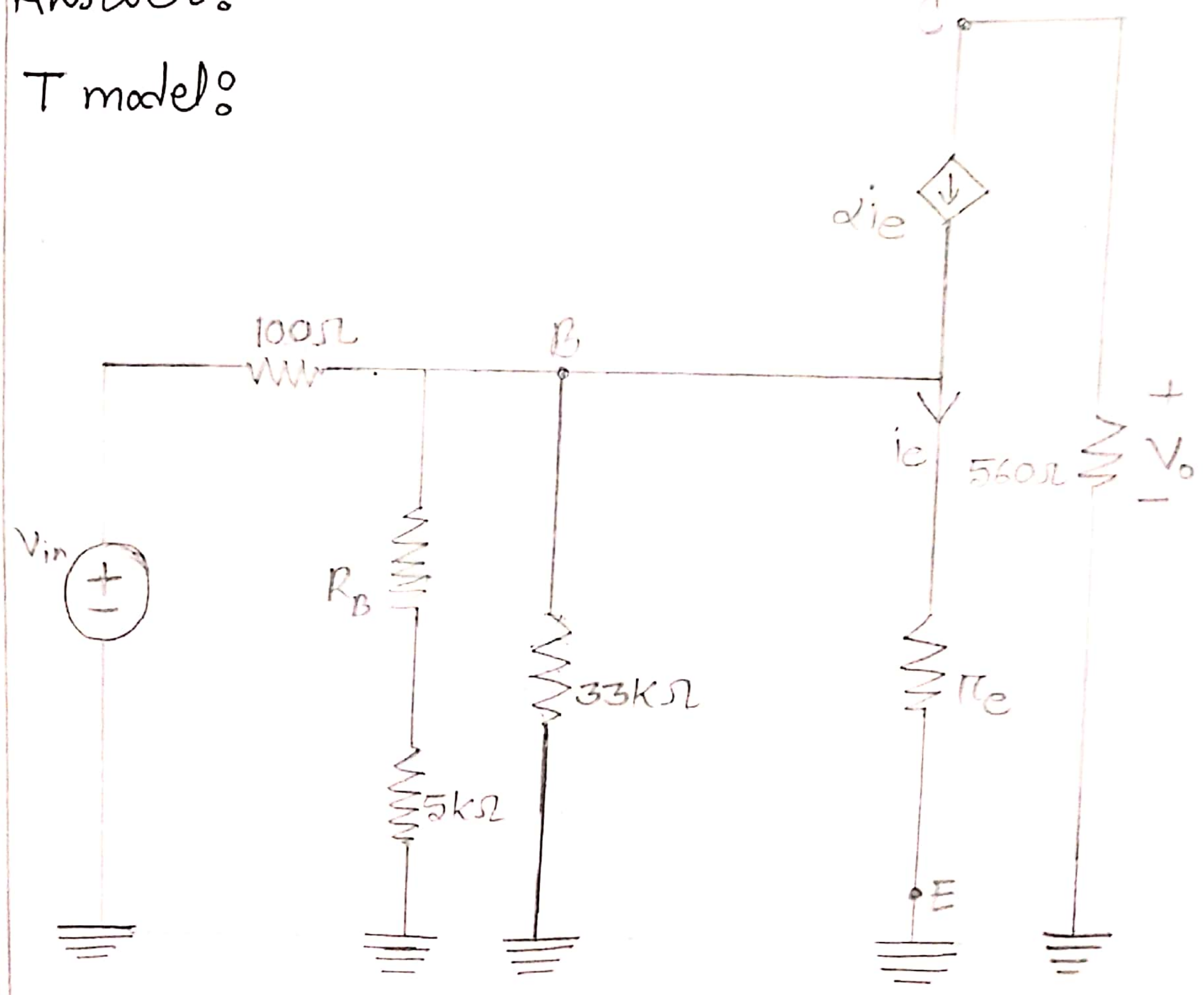
Prelab work:

