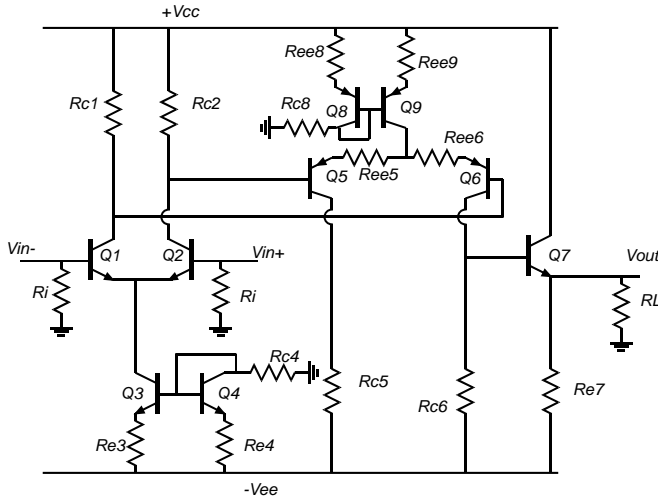
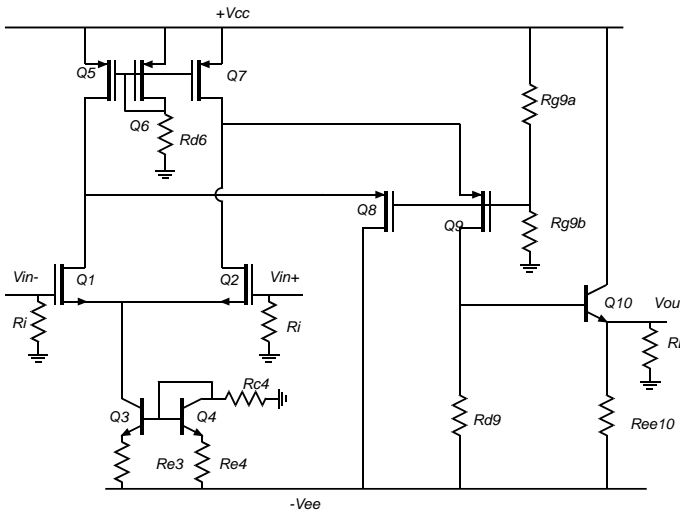


ECE137A Problem set #6



Problem 1: The supplies are +/- 5 V. The transistors all have $\beta=500$ and $V_a=100$ Volts. The Emitter resistors (Re_3 and Re_4 , Ree_8 , Ree_9) all have 200 mV DC voltage drop. $R_i=10$ kOhm. $R_L=1$ kOhm. $Ree_5=Ree_6=100$ Ohm

The DC input voltages are 0 V, the DC output voltage is to be 0 V. Q_1 and Q_2 are biased at 100 μ A, Q_5 and Q_6 at 1 mA, and Q_7 at 5 mA. The bases of Q_5 and Q_6 are at +3 Volts. Find all bias values, all resistor values, the differential and common-mode voltage gains, the CMRR, and the output impedance.



Problem 2:
The NMOS FETs have 1.2 nm oxide thickness, 250 nm gate length, and a 0.4 V threshold. Mobility is $400 \text{ cm}^2/(\text{V}\cdot\text{s})$, and $1/\lambda=25 \text{ V}$. The PMOS FETs are the same, except have -0.4 V threshold and $200 \text{ cm}^2/(\text{V}\cdot\text{s})$ mobility. The FETs are to all operate at $|V_{gs}|=0.6$ V. $I_{d1}=I_{d2}=100 \mu\text{A}$. $I_{d5}=I_{d6}=I_{d7}$ $I_{d8}=I_{d9}=1 \text{ mA}$. $I_{c3}=I_{c4}$. The voltage drops across Re_3 and Re_4 are 300 mV. The supplies are +/- 2 V, and the gates of Q_8 and Q_9 are at +0.25 V.

a) Find all resistor values, all FET widths, all DC bias currents and voltages. (b) Find the amplifier differential and common mode gains. (c) Find the differential input impedance. Find the output impedance and the maximum peak-peak output swing.

Ignore the effect of λ in the DC analysis but not the AC analysis. Q_{10} operates at 1 mA emitter current. V_{in-} and V_{in+} are at zero volts DC, as is V_{out} . The BJTs have $\beta=200$. R_{g9A} is 1 MOhm.