DEPARTMENT OF ELECTRICAL ENGINEERING

(Rachna College of Engineering & Technology, Gujranwala)

Lab: Analog Electronics **Design By: Muhammad Ansir**

Name	**Grade**
Reg.#	**Date**

Lab 05:

AC Analysis Of Common Emitter Amplifier

Objective: In this lab you will learn how to do AC analysis of a common emitter amplifier.

Theory:

The input signal, *Vin*, is capacitively coupled to the base terminal, the output signal, *Vout*, is capacitively coupled from the collector to the load. The amplified output is 180° out of phase with the input. Because the ac signal is applied to the base terminal as the input and taken from the collector terminal as the output, the emitter is common to both the input and output signals. There is no signal at the emitter because the bypass capacitor effectively shorts the emitter to ground at the signal frequency.

The AC input resistance is

$$Ri = v_{be} / i_b$$

Recalling that, $i_e = (\beta+1)\ i_b$

We have, $R_i = v_{be} / i_e / \beta+1 = (\beta+1)\ v_{be}/i_e$

But, $v_{be} / i_e = r_e$, so

$$R_i = (\ \beta+1)\ re \approx \beta r_e$$

The CE output resistance $r_o=r_c/\beta$ is the reciprocal of the slope of the curve for I_{BQ} in the active region of the CE output characteristic, that is,

$$r_o=\Delta V_{ce}/\Delta I_c$$

Note that the dc supply voltages are treated as AC short circuits. It can be seen that r_c/β is in parallel with RC, which implies that rout=r_o||RC. Note also that AC load resistance, $r_L=R_C||R_L$, it is clear that

$$I_c = r_o / r_o + r_L (\beta i_b)$$

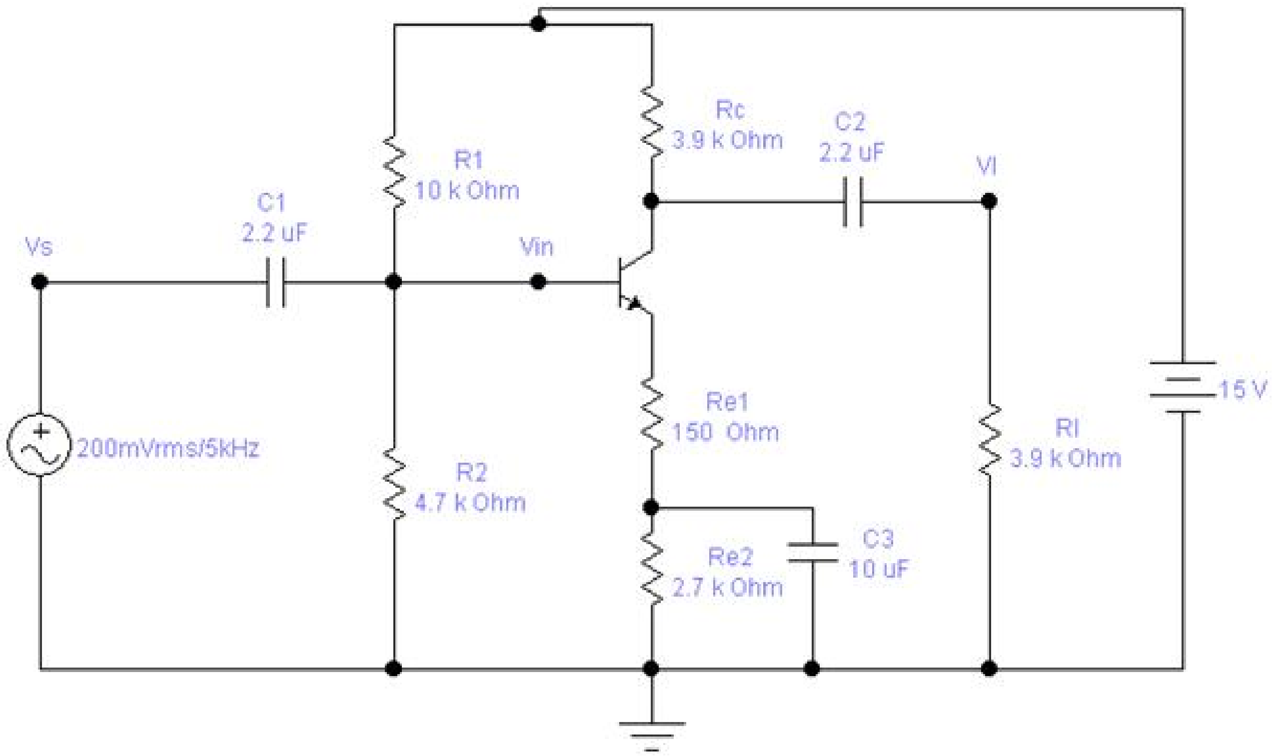
And $$Ai = i_c / i_b$$

$$= \beta (r_o / r_o + r_L)$$

Further the voltage gain is given by the equation

$$Av = -r_L / r_e \qquad (r_o >> r_L)$$

Circuit Diagram:



Components:

- Transistor NPN(2N3904)
- Resistors (R_1=10kΩ , R_2 = 4.7kΩ , R_C = 3.9kΩ , R_{E1} = 150 Ω , R_{E2} = 2.7 kΩ , R_L = 3.9 kΩ),
- Capacitors 2.2 uF , 2.2 uF , 10 uF .
- Connecting wires
- Bread board
- Power supply
- Multimeter
- Function Generator.

Lab Tasks:

1) Construct the logic diagram of the given experiment and note the specifications of the given accessories.
2) Simulate your circuit diagram on Proteus ISIS and note all the required readings.
3) Perform hardware implementation in the lab and note the respective readings with the help of multimeter and ammeter.
4) Also calculate all the readings with the help of given equations.
5) Now compare all your readings in a single table and calculate percentage error in readings also compare their graphs if possible.

Observations:

	Data	Proteus Values	Calculated	Measured
1	I_E			
2	r_e			
3	r_{in}			
4	$r_{in(stage)}$			
5	$r_{o(stage)}$			
6	Vin_{p-p}			
7	$Vout_{p-p}$			
8	Av=Vout/Vin			
9	V_{Lp-p}			
10	Vs_{p-p}			
11	V_L/Vs			

Conclusions:

Write down the summary, general observation and conclusion about the results obtained in this experiment. Compare your results with the hand calculated results and simulated results on graphs.

Applications:

1) Low frequency voltage amplifier.
2) Radio

Common-emitter amplifiers are also used in radio frequency circuits, for example to amplify faint signals received by an antenna. In this case it is common to replace the load resistor with a tuned circuit. This may be done to limit the bandwidth to a narrow band centered around the intended operating frequency. More importantly it also allows the circuit to operate at higher frequencies as the tuned circuit can be used to resonate any inter-electrode and stray capacitances, which normally limit the frequency response. Common emitters are also commonly used as low-noise amplifiers.

Activity:

- Perform the above experiment with different values of R_1 and R_2.

Questions:

- Does Vcc have any effect on the gain?
- Is anything in this circuit affected by the beta? Explain.
- To simulate an AC input voltage, move the slider about zero and observe the changes in the output voltage at the collector. Do you see evidence of amplification? The gain of the circuit is defined as $deltaV_{out}/deltaV_{in}$; compute this ratio and compare it to the ratio of R_c to R_e

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(Signature of Teacher) (Signature of Lab Assistant)