ECE2280 **Homework #6**

Use the circuit to the right

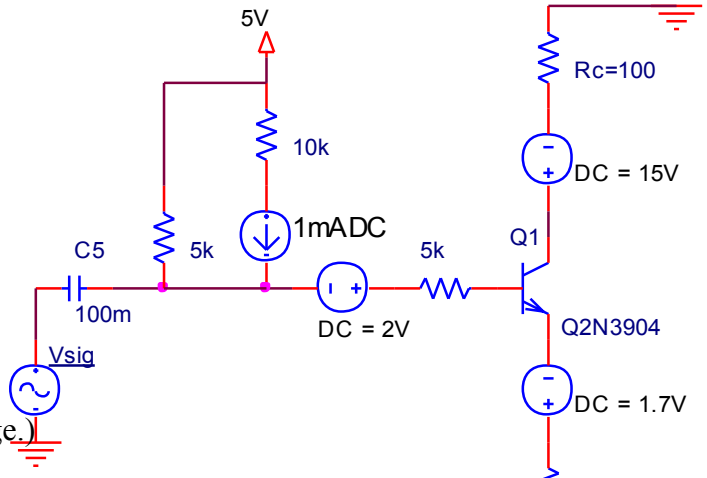
1. Use: ignore r_o, $|V_{BE}|$=0.7, β=100

(a) Assume active mode and solve for the DC values:

a. I_{B1}, I_{E1}, I_{C1}

b. V_{B1}, V_{E1}, V_{C1}

(b) Prove or disprove operation in the active region for the transistor.



2. Use the circuit at the right and results of #1.

(a) What will be the maximum input for V_{sig} if the AC gain is V_C/V_{sig} = -5V/V? (Assume the circuit is operating in the correct frequency range.)

(b) What condition (state a numerical value) for Rc to keep this transistor in the ACTIVE region?

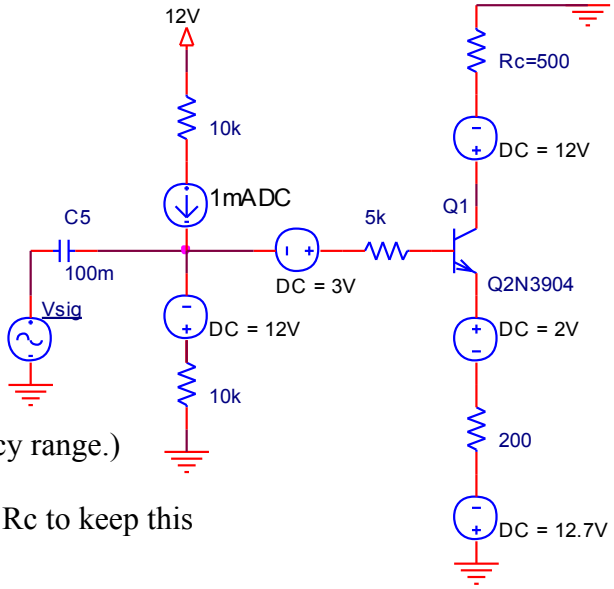
3. Use: ignore r_o, $|V_{BE}|$=0.7, β=100

(a) Assume active mode and solve for the DC values:

a. I_{B1}, I_{E1}, I_{C1}

b. V_{B1}, V_{E1}, V_{C1}

(b) Prove or disprove operation in the active region for both transistors.



4. Use the circuit at the right and results of #3.

(a) What will be the maximum input for V_I if the AC gain is V_C/V_{sig} = -10V/V? (Assume the circuit is operating in the correct frequency range.)

(b) What condition (state a numerical value) for Rc to keep this transistor in the ACTIVE region?