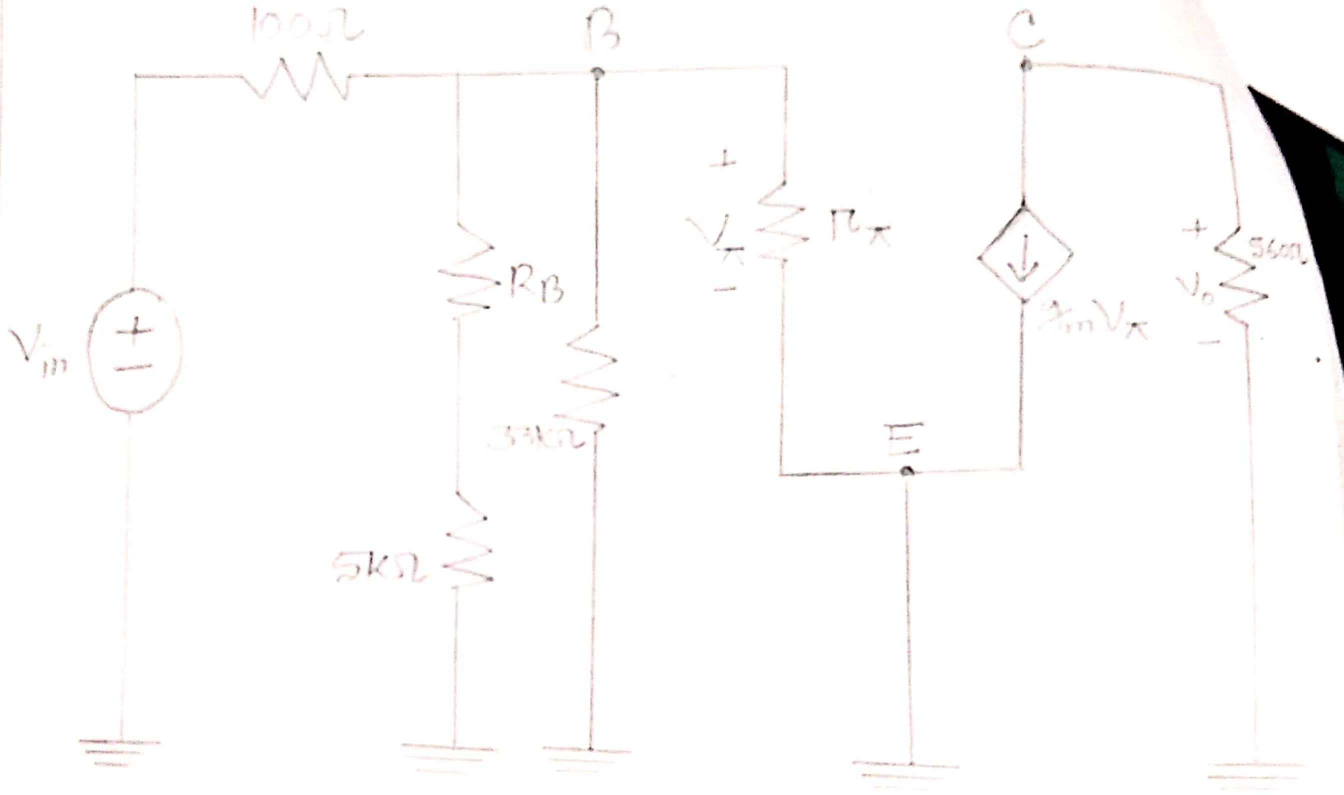
1. Draw the small signal equivalent circuits of the CE Amplifier circuit.

Answer:

T model:

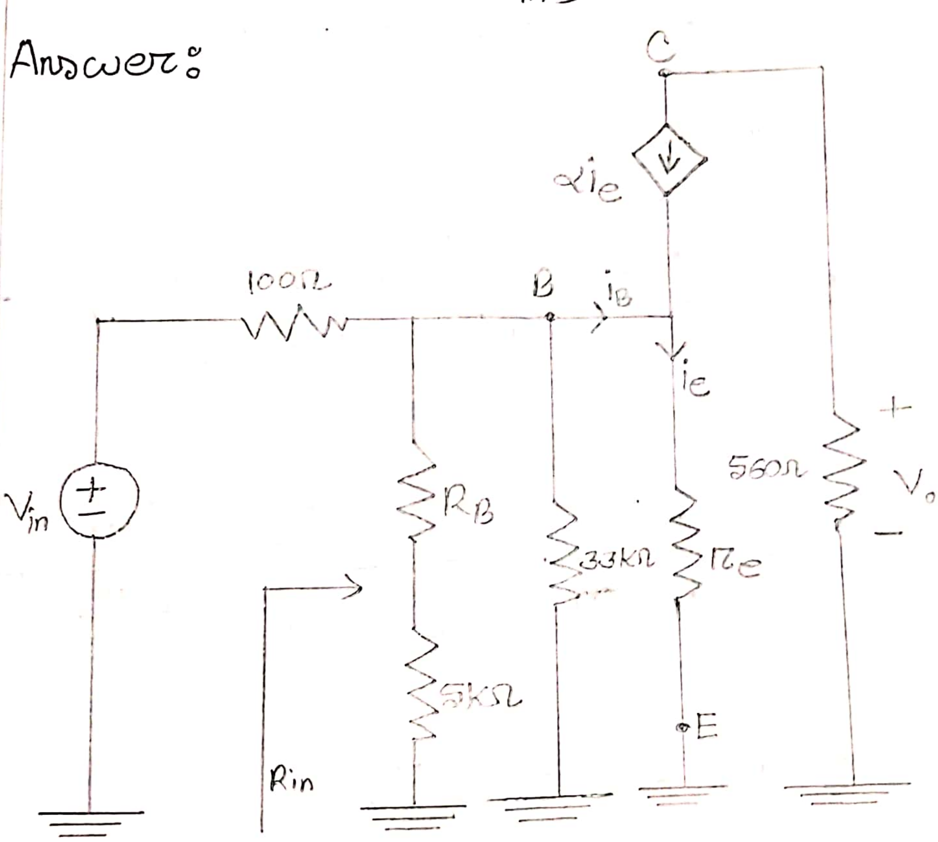


π model:



2. Obtain an expression for the voltage gain $\left(\frac{V_o}{V_{in}}\right)$.

Answer:



$$V_o = -560\alpha i_e \quad \cdots (i)$$

$$V_b = i_e r_e \quad \cdots (ii)$$

$$R_{in} = \left(\frac{1}{33\times10^3} + \frac{1}{R_B + 5\times10^3} + \frac{1}{r_e}\right)^{-1} \Omega$$

$$V_b = \frac{\left(\frac{1}{33\times10^3} + \frac{1}{R_B+5\times10^3} + \frac{1}{r_e}\right)^{-1}}{100 + \left(\frac{1}{33\times10^3} + \frac{1}{R_B+5\times10^3} + \frac{1}{r_e}\right)^{-1}} V_{in} \quad \cdots (iii)$$

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from (i) and (ii),

$$\frac{V_o}{V_b} = -\frac{560\alpha}{r_e} \quad \cdots (iv)$$

from (iii) and (iv),

$$A_V = \frac{V_o}{V_{in}} = \frac{\left(\frac{1}{33\times10^3}+\frac{1}{R_B+5\times10^3}+\frac{1}{r_e}\right)^{-1}}{100+\left(\frac{1}{33\times10^3}+\frac{1}{R_B+5\times10^3}+\frac{1}{r_e}\right)^{-1}} \times \frac{-560\alpha}{r_e}$$

$$= \frac{-560\alpha\left(\frac{1}{33\times10^3}+\frac{1}{R_B+5\times10^3}+\frac{1}{r_e}\right)^{-1}}{r_e\left\{100+\left(\frac{1}{33\times10^3}+\frac{1}{R_B+5\times10^3}+\frac{1}{r_e}\right)^{-1}\right\}}$$

