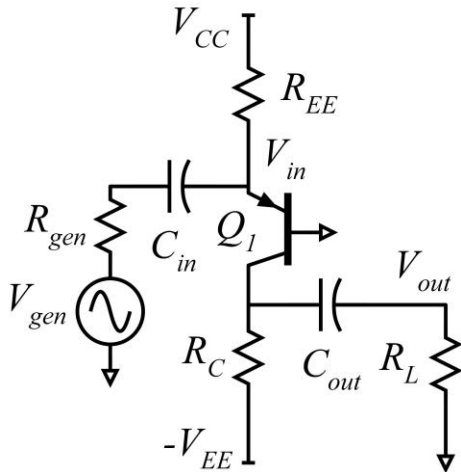
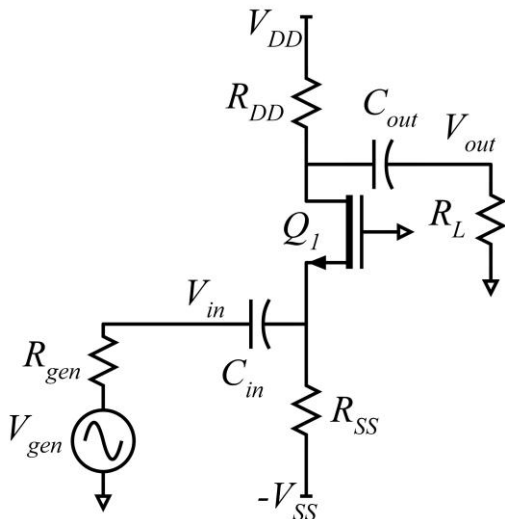


ECE137A Problem set #4

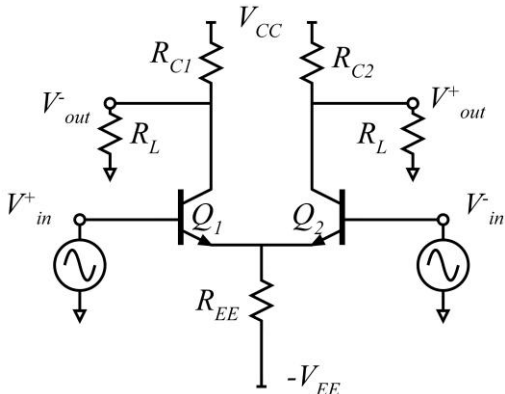


a) Give all resistor values



a) Give all resistor values and the gate width.

b) Find the small signal V_{out}/V_{in} , V_{in}/V_{gen} and V_{out}/V_{gen}



1) Common base amplifier. Q1: $\beta=50$, $V_A =$

infinity V, $V_{ce,sat}=0.5V$

The supplies are +5V and -5 V.

You will bias the transistor with 2mA collector current. The DC collector bias voltage is -2.5V.

R_L is 500Ω , R_{gen} is 50Ω ,

C_{out} and C_{in} are very large (AC short-circuit at the signal frequency)

b) Find the small signal V_{out}/V_{in} , V_{in}/V_{gen} and V_{out}/V_{gen}

2) Common gate amplifier.

The transistor has $v_{th}=0.25$ Volt,

$K_{\mu}=0.55mA/V^2 \cdot (W_g/1\mu m)$,

$K_v=0.69mA/V \cdot (W_g/1\mu m)$

$\Delta V=0.625V$ and $1/\lambda=10$ Volts

The supplies are +1V and -1 V

You are to bias the transistor at 2mA drain current, with -0.5 V DC source voltage and +0.5V drain voltage

$R_{gen}=25\Omega$, $R_L=5k\Omega$

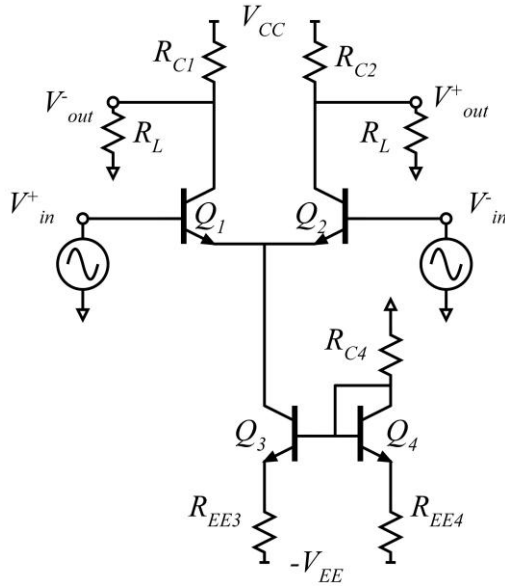
c) Find the amplifier input and output impedances

d) Find the maximum positive-going and negative going outputs.

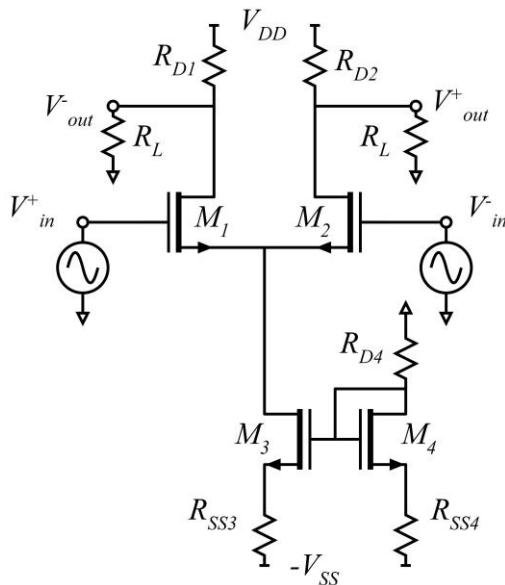
Problem 3 The circuit above uses 2n3904 bjts. -

-uses datasheet values for beta and Rce. For DC bias, V_{in+} and V_{in-} are zero volts. $V_{cc}=+5V$, $V_{ee}=-5V$. The DC emitter currents are each 0.25 mA, and the DC collector voltages are 0.0 V. R_L is $20k\Omega$. Find all resistor values.

Find the bias conditions, the differential input impedance, the differential gain, and the common-mode rejection ratio.



Problem 4 The circuit now uses a constant current source to bias the differential amplifier. For Q1 and Q2 the DC collector voltages and DC collector currents remain the same as in problem 2. There is a 0.30 V IR drop across R_{EE3} , while the DC current in R_{EE4} is 1/10th of the emitter current of R_{EE3} . Find all resistor values. Find the bias conditions, the differential and common-mode gains, and the common-mode rejection ratio. The diode has the same "on" voltage as the transistors.



Problem 5 The NMOSFETs have $v_{th} = 0.25$ V

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

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

$$\Delta V = 100 \text{ mV}, 1/\lambda = 5 \text{ Volts}$$

The supplies are + and - 1.0 Volts. M1 and M2 are to carry 0.25 mA drain current at $V_{gs} = 0.35$ V. M3 and M4 have equal gate widths and have $V_{gs} = 0.35$ V. $R_{SS3} = R_{SS4} = 0$ Ohms. The drain voltages of M1 and M2 are to be 0.0 Volts. The load resistances (R_{L1}, R_{L2}) are 100 kOhm. Find all resistor values. Find the bias conditions, FET widths, the differential and common-mode gains, and the common-mode rejection ratio.