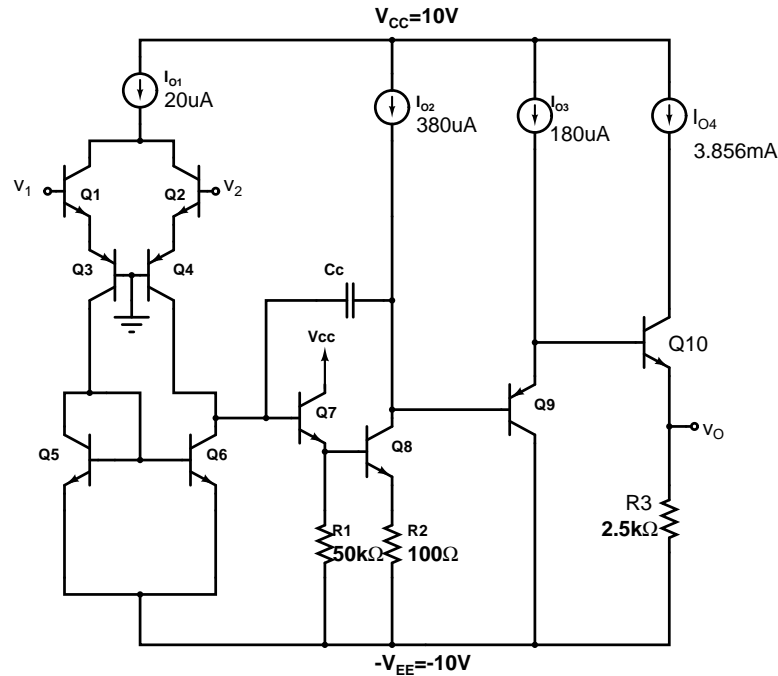


INEL4202 Bonus Homework 2 - May 14, 2013

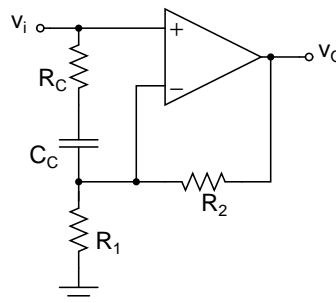
The following problems will count for 5 bonus points each. You may work in groups of up to 3 students and submit one solution per team. Solutions are due at the beginning of the final exam.

1. Shown below is the schematic diagram for an opamp. Assume ideal current sources, and  $\beta = 100$ ,  $V_A = 100V$  for all transistors, Determine

- the differential-mode gain,  $A_{dm} = \frac{v_O}{v_2 - v_1} = \frac{v_O}{v_d}$
- the common-mode gain,  $A_{cm} = \frac{v_O}{v_{cm}}$  (when  $v_1 = v_2 = v_{cm}$ )
- the input and output resistances ( $R_{in}$  and  $R_{out}$ ) for differential-mode signals, and
- the slew-rate and unity-gain frequency,  $f_t$ , if  $C_C = 10pF$ .



2. An otherwise ideal op amp has one pole at 10kHz, a second pole at 200kHz, and a unity-gain frequency of 10MHz. The op amp will be used to design a one-stage non-inverting amplifier as shown in the following figure.



Determine the following quantities:

- opamp open-loop d.c. gain if  $C_C$  and  $R_C$  are not present.
- phase-margin if  $R_2 = 10k\Omega$  and  $R_1 = 100\Omega$  if  $C_C$  and  $R_C$  are not present.
- Select  $R_C$  and  $C_C$  to get a phase margin of  $45^\circ$ .