or, $R_{in} = (1+\beta)r_e$

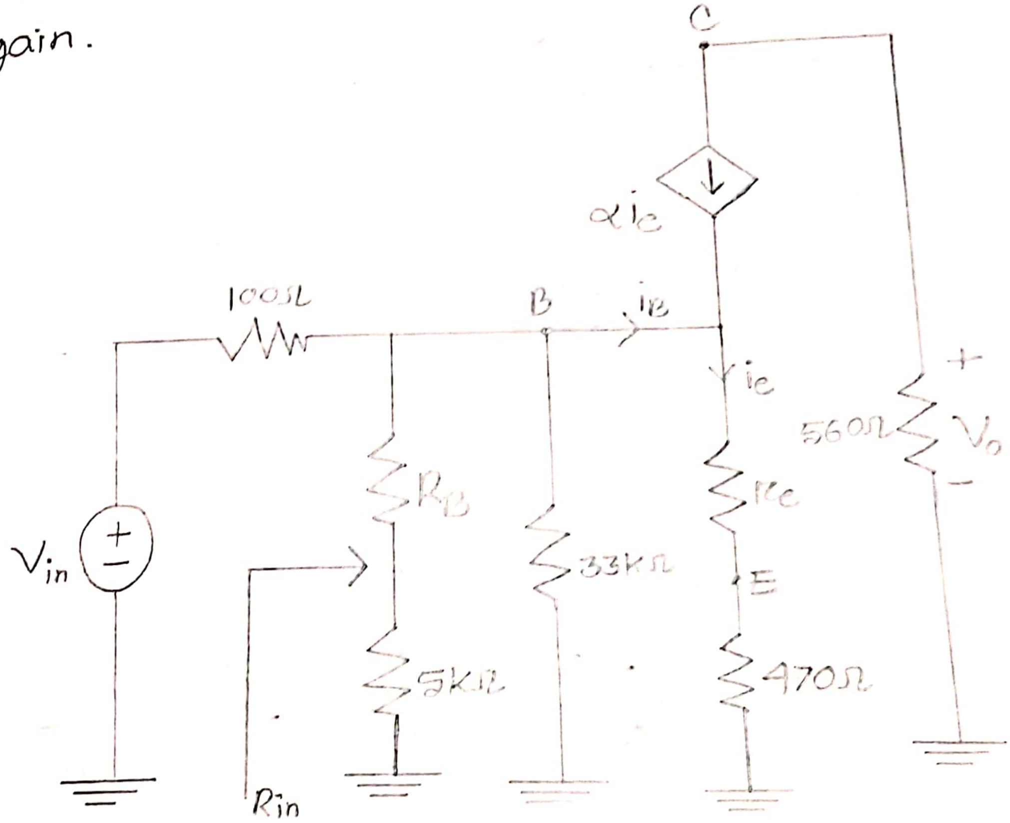
$$A_V = \frac{-560\alpha(1+\beta)r_e}{r_e\{(1+\beta)r_e+100\}}$$

$$= \frac{-560\alpha(1+\beta)}{(1+\beta)r_e+100}$$

Remove $C_E = 10$

gain.

Remove $C_E = 10\mu F$ and obtain voltage gain.



$$V_o = -560\alpha i_e \quad \ldots (i)$$

$$V_b = i_e(r_e + 470) \quad \ldots (ii)$$

$$R_{in} = \left(\frac{1}{33\times10^3} + \frac{1}{R_B + 5\times10^3} + \frac{1}{r_e + R_e}\right)^{-1}$$

$$V_b = \frac{\left(\frac{1}{33\times10^3} + \frac{1}{R_B+5\times10^3} + \frac{1}{r_e+R_e}\right)^{-1}}{100 + \left(\frac{1}{33\times10^3} + \frac{1}{R_B+5\times10^3} + \frac{1}{r_e+R_e}\right)^{-1}} V_{in} \quad \ldots (iii)$$

from (i) and (ii)

$$\frac{V_o}{V_b} = -\frac{560\alpha}{r_e + 470}$$

from (iii) and (iv)

$$A_V = \frac{V_o}{V_{in}} = \frac{-560\alpha\left(\frac{1}{33\times10^3} + \frac{1}{R_B + 5\times10^3} + \frac{1}{r_e+470}\right.}{\left\{\left(\frac{1}{33\times10^3} + \frac{1}{R_B+5\times10^3} + \frac{1}{r_e+470}\right)^{-1} + 100\right\}\left\{r_e + 4\right.}$$

or, $R_{in} = (1+\beta)(r_e + 470)$

$$\therefore A_V = \frac{-560\alpha(1+\beta)(r_e+470)}{(r_e+R_e)\left((1+\beta)(r_e+470)+100\right)}$$

$$= \frac{-560\alpha(1+\beta)}{(1+\beta)(r_e+470)+100}$$

obtain an expression for output resistance R_o.

