SINGLE-STAGE RC COUPLED CE AMPLIFIER

Aim:

i. To design a single stage RC coupled CE amplifier for the given specifications.
ii. To plot its frequency response.

Designing equations:

Q: Design a single stage RC coupled amplifier using a BJT in CE configuration to provide a gain of 100, lower cutoff frequency 55Hz and an upper cutoff frequency of 55 KHz. Use BC547 for which β= 200, h_{fe}=50, h_{ie}=1.5KΩ and $V_{BE(active)}$=0.65V. The biasing conditions are as follows.

V_{CC}=12V, I_C=1mA, V_{CE}=6V and Stability factor is S=10. Use R_C=4.7KΩ

Design:

Use $I_C=\beta I_B$

⇨ I_B= 5 μA

Apply KVL to the output loop:

$-V_{CC} + I_C R_C + V_{CE} + I_C R_E = 0$, by assuming R_C = 4.7KΩ

⇨ R_E= 1.3KΩ

Apply Thevenin's theorem to the base circuit, then

$V_{TH} = (V_{CC} R_2)/ (R_1 + R_2)$ and $R_{TH} = (R_1 R_2)/ (R_1 + R_2)$

We know that the stability factor for a self bias circuit is given by,

$S= (1+\beta)/ (1+\beta R_E/ (R_{TH} + R_E))$

⇨ R_{TH} = 12.31KΩ

Apply KVL to the input loop, then

$-V_{TH} + I_B R_{TH} + V_{BE} + I_C R_E = 0$

$\Rightarrow V_{TH} =$ 2.01V

Divide R_{TH} with V_{TH}

⇨ $R_1= (V_{CC} R_{TH})/(V_{TH})$ =73.5KΩ

Also $R_B = (R_1 R_2)/ (R1 + R_2)$

⇨ R_2 =14.8KΩ

Design of R_L:-

We know that, gain $Av = (-h_{fe} R_L^1)/ h_{fe}$

⇨ $R_L^1 = 3K\Omega$

But, $R_L^1 = (R_L R_C)/ (R_L + R_C)$

⇨ $R_L = 8.3K\Omega$

Design of C_E and C_{sh}:-

We know that $f_L = (1+ h_{fe})/ 2\pi h_{ie} C_E$

⇨ $C_E = 100\mu F$

Also $f_H = 1/ 2\pi R_L^1 C_{sh}$

⇨ $C_{sh} = 1KPF$

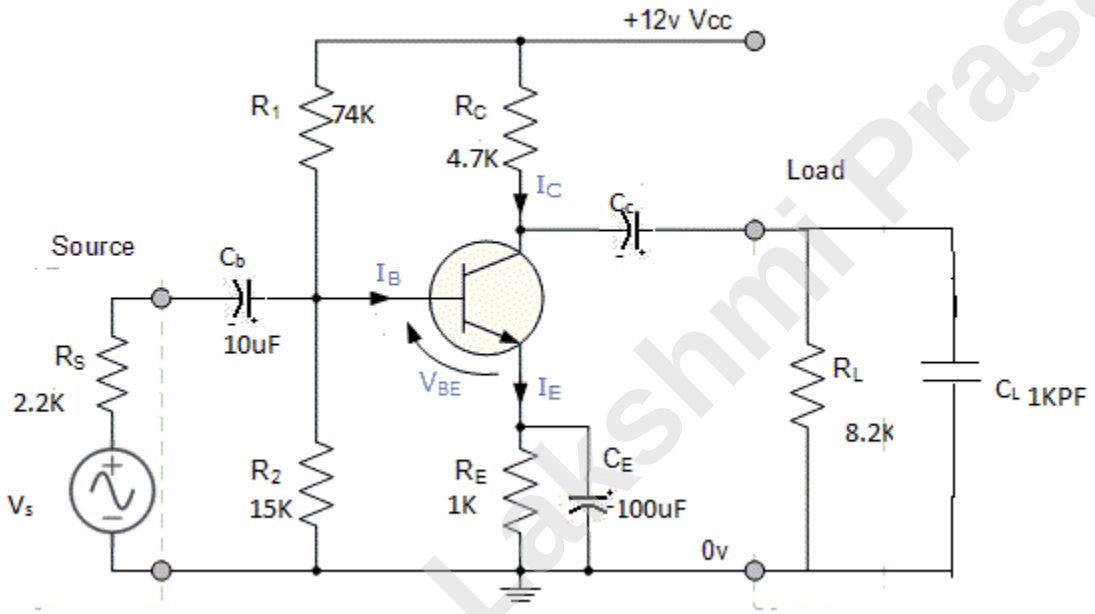
Assume $C_b = C_C = 10\mu F$ and Rs $= 2.2K\Omega$.

