1.8 TABULATION

Transient Analysis

	Amplitude	Frequency	Phase difference
Input signal	50 mV	1kHz	
Output signal	10V	1KHz	180°

(a)

Frequency Response

Vi = 50mV

Frequency (Hz)	Output Voltage (Vo) (V)	Gain (Av)	Gain in db Av = 20 log(Vo/Vi)
20	5	5	13.9
30	6	6	15.5
40	7	7	16.9
50	9	9	19.0
100	10	10	20.0
200	11	11	20.8
300	12	12	20.8
900	12	12	21.5
1k	12	12	21.5
2K	12	12	21.5
3K	12	12	21.5
4K	12	12	21.5
5K	12	12	21.5
6K	12	12	21.5
50K	12	12	21.5
100K	12	12	21.5
200K	11	11	20.8
300K	10	10	20.0
400K	9	9	19.0
500K	8	8	18.0

(b)

of CE amplifie

E amplifier.

1.10 POSTLAB QUESTIONS

1. How do coupling capacitors C_1 and C_2 affect the frequency response? Why?
2. What is the effect on the amplifier performance of omitting R_E?
3. What is the effect on input impedance of removing bypass capacitor C_E?
4. (a) What is the phase relationship between the input and output signals of a C_E amplifier?

   (b) Was this relationship confirmed by the results of your experiments? Explain how.
5. Is the output impedance of a Common emitter amplifier a fixed quantity? Confirm your answer by referring specifically to any substantiating data in this experiment.
6. From a measurement of the rise time of the output pulse of an amplifier, whose input is a small amplitude square wave, one can estimate the ________ parameter of the amplifier.
7. What is the effect found when $V_{CE} > V_{CC}/2$?

1.11 RESULT

a. The phase difference between the input and output voltage waveform is 180°

b. The Mid-band voltage gain = 18.5 db

c. The Lower cutoff frequency = 50 Hz

d. The Upper cutoff frequency = 300 KHz

e. Bandwidth = 300 K − 50 Hz

= 299.95 KHz

8/4/22

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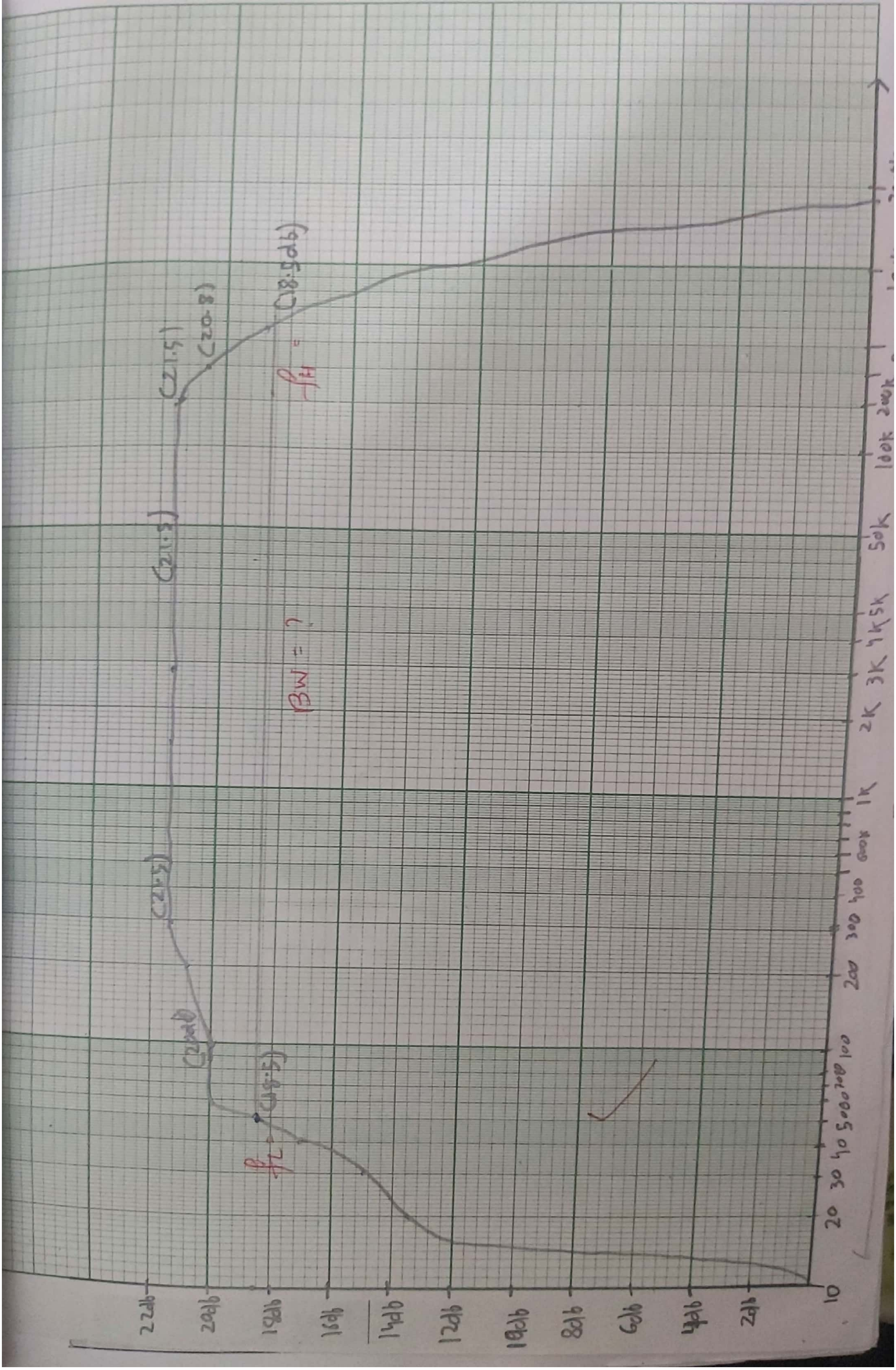
22db
20db
18db
16db
14db
12db
10db
8db
6db
4db
2db
10
20
30
200
300
400
1K
2K
3K
50K
100K
200K
(21.5)
(21.3)
(20.8)
(18.5db)
f_L
f_H =
BW = ?