Answer:

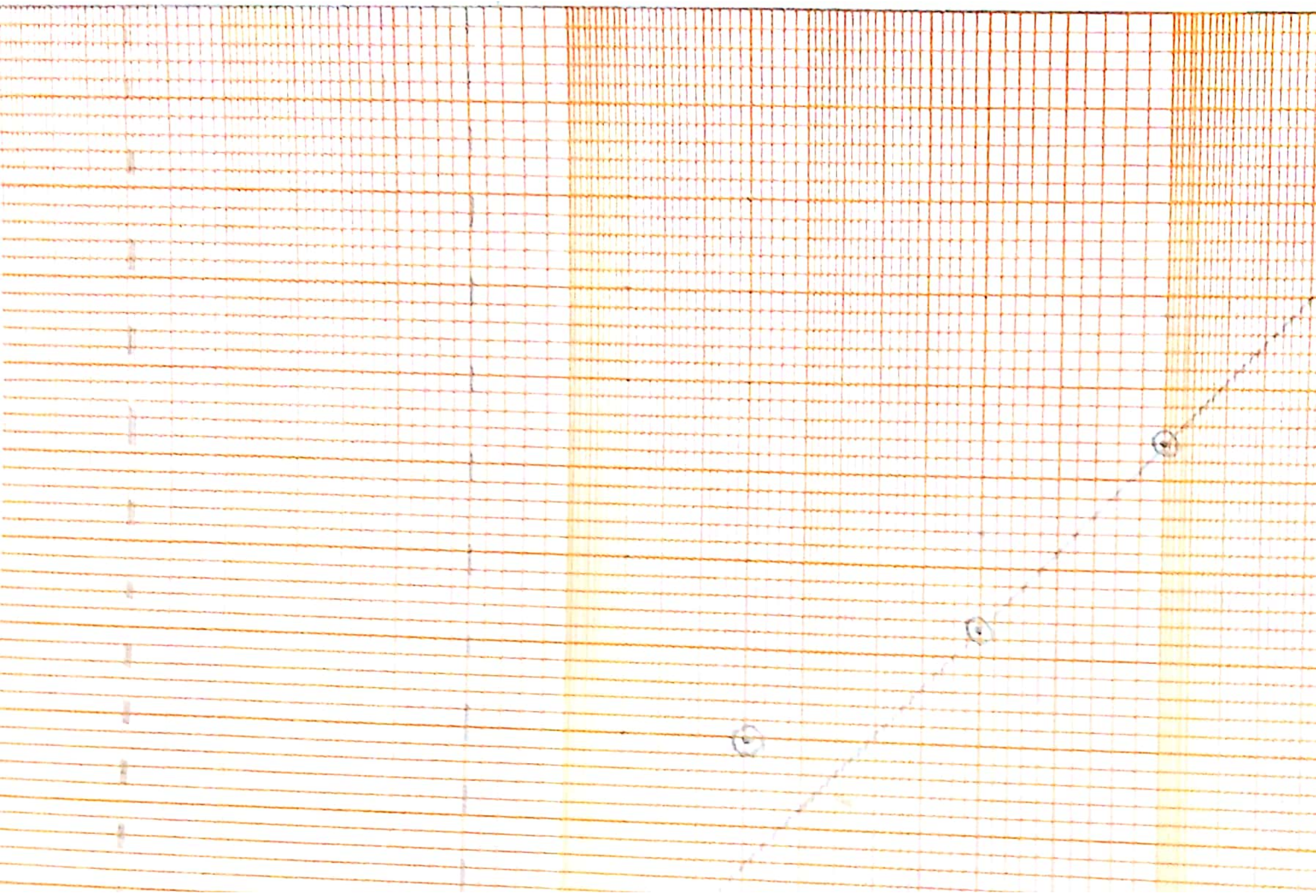
By the small signal equivalent circuit $R_o = 560\Omega$

Report:

Plot the gain in dB as a function of frequency in a semi log paper.

