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Reg. #	2019-EE-381,383
Marks	

Experiment # 5

Two Stage RC Coupled Amplifier

Objectives:

- To study a two stage RC coupled common emitter amplifier using BJTs.
- Design and setup two stage RC coupled common emitter amplifier.

Apparatus:

Transistor - 2N3904, Capacitors, Resistors, DMM, CRO, Function Generator, Jumpers, Connecting wires, DC source bread board.

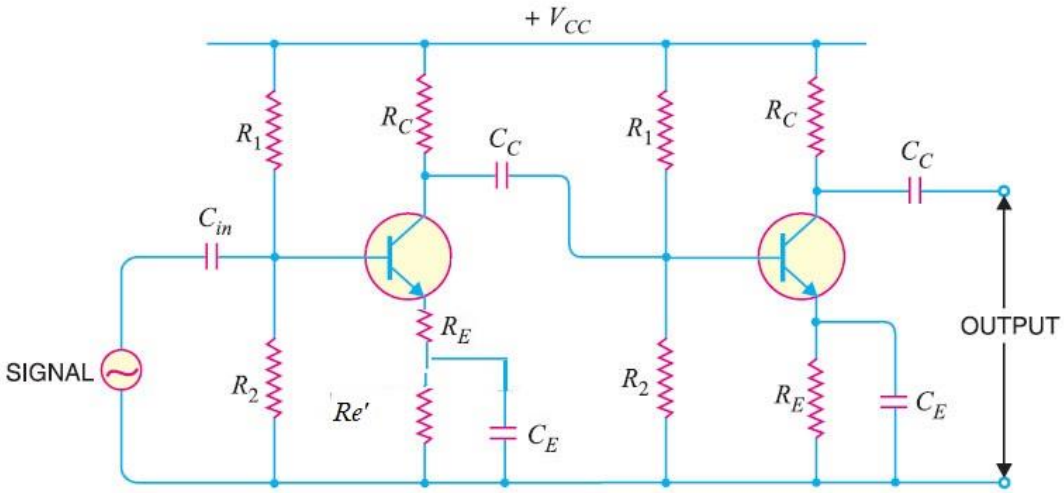
Theory:

Single amplifier circuits, such as a common emitter, common base and common collector amplifiers are seldom found alone, as a single stage amplifier, in any system. Generally, at least two or more than two stages are connected in cascade combination. If the output of one amplifier is connected (coupled) to the input of another amplifier the stages are said to be connected in "cascade". The benefit of cascaded amplifiers is to develop an output voltage larger than either stage alone can develop. In fact, the overall gain of the cascaded amplifiers (called system gain) is the product of each individual stage gain, or

$$A_V = A_{V1} \times A_{V2}$$

Common emitter stages are cascaded to increase the voltage gain. Since the each stage provides a phase inversion, the final output signal is in phase with input signal. Care must be taken while selecting A_1 and A_2. If A_1 the input to second stage will become too high. This may pull out the transistor of the second stage from active region. For example if we need overall voltage gain of

100, select A_1=4 and A_2=25. Gain of first stage will be controlled by a negative feedback in series with emitter. This can be achieved by the un bypassed resistor Re.



General procedure:

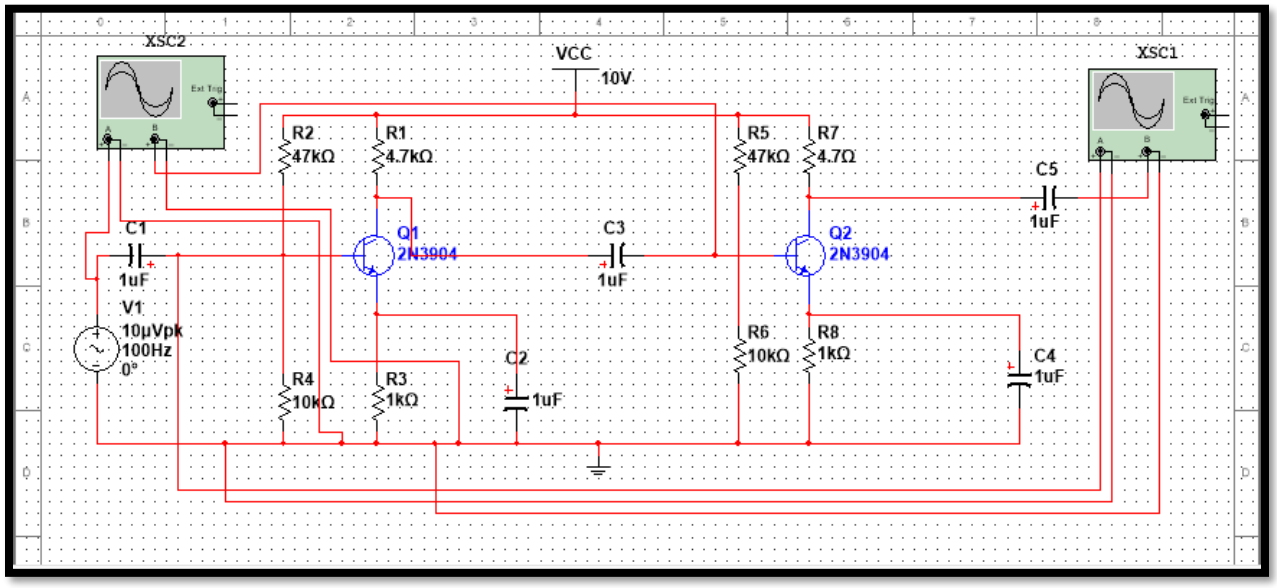
- Connect the circuit as per circuit diagram.
- Set Vs=100mV at 100 Hz frequency using signal generator.
- Then find out the first stage voltage gain and second stage voltage gain theoretically and practically and note down on table
- Change the Vs and repeat the above procedure

