PH 211

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Experiment Name - (CE) Single Stage Amplifier.

Experiment NO - 1

Date - 07/08/23.

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Experiment 1: Single stage Amplifier

Objective:
- To observe the operating characteristics of the common emitter (CE) configuration and to learn how it can be used for small signal amplification.
- To determine voltage gain of amplifier
- To find out the clipping voltages for positive and negative polarity peaks of the output signal.
- To study the frequency response to calculate bandwidth for sinusoidal wave.
- To compare the input and output frequency spectrum.

Formulae:-

(i) Voltage Gain $A_V = \frac{V_{out}}{V_{in}}$

A_V (theoritical) $= \frac{R_C}{R_E}$

A_V (in decibels) $= 20 \log_{10} \left(\frac{V_{out(p-p)}}{V_{in(p-p)}} \right)$

$V_{out(p-p)}$ = Output voltage (peak to peak).

$V_{in(p-p)}$ = Input voltage (peak to peak)

Bandwidth = $(f_2 - f_1)\ H_2$

f_1 & f_2 = lower & upper cut-off frequencies.

$I_E = I_B + I_C$

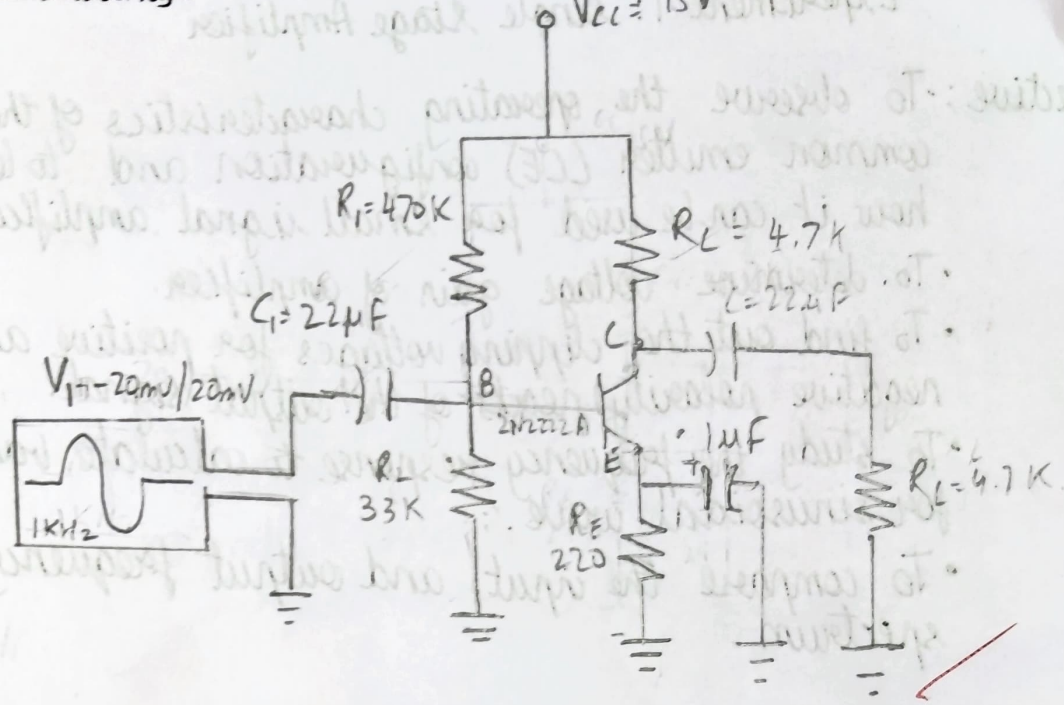
$\alpha = \frac{I_C}{I_E}$ $\quad$ $\beta = \frac{I_C}{I_B}$

