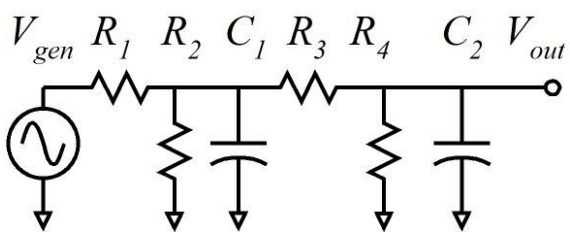
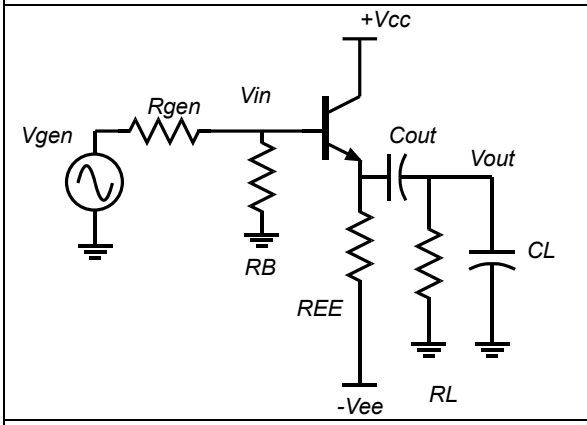
ECE137b Problem set 4



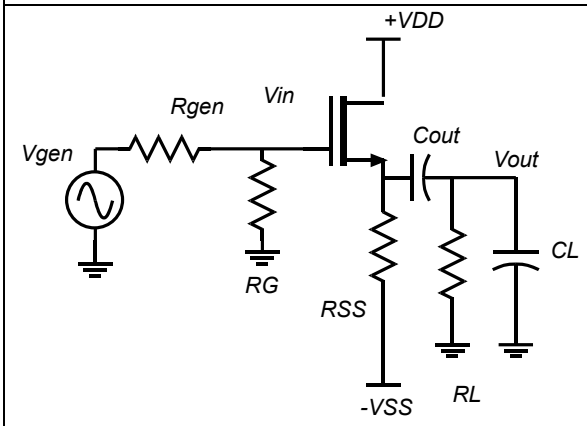
Problem 1.

$$V_{out}(s)/V_{in}(s) = c\frac{1+b_1s^2+b_2s^2+\ldots}{1+a_1s^2+a_2s^2+\ldots}$$

R1=1 KOhm, R2=2kOhm, R3=3 kOhm, R4=4 kOhm C1= 1 fF C2=2 fF Find a1 and a2 (give units!).Find, approximately, the 2 dominant pole frequencies of the transfer function.
HINT: USE MOTC !



Problem 2.
The transistor has tau_f=1 ps, Cje=Ccb=5 fF. beta is 100 . Vcc and Vee are +/- 3 volts. RL=200 Ohm, CL=200 fF. Rb=10*Rgen, Rgen=1 kOhm. Choose REE to bias the transistor at 5 mA.
a) Find bias conditions, mid-band Vout/Vin, Vin/Vgen, Rout_amp, Rin_amp
b) USE MOTC to find a1 and a2 of the transfer function. Find the dominant poles: are they real or complex ?
c) Draw a Bode Magnitude plot of the transfer function Vout/Vgen. What is the 3 dB bandwidth ?



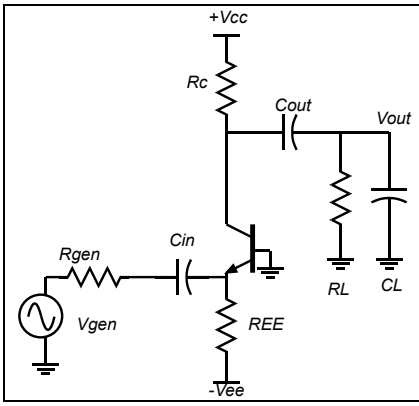
Problem 3.
The NMOS FET

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

$K_v = 2.0\text{mA/V} \cdot (W_g/1\mu\text{m})$ $\Delta V = 0.1\text{V}$, $1/\lambda = 4$ Volts, and a 0.25 V threshold. L_g =30nm

The gate-source capacitance C_{gs} is $(20\text{fF}/(\mu\text{m})^2)\cdot L_g W_g + (0.5\text{fF}/\mu\text{m})\cdot W_g$ while C_{gd} is $(0.5\text{fF}/\mu\text{m})\cdot W_g$.

We will bias the device at 1 mA drain current, and pick a gate width such that the FET Vgs is 0.3 Volts. The supplies are +0 V and -3.0 V. Rgen=200 kOhm. RL is 1000 Ohms and Cl is 100 fF.
a) Find Rss, the bias conditions, mid-band Vout/Vin, Vin/Vgen, Rout_amp, Rin_amp, the device capacitances, and the transistor ft. b) USE MOTC to find a1 and a2 of the transfer function. Find the dominant poles: are they real or complex ?
c) Draw a Bode Magnitude plot of the transfer function Vout/Vgen. What is the 3 dB bandwidth ?



Problem 4.
The transistor has tau_f=0.5 ps, Cje=10 fF and Ccb=25 fF. beta is 100. Vcc and Vee are +/- 3.3 volts. RL=600 Ohm, CL=50 fF. Rgen=100 Ohm. Choose REE to bias the transistor at 1mA, choose Rc to bias the transistor with Vce=2.0 volts
a) Find bias conditions, mid-band Vout/Vin, Vin/Vgen, Rout_amp, Rin_amp
b) any method you like find a1 and a2 of the transfer function. Find the dominant poles frequencies.
c) Draw a Bode Magnitude plot of the transfer function Vout/Vgen. What is the 3 dB bandwidth ?