Answer: Different gain in different frequency was measured during the experiment.

Frequency Hz	Gain (dB) (10log Av)
50	3.01
100	3.97
200	6.98
500	10
800	12.50
1000	13.01
2000	16.98
5000	16.98



lower cutoff frequency: 2000 Hz

Higher cutoff frequency: 5000 Hz

mid band gain: 16.98 dB

3. What is the input impedance, output impedance and phase relationship between input and output for CE amplifier and comment on them.

input impedance: input impedance is the impedance seen by the source.

It is the ratio of voltage to current flowing in. $R_{in} = \frac{V_b}{I_b}$

from experiment $R_{in} = 2.3\Omega$

Output impedance: The output ~~the~~ impedance is the ratio of the output voltage and the output current.

from experiment $R_o = 622\Omega$

Phase relationship: The phase difference in CE amplifier is 180°. It was noticed from the experiment.

* What is the function of bypass capacitor and dc blocking capacitor?

Answer:

Bypass capacitor: The capacitor in parallel with the emitter resistance is bypass capacitor. It is called bypass capacitor because in high frequency the AC current bypasses the R_E and flows through the capacitor. It works like a short circuit then. In high frequency $X_C < R_E$. But in low frequency it works like an open circuit. Moreover it decreases the input impedance and increases the voltage gain.

DC blocking capacitor: The capa[cito]rs in series with Vin and V_o are called DC blocking capacitor or coupling capacitor. It blocks the DC part of the signal from going to base. It also blocks the DC part of the output at V_o. Only the AC signal passes through capacitors.

what is the advantage and disadvantage of common emitter amplifier?

Answer:

Advantages:

It has very low input impedance. The current and voltage gains are very good. It has wide frequency response and large bandwidth. It's power gain is the highest.

Disadvantages:

It has a high output resistance. It's voltage gain is not stable. It responds bad to very high frequencies.

6. Using measured value of R_B, calculate voltage gain from rel expressions for $\beta = 75$. if value of g_m and r_π required. determine g_m and r_π from dc analysis for the circuit.

Answer: $\beta = 75$, $\therefore \alpha = 0.99$

$V_{CC} = 15V$ $\quad R_B = 400\ \Omega$

$V_{CE} = 7.6V$

$$I_C R_C + V_{CE} = V_{CC}$$

$$\Rightarrow \quad I_B = \frac{V_{CC} - V_{CE}}{\beta R_C}$$

$$= \frac{15 - 7.6}{75 \times 560}$$

$$= 1.76 \times 10^{-4} A$$

$$\therefore I_E = (\beta + 1) I_B = 0.013A$$

$$\therefore r_e = \frac{V_t}{I_E}$$

$$= \frac{25 \times 10^{-3}}{0.013}$$

$r_e = 1.92\Omega$

while C_E is connected

$$A_V = \frac{-560 \times .99 \left(\frac{1}{33\times10^3} + \frac{1}{400+5\times10^3} + \frac{1}{1.92}\right)^{-1}}{1.92\left\{100 + \left(\frac{1}{33\times10^3} + \frac{1}{400+5\times10^3} + \frac{1}{1.92}\right)^{-1}\right\}}$$

$= -5.437$

while C_E is disconnected

$$A_V = \frac{-560 \times .99 \left(\frac{1}{33\times10^3} + \frac{1}{400+5\times10^3} + \frac{1}{1.92+470}\right)^{-1}}{(1.92+470)\left\{100 + \left(\frac{1}{33\times10^3} + \frac{1}{400+5\times10^3} + \frac{1}{1.92+470}\right)\right\}}$$