Design:

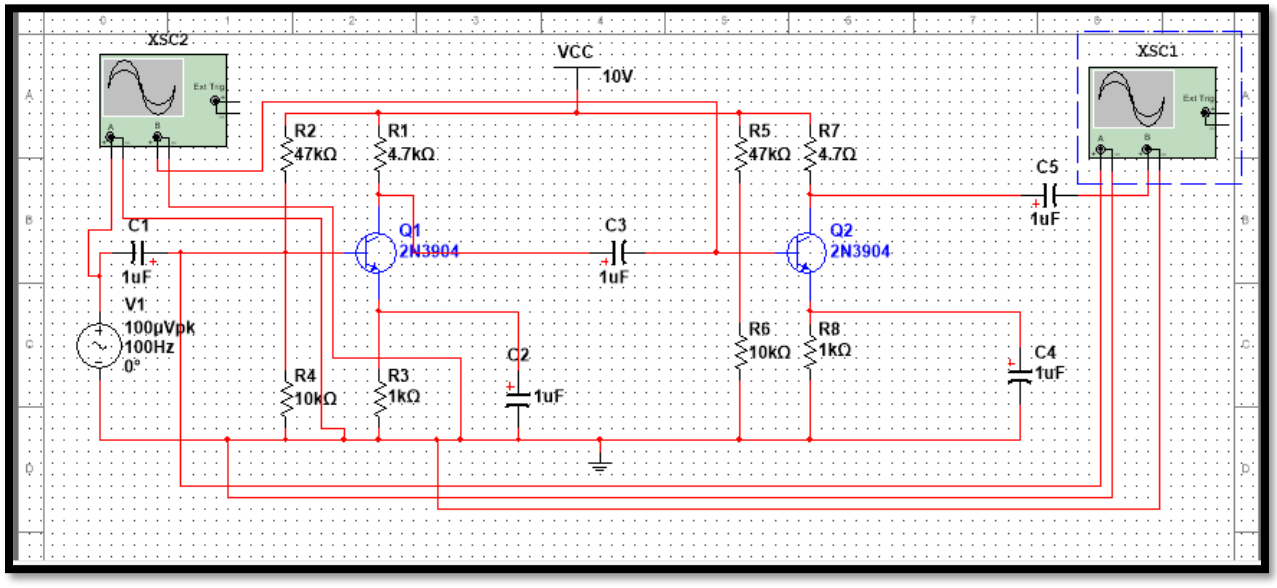
Design Two stage RC coupled common emitter amplifier. Find the voltage gains at different input voltage.

Circuit:

- ***Vs=10uV:***



- ***Vs=100uV:***



- ***Vs=200uV:***

Calculations:-

For 10KV:-

Voltage gain of first stage:-

$I_E = 0.63mA$

$r_e' = 40\Omega$

$R_{in(base)} = 6K\Omega$

$R_{C1} = 2.5K\Omega$

$$A_{V1} = \frac{2.5K}{40} = 62.5$$

$\boxed{A_{V1} = 62.5}$

Voltage gain of second stage:-

$$A_{V2} = \frac{R_7}{r_e'} = \frac{4.7K}{40}$$

$\boxed{A_{V2} = 117.5}$

Overall gain.

$$A_V' = A_{V1} A_{V2}$$

$$= (62.5)(117.5)$$

$\boxed{A_V' = 7,344}$

For $V_c = 100\,\mu V$.

First stage gain:-

$I_E = 0.7\,mA$.

$r_e' = 35.7\,\Omega$.

$R_{in(base)} = 5k\Omega$.

$R_{C1} = 2.1k\Omega$.

