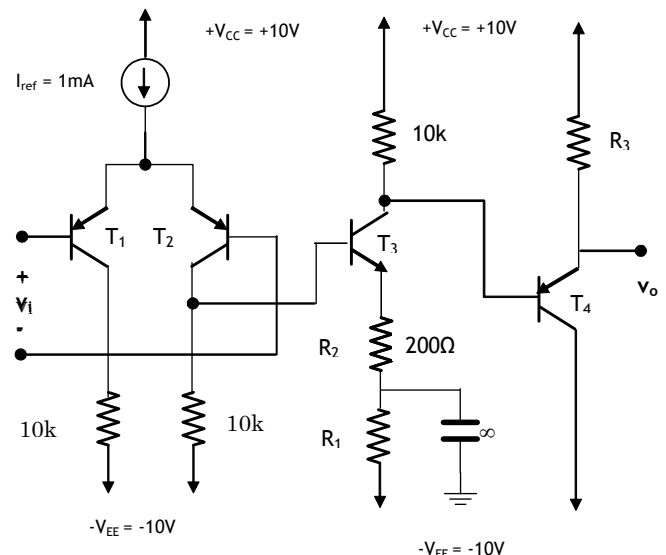
6. On the left you see an IC MOS amplifier.
   Assuming the biasing current sources have very high output resistance, find an expression for the overall voltage gain in terms of gm and ro of individual MOS transistors.
   How does the overall gain change when a signal source with internal resistance R_s is used and a load resistor R_L is connected to the output? (20 points)
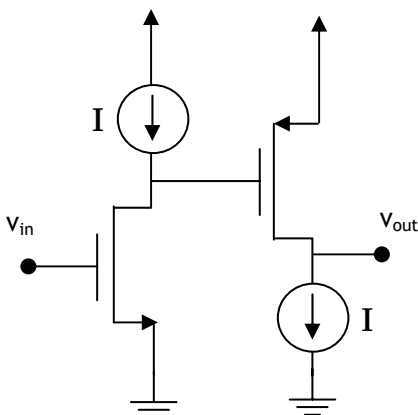
GOOD LUCK!

Please see previous years' pages for solutions....