EE212

SPRING 2019-2020 SPRING

HOMEWORK

ALL SECTIONS

Assigned: June 10, 2020

Due: June 29, 2020

To be uploaded to ODTUClass before midnight (23.55)!

Late submissions will not be accepted

Rules and Reminders

- Include your name and id number to your circuits by adding text comment.
- Your report should be in order and easy to read. You are expected to upload a single .pdf file.
- If you have troubles with LTSpice software, reinstall the newest version from following url.: https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html

Construct the circuit in figure 1 on a circuit simulator software, preferably LTSpice.

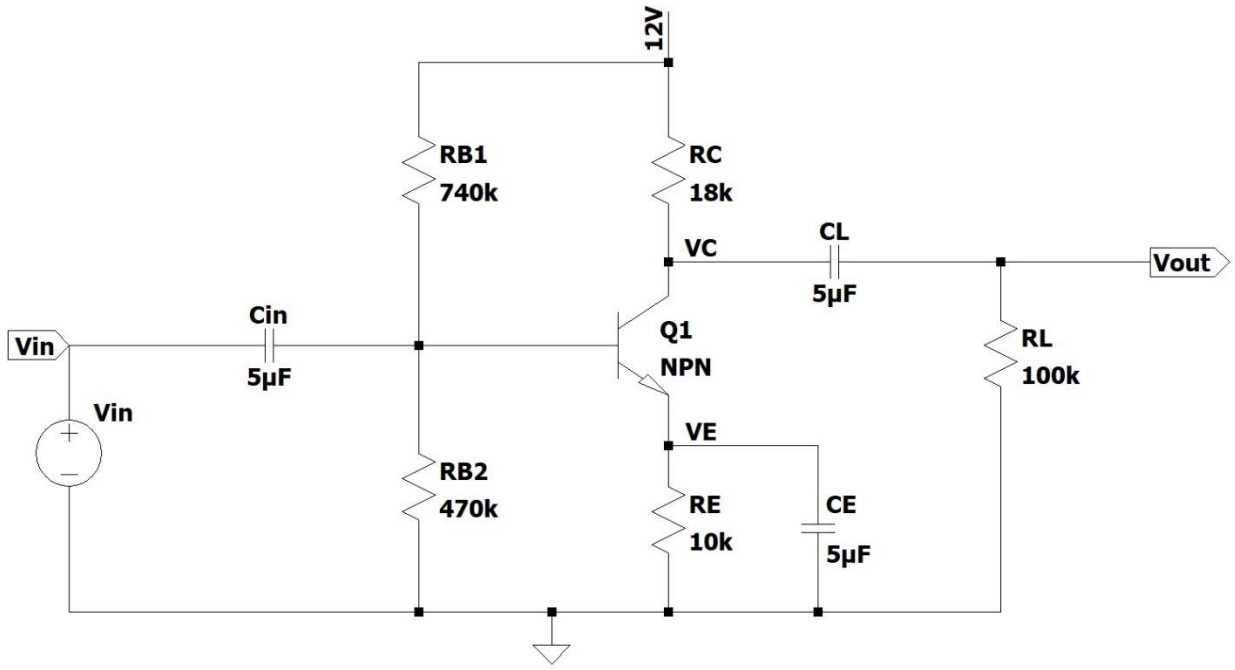

Figure 1. Common-Emitter amplifier

Part 1)

i) Edit the default NPN model to change the forward active current gain to (β_f) 200. Run transient analysis for 0.5 ms and observe the input & output voltages. What is the AC voltage gain of the circuit? Specify how you selected the frequency and amplitude of Vin and find a limit to the amplitude of Vin for a reasonable operation. (Hint: You can observe input and output waveforms for various amplitude of Vin)

ii) Now you will see how the output voltage changes with the different gain. Run transient analysis for different β_f of 50, 100, 200 and 400. Observe the output voltages for different $\beta_f s$. Comment on what you have observed in this part. Is the output gain linearly proportional to the β_f? Why or why not? Comment on possible reasons.

iii) Change the collector resistance (RC) to 50 kΩ (with β_f = 200). Run the transient simulation. Observe the output voltage and voltage gain. Comment on it.

iv) Now you will use the last two digits of your ID number, call them XY. Have the software perform transient analysis for load resistance of (RL) of (X+Y+1) kΩ, XY kΩ, 50 kΩ, and (100-XY) kΩ. Observe the output for four different load resistances. Comment on what you have observed in this part. For instance, ID number of 1234567: X=6, Y=7, (X+Y+1)=14, XY=67, 100-XY=33.