5. Use: **ignore r_o, $|V_{BE}|$=0.7, β=100, V_T=25mV**

V_{sig} = 10+0.002sin(20t)

$r_{\pi 1}$=4,000 and g_{m2}=4mA/V

For the following hybrid-π equivalent circuit below, find the following values:

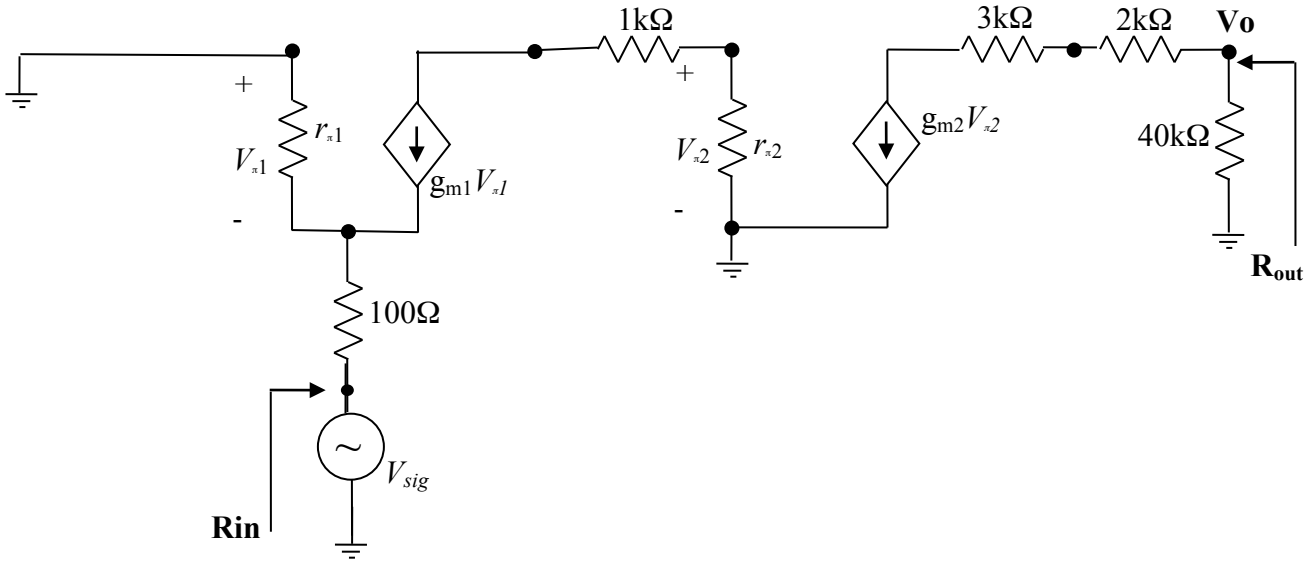
(a) R_{in} (input resistance –ignore only the input source, Vsig and include all resistors at the base)

(b) R_{out} (output resistance-include **all** resistors {no load is connected})

(c) midband gain, $\frac{Vo}{Vsig}$

(d) Comment on the values found for $R_{in}, R_{out}, V_o/V_{sig}$ whether they are good values or not for an ideal amplifier.

(e) If r_o is included in parallel to the second transistor, how does this effect R_{out}. Will R_{out} increase or decrease in value?



