ECE137A Problem set #5
Problem 1

The NMOSFET has

$K_\mu = 10\text{mA/V}^2 \cdot (W_g / 1\mu\text{m})$

$K_v = 2.0\text{mA/V} \cdot (W_g / 1\mu\text{m})$

$\Delta V = 100\text{mV}$, $1/\lambda = 5$ Volts, and a 0.25 V threshold.

Q2 : $\beta = 100$, V_A =infinity V

+Vcc= +3.0 volts.   Rgen=100 kOhm

RL=2 kOhm, Rg2= 400 kOhm

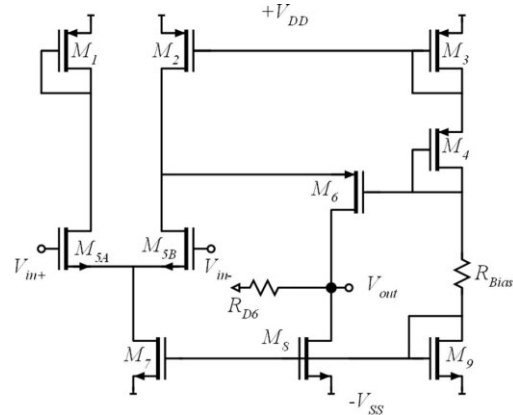Q1 is biased at 0.5 mA drain current and Vgs=0.35 V, Q2 is biased at 1 mA collector current, and the emitter of Q2 is biased at 2.0V.
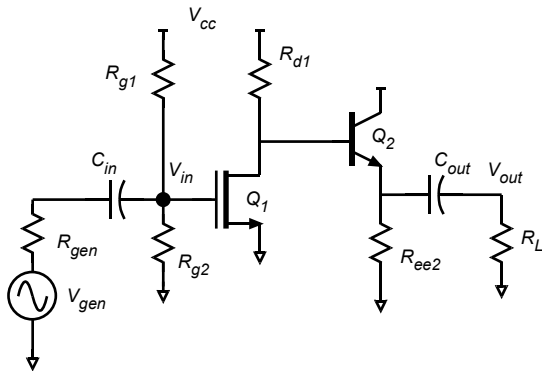
(a) Find all unspecified resistor values.
(b) Find the small signal gain and the input impedance of Q2
(c) Find the small signal gain and the input impedance of Q1.

(d) Find the input impedance *** of the amplifier **** , Vin/Vgen, Vout/Vin, and Vout/Vgen
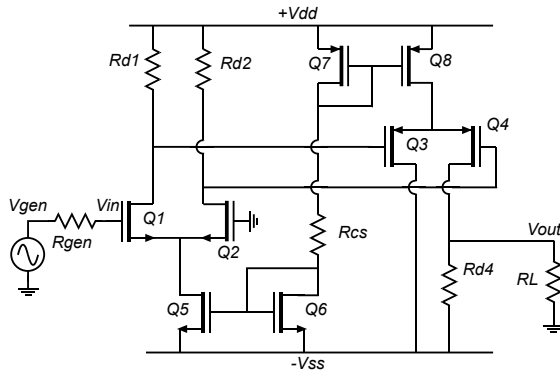
Problem 2

The NMOSFETs have

$K_\mu = 10\text{mA/V}^2 \cdot (W_g / 1\mu\text{m})$

$K_v = 2.0\text{mA/V} \cdot (W_g / 1\mu\text{m})$

$\Delta V = 100\text{mV}$, $1/\lambda = 5$ Volts, and a 0.3 V threshold. The PMOS FETs are the same, except have -0.3 V threshold. All FETs are to operate with |Vgs|=0.35V, M5A, M5B, M3, and M6 are to operate with 25 microamps drain current. The supplies are +/- 1 V. Thes gate of M5A and M5B are at +0.0 V. Vout is zero volts. RD6 is 1 MOhms

(a) find all resistor values and FET widths.
(b) find the drain currents, and the drain, gate, and source voltages of all transistors

(c) find the small signal gain and input impedance of the M5AB differential pair.
(d) find the small signal gain and input impedance of M6.

(f) find Vin/Vgen, Vout/Vin, and Vout/Vgen of the amplifier.
(g) find the maximum signal swing of the amplifier. This will involve finding the maximum signal swings of M5A, M6B, M6, and M8, and scaling each by the appropriate gains.

Problem 3

The NMOSFETs have

$K_\mu = 10\text{mA/V}^2 \cdot (W_g / 1\mu\text{m})$

$K_v = 2.0\text{mA/V} \cdot (W_g / 1\mu\text{m})$

$\Delta V = 100\text{mV}$, $1/\lambda = 5$ Volts, and a 0.25 V threshold. The PMOS FETs are the same, except have -0.25 V threshold. The FETs are to all operate at |Vgs|=0.30 V. Id5=Id6=Id7=Id8 = 0.1 mA. The supplies are +/- 1 V. Vd1=Vd2=+0.3 V. Vout=0 V. RL=5*Rd4.

(a) find all resistor values, all FET widths.
(b) find the drain currents, and the drain, gate, and source voltages of all transistors

(c) find the small signal gain of the differential pair Q3/Q4

(e) find Vin/Vgen, Vout/Vin, and Vout/Vgen of the amplifier.

(d) find the small signal gain of the differential pair Q1/Q2. Note that because both ouputs (the drains of both Q1 &Q2) are used, the gain is doubled.

(f) Do not at this time find the maximum signal swings

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