EE 140/240A Prof. Pister
Spring 2016

Homework Assignment #8

Due by online submission **Wednesday** 3/30/2016 (Thursday 9am)

1. 08sp Midterm2 problem 4
2. 15sp Midterm2 problem 5
3. In Figure 9.20 in the book, what is causing the zero in the transfer function? For each of Figures 9.21, 22, and 23, explain both how the capacitor still provides Miller compensation, and yet the circuit topology gets rid of the zero. To explain, you probably need to talk about forward current from the output of stage 1 to the output of stage 2, and reverse current from the output of stage 2 to the output of stage 1.
4. "Frequency response notes" (linked from web page) problem 9
5. For the bandgap reference labeled "Figure 6" in your Lab4 assignment, assume that the circuit is operating properly with 10uA of current flowing in each leg, N=10, the temperature coefficient of the diode voltage at constant current is -1.5mV/K, and that at room temperature the diode voltage necessary to pass 10uA through a single diode is 0.7V.
   a. What is the room-temperature voltage necessary for 10 diodes in parallel to pass 10uA?
   b. What is the room-temperature voltage across R1 (assuming an ideal op-amp, so V+=V-)
   c. On the same plot, carefully sketch by hand the voltage on the single diode, the voltage on the 10 parallel diodes, and the voltage on R1, all vs. temperature from 60C below to 60C above room temperature. For simplicity, assume that room temperature is 27 Celsius, or 300 K (that's actually a little hot for room temp but makes the math easier).
6. In the circuit below, assume that the supply is 1V, the magnitude of the threshold voltages is 0.5V, the overdrive voltage in M1A is 200mV, that M2AB makes a perfect current mirror, and that M1B is made up of four copies of M1A. All transistors are well-modeled by the quadratic model.
   a. What are the bias voltages on all of the nodes?
   b. What is the current in each leg?
   c. What is gm of M1A?
   d. What is gm of M1B?
   e. What is the minimum supply voltage that will keep all of the devices in saturation?
7. [240A] How would the circuit in the previous problem behave if all of the devices were velocity saturated?
8. [240A] For the low-voltage bandgap reference in Banba et al., what is a practical lower limit on the supply voltage?