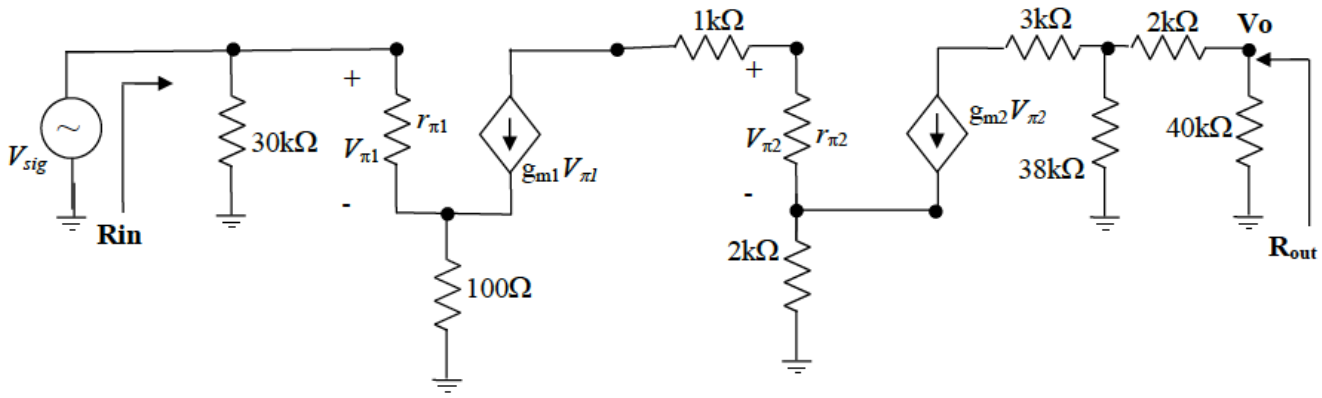
6. Use: **ignore r_o, $|V_{BE}|$=0.7, β=100, V_T=25mV**
V_{sig} = 10+0.002sin(20t)

$r_{\pi 1}$=2,000 and g_{m2}=2mA/V

For the following hybrid-π equivalent circuit below, find the following values:
(a) R_{in} (input resistance –ignore only the input source, Vsig and include all resistors at the base)
(b) R_{out} (output resistance-include **all** resistors {no load is connected})
(c) midband gain, $\frac{Vo}{Vsig}$

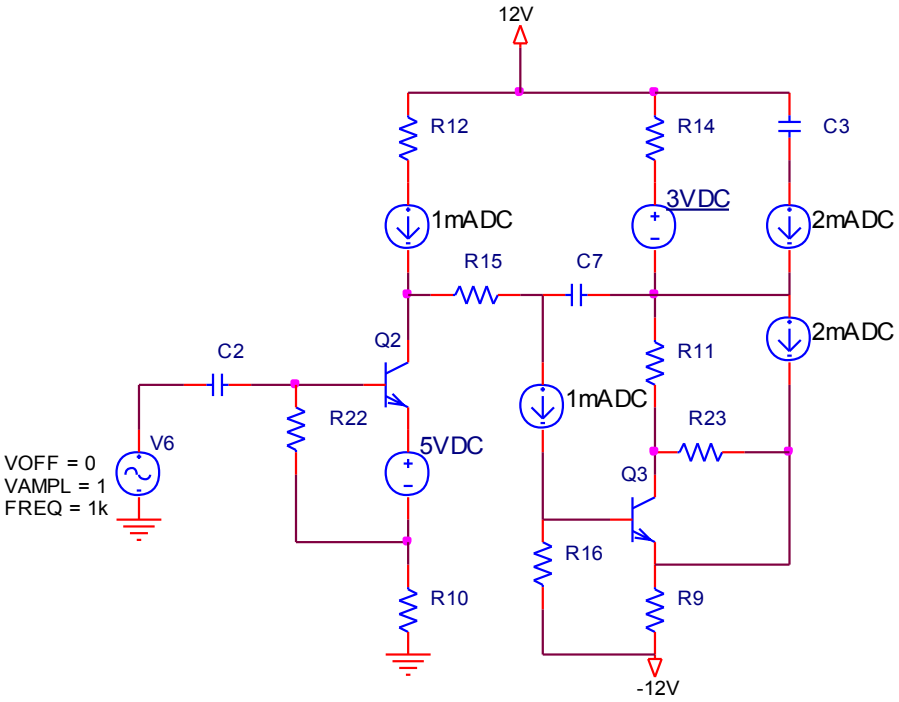
(d) Comment on the values found for $R_{in}, R_{out}, V_o/V_{sig}$ whether they are good values or not for an ideal amplifier.

(e) If r_o is included in parallel to the second transistor, how does this effect R_{out}. Will R_{out} increase or decrease in value?