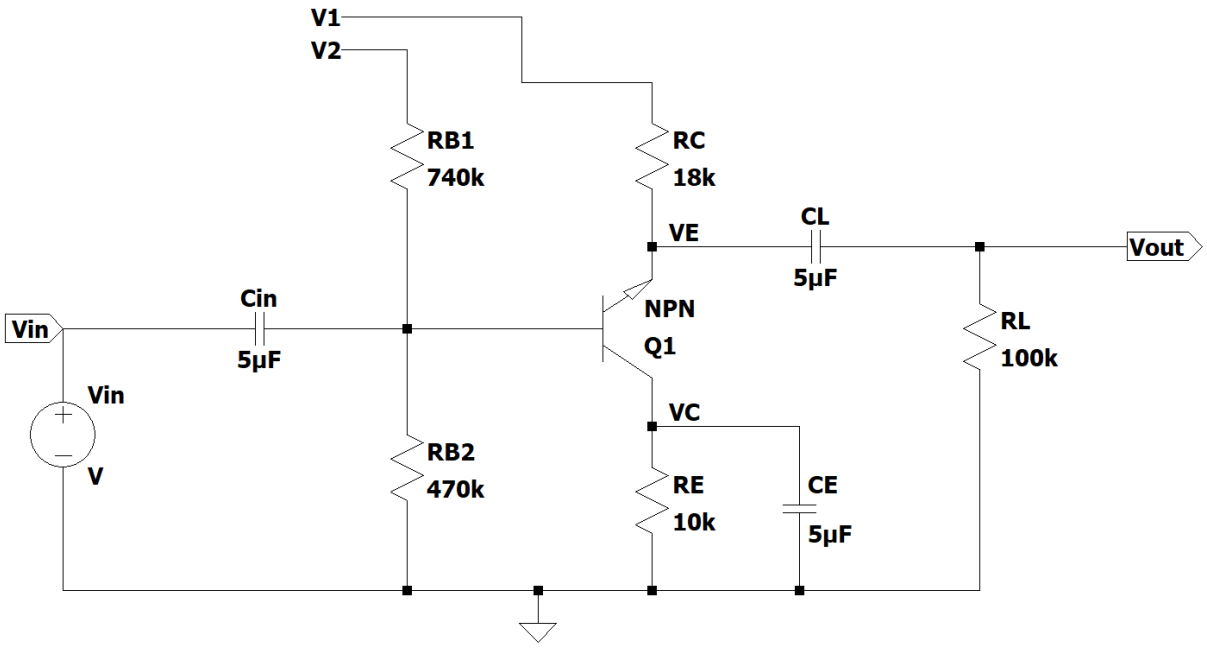

Figure 2. Common-Emitter amplifier (reverse-active mode)

Part 2)

i) Now cut the connection between RB1 and RC resistors (figure 1). Connect different voltage sources for both of the open connections. Using 'DC Sweep', sweep the voltage sources accordingly:
(V1): The one connected to RC: Start value = 0 V, Stop value = 12 V, Linear increment = 0.1V.
(V2): The one connected to RB1: Start value = 1 V, Stop value = 7 V, Linear increment = 1 V.
Plot the I_C vs. V_{CE} diagram. Observe the graph and comment on operation regions of the transistor. (β_F = 200).

ii) Construct the circuit in figure 2. Using the same DC sweep parameter at i); Plot the I_C vs. V_{CE} diagram. Observe the graph and comment on operation regions of the transistor. What are the differences between these two plots? Comment on your observations.

iii) Using transient analysis, find reverse active current gain (β_R) of the transistor.