I_E = Emitter current

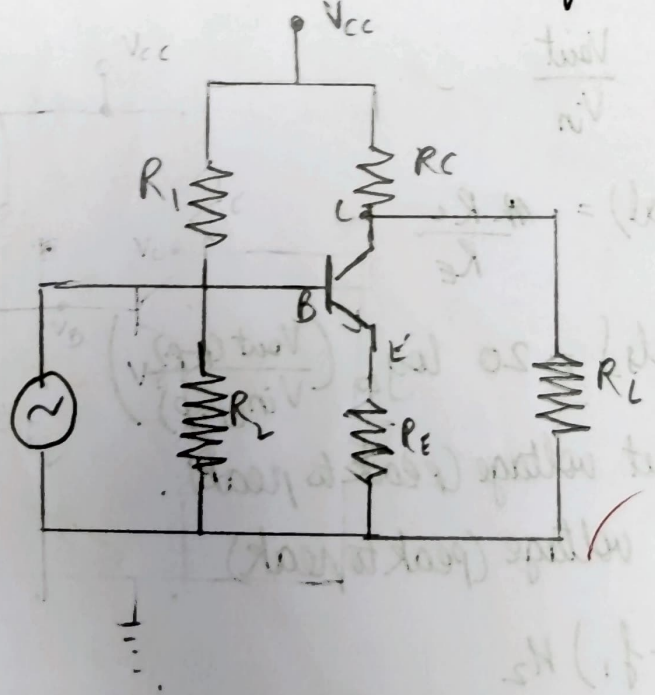
I_C = Collector current

I_B = Base current.

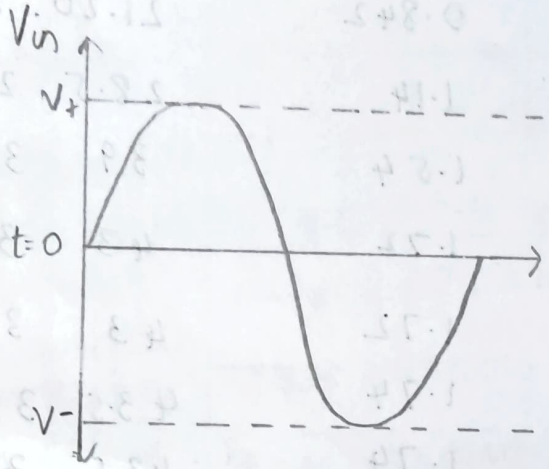
General Circuits

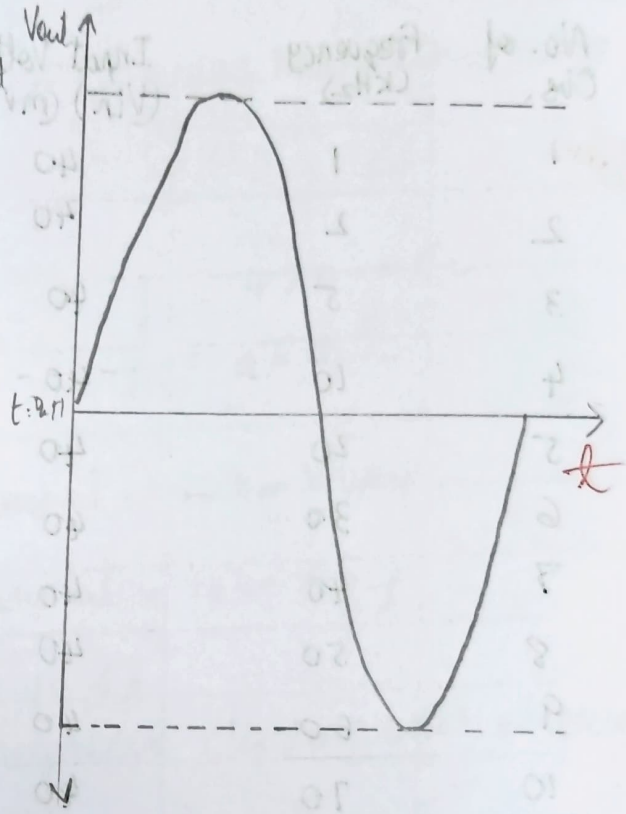


DC Equivalent Circuit and Analysis.