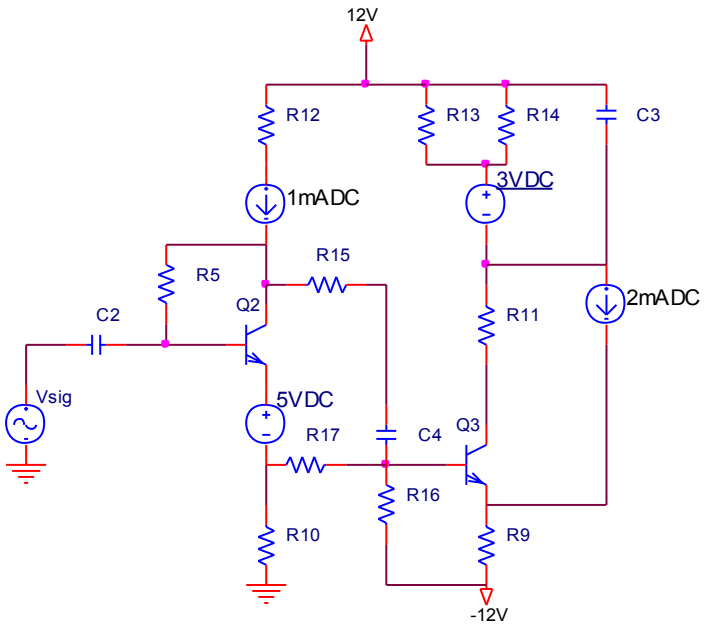


7. For the circuit shown below, **draw** the AC small-signal equivalent circuit(use hybrid-π or model T).

Make sure that everything is labeled in terms of the transistor number. (e.g. g_{m1}, $v_{\pi 2}$, etc.). **Include r_o** for all transistors. Assume that the capacitors act as a short.



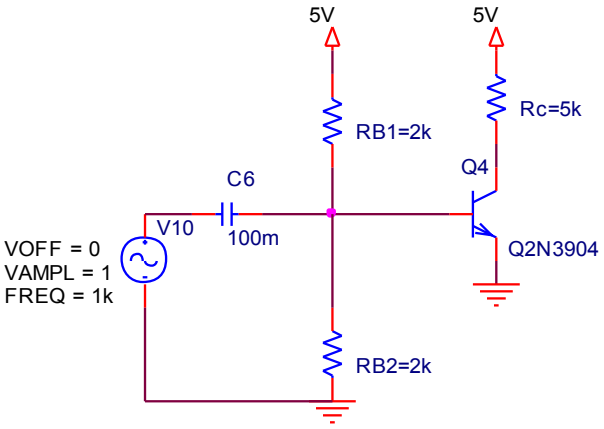
8. For the circuit shown below, **draw** the AC small-signal equivalent circuit(use hybrid-π or model T). Make sure that everything is labeled in terms of the transistor number. (e.g. g_{m1}, $v_{\pi 2}$, etc.). **Include r_o** for all transistors. v_{sig}=0.001sin(10t) AC. Assume that the capacitors act as a short.



9. $|V_{BE}|$=0.7, β=100, V_T=25mV, $\left|V_{CE_{SAT}}\right|$ =0.2V, ignore r_o, v_{sig} ={2+0.1sin(ωt)}Volts. Assume that the capacitor acts as an open for DC operation and short for AC operation.

(a) Assume transistor is acting in saturation, **solve** for I_B, I_C, and β_{forced}.

(b) Express the range of values for the Rc resistor, without changing any other supply voltage or resistors, that keeps the transistor in **active region.**



10. $|V_{BE}|$=0.7, β=100, V_T=25mV, $\left|V_{CE_{SAT}}\right|$ =0.2V, ignore r_o, v_{sig} ={2+0.1sin(ωt)}Volts. Assume that the capacitor acts as an open for DC operation and short for AC operation.

(a) Assume transistor is acting in saturation, **solve** for I_B, I_C, and β_{forced}.

(b) Express the range of values for the Rc resistor, without changing any other supply voltage or resistors, that keeps the transistor in **active region.**