$= -0.95$

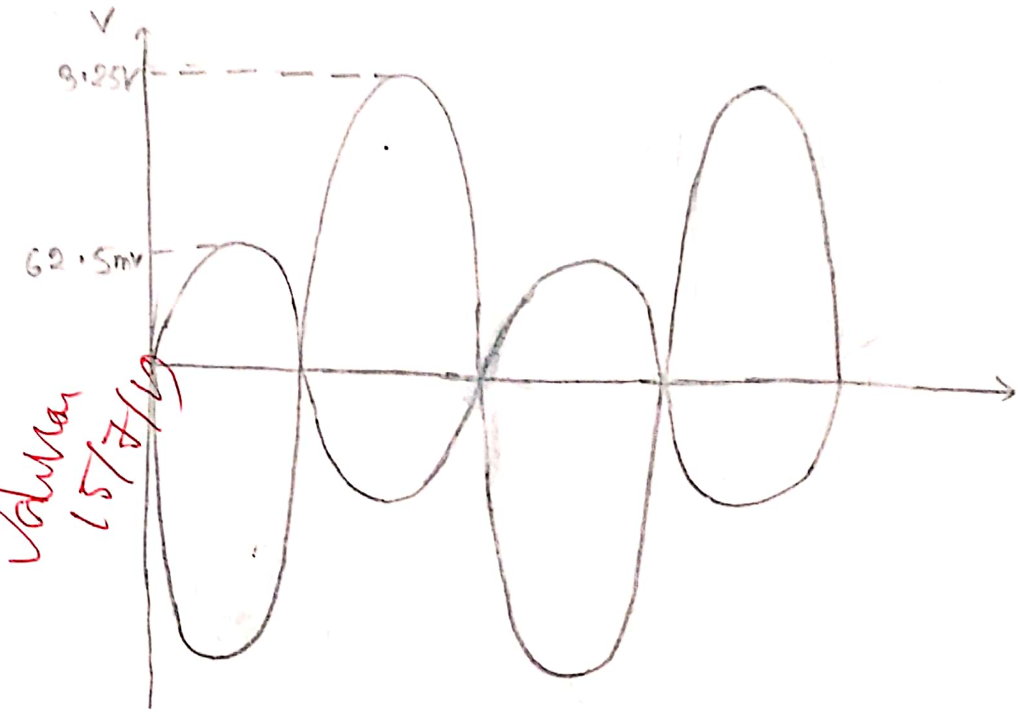
$V_{CC} = 15V$

$V_{CE} = 7.6V$

$V_{in} = 125mV$

$V_o = 6.5V$

$A_v = \frac{V_o}{V_{in}} = \frac{6.5}{125\times10^{-3}} = 52$



Valluri 15/7/19

4. potentiometer 0.4kΩ

5. Peak value = 0.5 mv

6. Gain = $\frac{10\ mV}{5.55\ mV} = 1.8$

7. $V_{in} = 100mV$; (50 Hz)

$V_{out} = \cancel{0.2V}\ 0.1\ V.$ Gain = $\frac{0.\cancel{1}2}{100\times10^{-3}} = \cancel{1}2$

100 Hz,

Vout = 0.25V Gain = 2.5

Vin = 100mV

200 Hz,

Vout = 0.5V Gain = 5

Vin = 100 mV

500 Hz,

Vout = 1 V Gain = 10

Vin = 100 mV

800 Hz, Vout = 1.8 V Gain = 18

Vin = 100 mV

1000 Hz, Vout = 2V Gain = 20

Vin = 100 mV

2000 Hz, Vout = 5V Gain = 50

Vin = 100 mV

~~2000 Hz, Vout =~~

5000 Hz, Vout = 5V Gain = 50

Vin = 100mV.

6000 Hz, Vout = 4V Gain = 40

Vin = 1000 mV

7000 Hz, Vout = 3.2V Gain = 32

Vin = 100 mV

000 Hz,

Vout = 2.5 V

Vin = 100 mV

Gain = 25

10,000 Hz

Vout = 1.8 V

Vin = 100 mV

Gain = 18