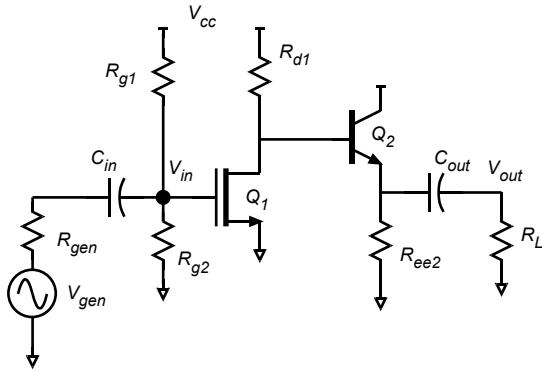


ECE137A Problem set #5

Problem 1



The NMOSFET has

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

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

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

Q2 : $\beta = 200$, $V_A = \text{infinity V}$

$+V_{cc} = +10.0 \text{ volts}$. $R_{gen} = 50 \text{ k}\Omega$

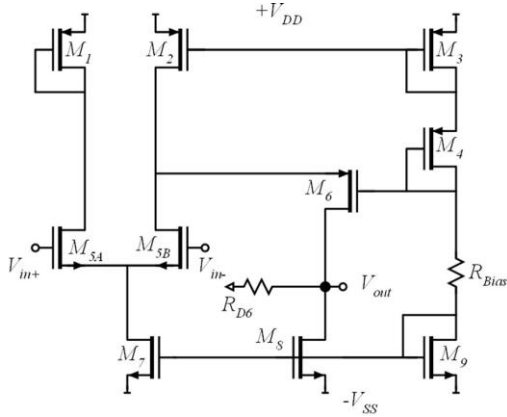
$R_L = 1 \text{ k}\Omega$, $R_{g2} = 400 \text{ k}\Omega$

Q1 is biased at 1 mA drain current and $V_{gs} = 0.35 \text{ V}$, Q2 is biased at 2 mA collector current, and the emitter of Q2 is biased at 2.0 V .

- Find all unspecified resistor values and the gate width.
- Find the small signal gain and the input impedance of Q2
- Find the small signal gain and the input impedance of Q1.

- Find the input impedance *** of the amplifier ****, V_{in}/V_{gen} , V_{out}/V_{in} , and V_{out}/V_{gen}

Problem 2



The NMOSFETs have

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

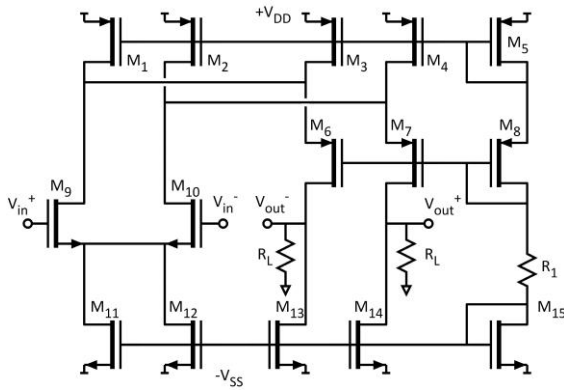
$$K_v = 2.0 \text{ mA/V} \cdot (W_g / 1 \mu\text{m})$$

$\Delta V = 100 \text{ mV}$, $1/\lambda = 5 \text{ Volts}$, and a 0.2 V threshold. The PMOS FETs are the same, except have -0.2 V threshold. All FETs are to operate with $|V_{gs}| = 0.3 \text{ V}$, M5A, M5B, M3, and M6 are to operate with 50 microamps drain current. The supplies are $\pm 1.5 \text{ V}$. The gates of M5A and M5B are at $+0.0 \text{ V}$. V_{out} is zero volts. R_{D6} is $500 \text{ k}\Omega$

- Find the small signal gain and input impedance of M6
- Find the small signal gain and input impedance of the M5AB differential pair.

- find all resistor values and FET widths.
- find the drain currents, and the drain, gate, and source voltages of all transistors
- find V_{in}/V_{gen} , V_{out}/V_{in} , and V_{out}/V_{gen} of the amplifier.
- 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

Problem 3



(c) Find the small-signal gains

$$V_{out}^+ / (V_{in}^+ - V_{in}^-) \text{ and } V_{out}^- / (V_{in}^+ - V_{in}^-)$$

appropriate gains.

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 0.2 V threshold. The PMOS FETs are the same, except have -0.2 V threshold. All FETs are to operate with $|V_{gs}| = 0.3 \text{ V}$. All FETs are to operate with 150 microamps drain current. The supplies are $\pm 1.5 \text{ V}$. The gates of M9 and M10 are at $+0.0 \text{ V}$. V_{out} is zero volts. R_L is 1 MOhm

(a) find all resistor values and FET widths.

(b) find the drain currents, and the drain, gate, and source voltages of all transistors

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