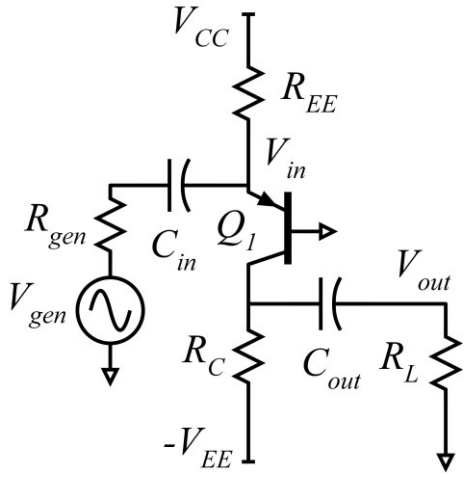
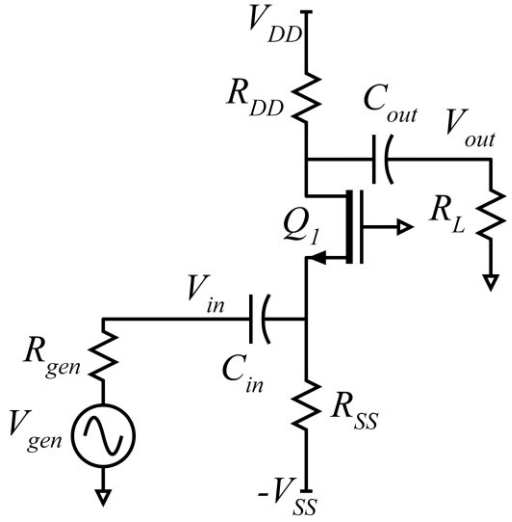
ECE137A Problem set #4



1) Common base amplifier. Q1: $\beta = 100$, $V_A =$ infinity V, Vce,sat=0.5V
The supplies are +10V and -10 V.
You will bias the transistor with 1mA collector current. The DC collector bias voltage is -5V.
R_L is 1 kΩ, R_{gen} is 100 Ω,
C_{out} and C_{in} are very large (AC short-circuit at the signal frequency)

a) Give all resistor values

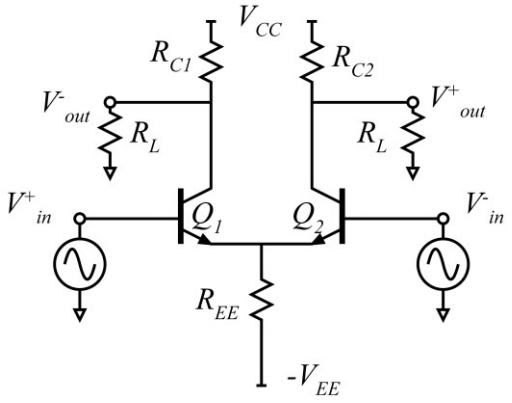
b) Find the small signal Vout/Vin, Vin/Vgen and Vout/Vgen



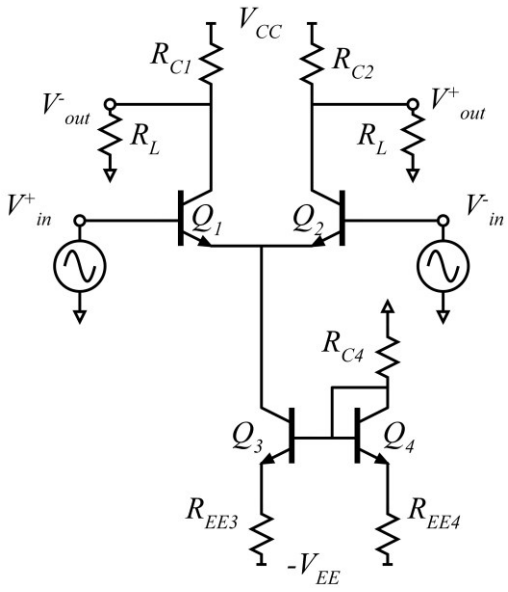
2) Common gate amplifier.
The transistor has v_{th} =0.25 Volt,
$K_\mu = 0.55\text{mA/V}^2 \cdot (W_g / 1\mu\text{m})$,
$K_v = 0.69\text{mA/V} \cdot (W_g / 1\mu\text{m})$
$\Delta V = 0.625\text{V}$ and $1/\lambda$ =10 Volts
The supplies are +2V and -2 V
You are to bias the transistor at 5mA drain current, with -0.5 V DC source voltage and +0.5V drain voltage
R_{gen}=300Ω, R_L=5kΩ

a) Give all resistor values
b) Find the small signal Vout/Vin, Vin/Vgen and Vout/Vgen

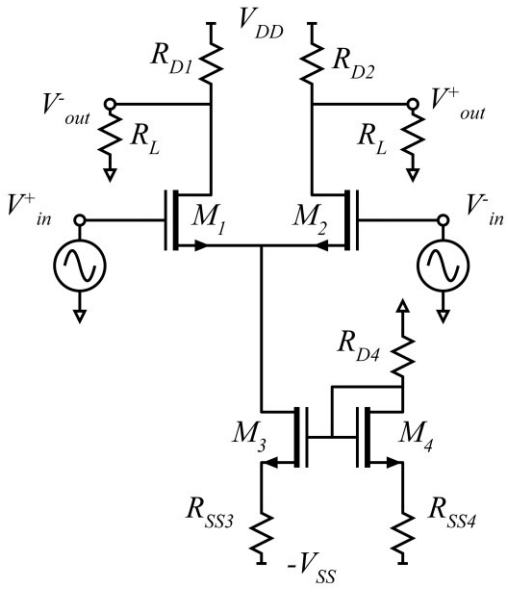
c) Find the amplifier input and output impedances
d) Find the maximum positive-going and negative going outputs.



Problem 3 The circuit above uses 2n3904 bjts. --use datasheet values for beta and Rce. For DC bias, Vin+ and Vin- are zero volts. Vcc= +5 V, Vee= -5V. The DC emitter currents are each 0.5 mA, and the DC collector voltages are 0.0 V. RL1,2 are 10 kOhm. 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 Ree3, while the DC current in REE4 is 1/10th of the emitter current of REE3. 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 Volts

The supplies are + and - 1.0 Volts. M1 and M2 are to carry 0.2 mA drain current at Vgs=0.35 V. M3 and M4 have equal gate widths and have Vgs=0.35 V. The drain voltages of M1 and M2 are to be 0.25 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.