$A_{V1} = \frac{2.1k}{35.7}$

$$\boxed{A_{V1} = 58.8}$$

Second Stage gain:-

$A_{V_2} = \frac{R_7}{r_e'} = \frac{4.7k}{35.7}$

$$\boxed{A_{V_2} = 131.6}$$

Overall gain

$A_V' = A_{V1} A_{V_2}$

$$\boxed{A_V' = 7,738}$$

For $V_C = 200mV$.

First stage gain:-

$$I_E = 0.71mA$$

$$r_e' = 35.2\Omega$$

$$R_{in(base)} = 5.2k\Omega$$

$$R_{C_1} = 1.9k\Omega$$

$$A_{V_1} = \frac{1.9k}{35.2}$$

$$\boxed{A_{V_1} = 53.9}$$

Second stage gain:-

$$A_{V_2} = \frac{R_7}{r_e'} = \frac{4.7k}{36.2}$$

$$\boxed{A_{V_2} = 133.5}$$

Overall gain:-

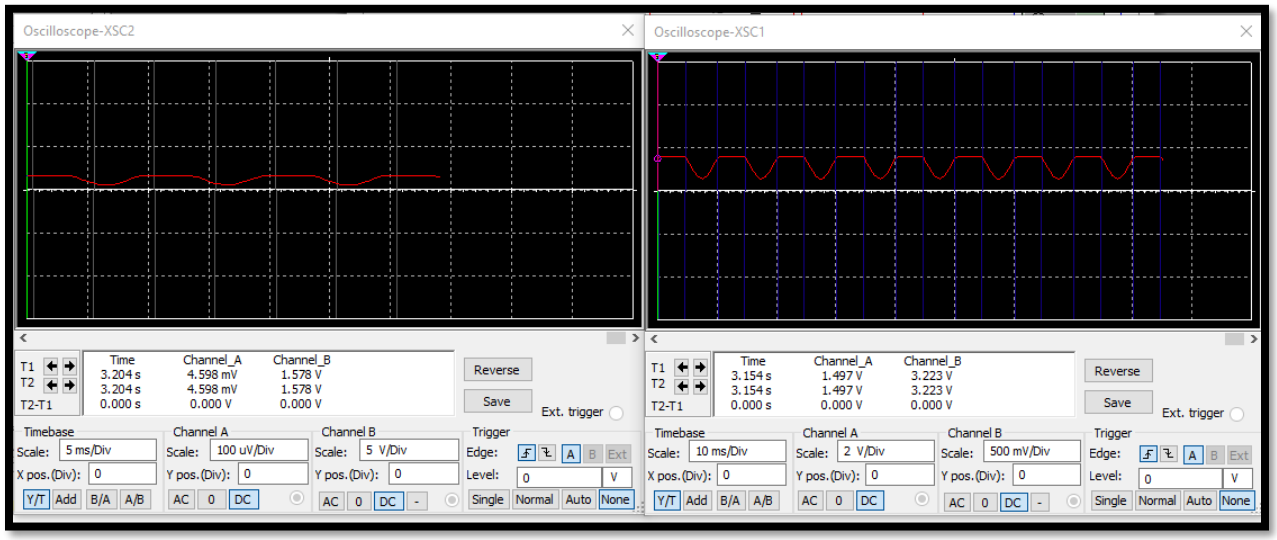
$$A_V' = A_{V_1} A_{V_2}$$

$$= (53.9)(133.5)$$

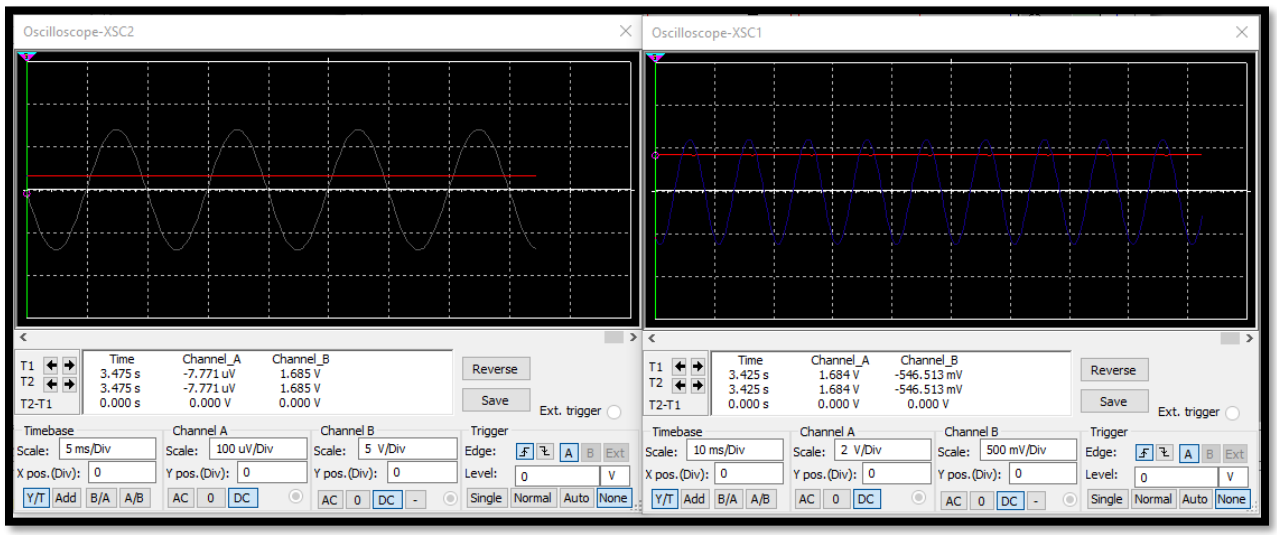
$$\boxed{A_V' = 7,196.8}$$

Input and Output Graph:

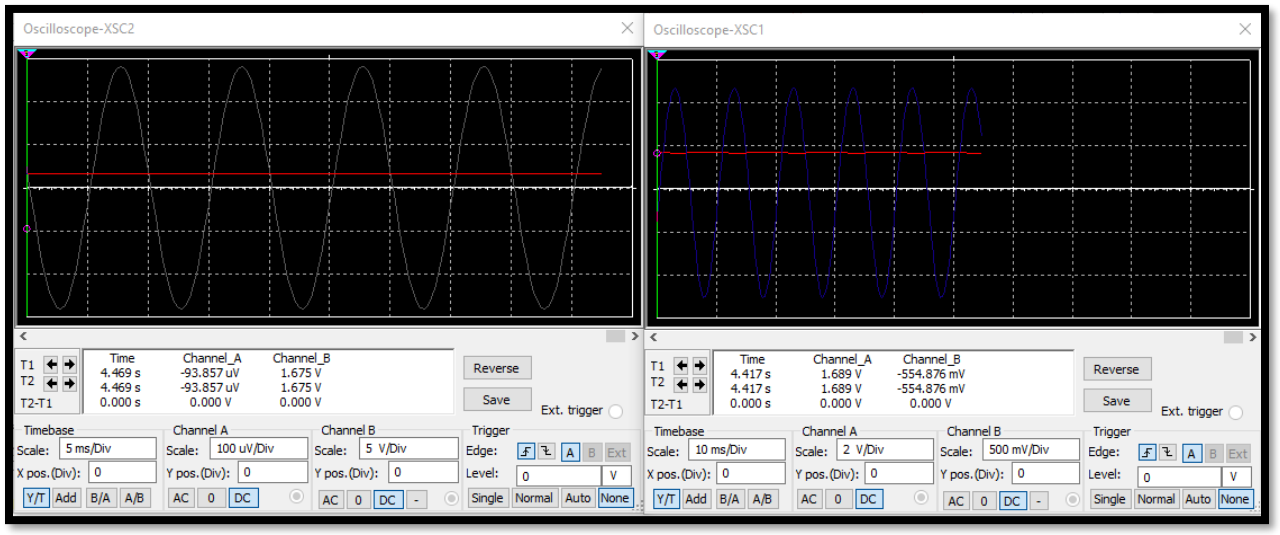
- ***Vs=10uV*** **(1st stage left 2nd stage right)**



- ***Vs=100uV:***



- ***Vs=200uV:***



Result:

Sr.#	**Source Voltage**	**$A_{v1(Th)}$**	**$A_{v1(Prac)}$**	**$A_{v2(Th)}$**	**$A_{v2(Pr)}$**	**$A_{v(th)}$**	**$A_{v(Prac)}$**
01	10 uV	62.5	21.53	117.5	243.19	7344	5235
02	100uV	58.8	32.4	131.6	216.831	7738	7025
03	200uV	53.9	48.5	133.5	145.5	7196.8	7056

Questions:

- **What is meant by stage?**

Amplifiers usually have several stages, which are connected in series. This is called a cascade connection. We can get single, double and multistage amplifier by coupling the cascade connection of amplifiers in series.

A stage contains an amplifier, a load circuit, and a coupling circuit to the preceding or following amplifier stage.

- **What are the characteristics of cascade amplifier?**

Cascade amplifier include some advantages like

- Less Input Resistance
- Moderate To High Current Gain
- Voltage As Well As High O/P Resistance.

The main drawback of the cascade amplifier is when several stages increases then the bandwidth will decrease.

- **Each stage of a four stage amplifier has a voltage gain of 15, what is overall voltage gain?**

Av1=15

Av2=15

Av3=15

Av4=15

$$A'v = (Av1)\ (Av2)\ (Av3)\ (Av4)$$

$$A'v = (15)\ (15)\ (15)\ (15)$$

$$\boldsymbol{A'v = 60}$$