Apparatus:

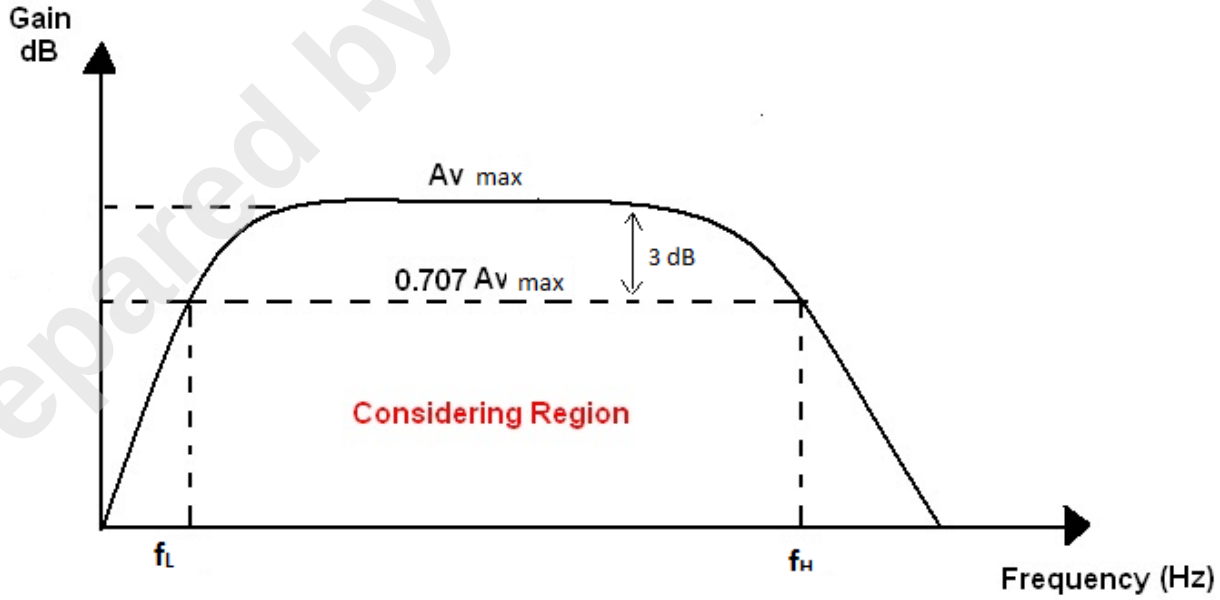
Sl. No	Name of the component	Specifications or range	Quantity
1	Transistor BC547	P_d = 500mW I_c(max) = 100mA β = 110-200	1
2	Capacitor	10µF,100µF,1KPF	2,1,1
3	CRO	20MHz	1
4	Resistors	2.2KΩ, 74KΩ, 4.7KΩ, 15KΩ, 1KΩ, 8.2KΩ,	1 each
5	Function generator	1MHz	1
6	Regulated power supply	(0-30)V,1A	1

Theory: Refer Text book to Write Theory related to the experiment.

CircuitDiagram:



Model Graph:



Experimental procedure:

1. Connections are made as per circuit diagram.
2. Apply the input signal of peak to peak amplitude in 30 to 50 mV in range such that the output signal obtained is distortion less.
3. Now change the frequency of the input signal from 50Hz to 500 KHz in suitable steps.
4. Calculate the gain in dB in each step by using the formula $A_v = 20 \log(\frac{V_o}{V_s})$.
5. Plot the frequency response of the amplifier by plotting Gain in dB Vs frequency.

Tabular form: input voltage V_i = ---------.

Sl. No	Frequency(Hz)	Output voltage(volts)	Gain $(\frac{V_o}{V_s})$	Gain in dB $A_v = 20 \log(\frac{V_o}{V_s})$.

Precautions:

1. All connections must be done carefully.
2. Switch off power supply before making connections.

Result: Thus the Single Stage RC coupled CE amplifier is designed and its frequency response curve is plotted.

Maximum gain=----------.

Lower cut-off frequency f_L = ----------.

Upper cut-off frequency f_H = ----------.

Band Width f_H - f_L = ----------.