Expected Waveform:





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Observation:

No. of Obs.	Frequency (KHz)	Input Voltage (Vin) (mv)	Output Voltage (Vout) in V	Voltage Gain(Av)	In Decibel
1	1	40	0.842	21.20	26.53
2	2	40	1.14	28.5	29.10
3	5	40	1.54	39	31.82
4	10	40	1.72	43	32.67
5	20	40	1.72	43	32.67
6	30	40	1.74	43.5	32.77
7	40	40	1.74	43.5	32.77
8	50	40	1.78	44	32.87
9	60	40	1.82	45.5	33.16
10	70	40	1.82	45.5	33.16
11	80	40	1.82	45.5	33.16
12	90	40	1.76	44	32.87
13	100	40	1.74	43.5	32.77
14	150	40	1.72	43	32.67
15	200	40	1.70	42.5	32.56
16	300	40	1.60	40.0	32
17	400	40	1.40	35.0	30.88
18	500	40	1.16	29	29.24
19	600	40	1.06	26.5	28.46
20	1000	40	0.908	22.7	27.12
21	2000	40	0.828	20.7	26.32

Apparatus: Breadboard, Digital Storage Oscilloscope, Function Generator, Power Supply, Resistors: [470K, 4.7K, 33 K, 220Ω] Capacitors: (22uf-2, 1uF-1) 2N2222 Transistors, wires

EXP = 10

Calculation

Band width: $f_2 - f_1$ (from graph calculated at -3decibels from peak to get 50% of A_V)

$= 470 - 3\ KH_2$

$= 467\ KH_2$.

$f_2 = 470\ KH_2$.

$f_1 = 3\ KH_2$

- +ve clipping occurs at = 104mV P-P
- -ve clipping occurs at = 144mV p-p
- Voltage gain (stable) = 33.16 dB
- ~~was clipping is positive~~ positive and negative clipping was observed on changing voltage.

Summary of Results:

→ Output signal and input signal is 180° out of phase.

→ Band width = 467 KH2.

→ A_V at $f_2 = 33.16\ KH_2$.

→ +ve clipping was at 104mV p-p

→ -ve clipping was at 144mV p-p

→ The graph remains constant from 60 KH2 to 90 KH2.

~~It is~~ The graph of voltage gain initially increases from 1 KH2 to 60 KH2 and then stablizes from 60 KH2 to 90 KH2.

→ The voltage gain then decreases from 100 KH2 - 2000 KH2.

→ The common emitter amplifier tremendously amplifies the amplitude of voltage. The amplification is highest in the bandwidth region of 10 KH2 to 200 KH2

→ Positive clipping occurs when the b.j.t is cut off i.e it becomes an open circuit while negative clipping occurs at saturated region.

Precautions:

→ Make sure the connections are tight.
→ Vin should remain constant.
→ Make sure the transistor is working in the active region.
→ Check the resistances of the resistor.
→ If there is noise in the signal make sure no wires are loose
→ Check and make sure the transistor is not broken
→ Make sure all apparatus and machines are working

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Input

sin wave :

freq. 1kHz

V_{p-p} - 40mV

Output

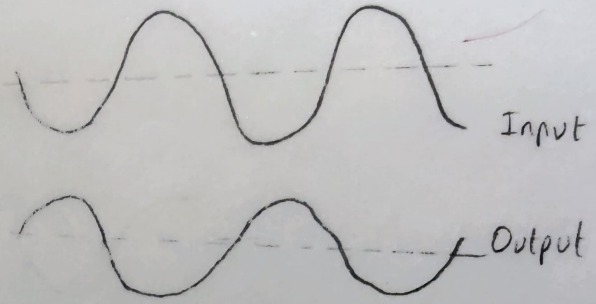
V_{p-p} - 654V

gain = 21.28

phase difference

b/w input & output = 180°

= π rads.



Graph of frequency v/s Voltage gain in (dB)

X axis:
frequency (KHz)
(log scale)

Y axis:
Voltage gain
0.5 graph units
= 2dB.