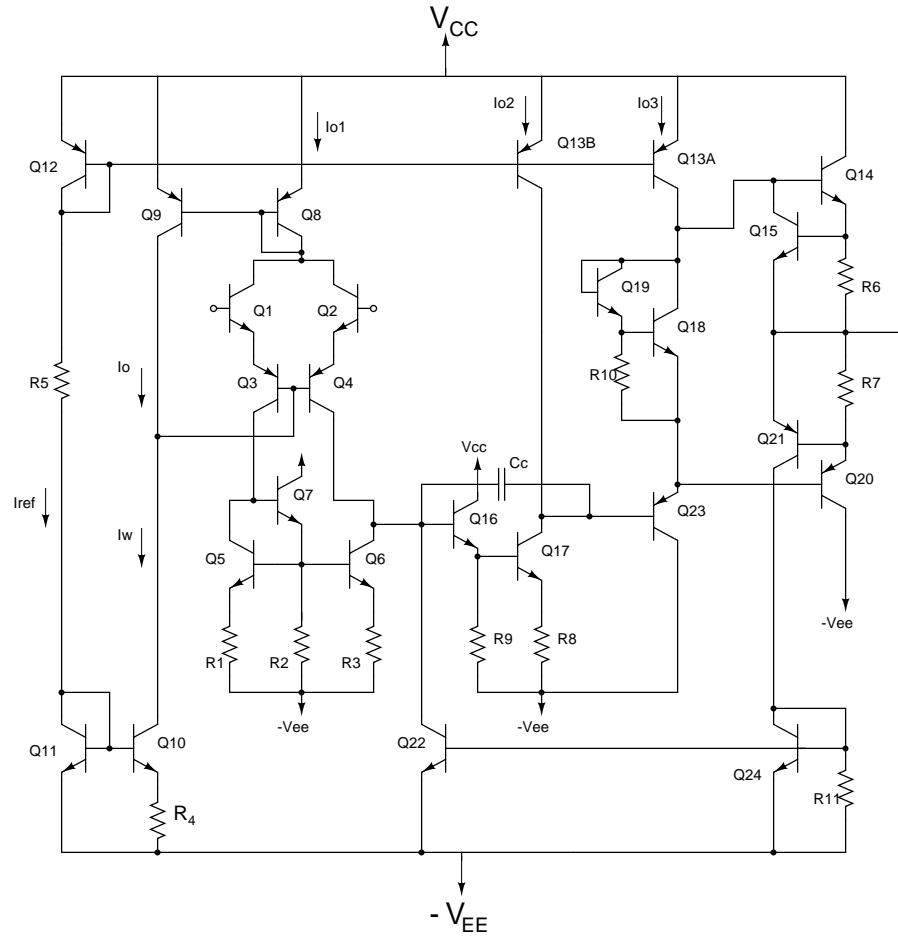


INEL 4202 - Electronics II - Opamp Circuits
Extra Practice Problem Set

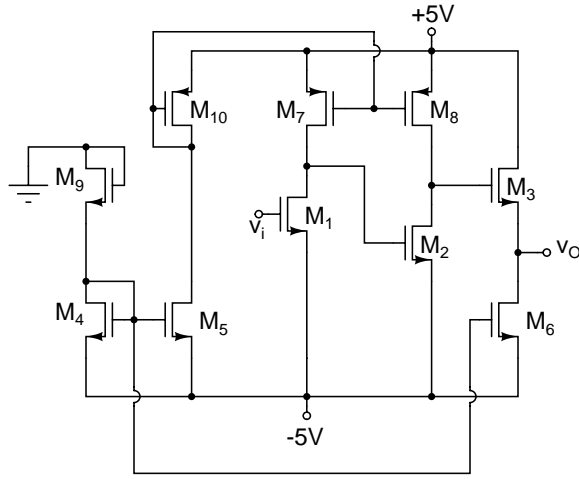
1. The schematic diagram for the uA741 operational amplifier is shown below. The supply voltages are $V_{CC} = V_{EE} = 5V$. The relevant resistor values are: $R_5 = 39k\Omega$ and $R_4 = 5k\Omega$. Assume that $Q_8, Q_9, Q_{10}, Q_{11}, Q_{12}$ have equal areas, and that the areas of Q_{13B} and Q_{13A} are 25 % and 75 % of the area of Q_{12} , respectively. Neglect the base current of transistors Q_3 and Q_4 in your analysis. Determine

- the bias currents I_{O1}, I_{O2} and I_{O3} .
- the input resistance $R_d = 4r_\pi$ of the amplifier looking from the base of Q_1 to the base of Q_2 .
- the overall voltage gain.
- the bandwidth and slew rate if $C_C = 30pF$

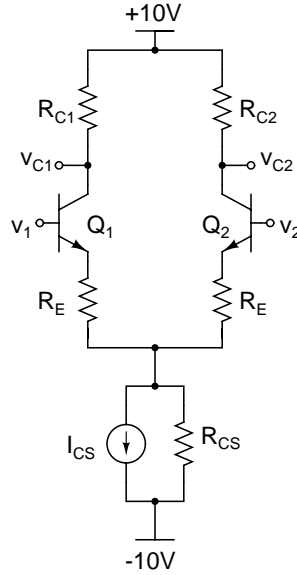


2. The following diagram shows a multistage amplifier biased by current mirrors. The transistor parameters are: $k'_n = 80\mu A/V^2$, $k'_p = 40\mu A/V^2$, $V_{tn} = -V_{tp} = 0.7V$, $\lambda_n = \lambda_p = 1/100V$, $(W/L)_{1,2,4,5,7,10} = 2/1$ and $(W/L)_{3,6,8,9} = 8/1$. Determine the following quantities:

- bias currents for all transistors.
- overall voltage gain if no load is present.
- voltage gain and power dissipated if $R_L = 1k\Omega$ is attached to the output.



3. For the following differential amplifier,



find

- The differential gain $A_d = \frac{v_{C1} - v_{C2}}{v_d}$ when $v_1 = +v_d/2$ and $v_2 = -v_d/2$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 0$, $R_{CS} = \infty$ and $I_{CS} = 200\mu A$.
- The differential gain $A_d = \frac{v_{C1} - v_{C2}}{v_d}$ when $v_1 = +v_d/2$ and $v_2 = -v_d/2$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 500\Omega$, $R_{CS} = \infty$ and $I_{CS} = 200\mu A$.
- The common-mode rejection ratio if $v_o = v_{C1}$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 0$, $R_{CS} = 500k\Omega$ and $I_{CS} = 200\mu A$.
- The common-mode rejection ratio A_{cm}/A_d if $v_o = v_{C1} - v_{C2}$, $R_{C1} = 20.5k\Omega$, $R_{C2} = 19.5k\Omega$, $R_E = 0$, $R_{CS} = 500k\Omega$ and $I_{CS} = 200\mu A$.