INPUT WAVEFORM

Scale

X-axis → 1unit - 0.25 mV

Y-axis → 1unit - 25 mV

Output Waveform

Scale

X axis → 1 unit - 0.25 m

Y axis → 1 unit - 1V

2.7 TABULATION

CS MOSFET AMPLIFIER WITH CURRENT-SERIES FEEDBACK :-

Transient Analysis

	Amplitude	Frequency	Phase difference
Input signal	5 mV	1 kHz	180°
Output signal	200 mV	1 kHz	

(a)

Frequency Response

Vi = 100mV

Frequency	Output Voltage (Vo)	Gain	Gain in db Av = 20 log(Vo/Vi)
20 Hz	18 V	18	25 db
30 Hz	26 V	26	28 db
40 Hz	30 V	30	29.5 db
50 Hz	32 V	32	29.6 db
60 Hz	33 V	33	30 db
100 Hz	33.5	33.5	30 db
1 KHz	37 V	37	31 db
2 KHz	37 V	37	31 db
3 KHz	37 V	37	31 db
4 KHz	37 V	37	31 db
10 KHz	37 V	37	31 db
20 KHz	36 V	36	31 db
30 KHz	35 V	35	31 db
40 KHz	34 V	34	30 db

1k

1000

Exp-2

50 KHz	33V	33	30db
100 KHz	26V	26	28db

(b)

CS MOSFET AMPLIFIER WITH VOLTAGE-SERIES FEEDBACK :-

Transient Analysis

	Amplitude	Frequency	Phase difference
Input signal	5 mV	1 KHz	180°
Output signal	100 mV	1 KHz	

(c)

Frequency Response

Vi = 100mV

Frequency	Output Voltage in V (Vo)	Gain	Gain in db Av = 20 log(Vo/Vi)
20 Hz	2.46	2.46	8
30 Hz	4.62	4.62	13
40 Hz	6.59	6.59	16
50 Hz	8.17	8.17	18.35
100 Hz	13.08	13.08	22.39
200 Hz	15.79	15.79	24
300 Hz	16.471	16.471	24.35
400 Hz	16.471	16.471	24.35
500 Hz	16.471	16.471	24.35
1 KHz	16.471	16.471	24.35
2 KHz	16.471	16.471	24.35
3 KHz	16.471	16.471	24.35
10 KHz	16.471	16.471	24.35
20 KHz	16.471	15.30	23.7
100 KHz	15.30	12.17	21.66
200 KHz	12.17	9.60	19.629
300 KHz	9.60	6.44	16.27
500 KHz	6.44	3.50	
1 MHz	3.50		

2.10 RESULT:

1. The current series and voltage series feedback amplifier were designed, simulated and its frequency response was plotted.
2. The following parameters were observed.

CS MOSFET Amplifier		Mid Band Voltage Gain	Bandwidth
Current Series Amplifier	With Feedback	28 db	100 KHz - 30 Hz ≈ 99.97 KHz
	Without Feedback		
Voltage Series Amplifier	With Feedback	31.35 db	200 KHz - 90 Hz ≈ 199.91 KHz
	Without Feedback		

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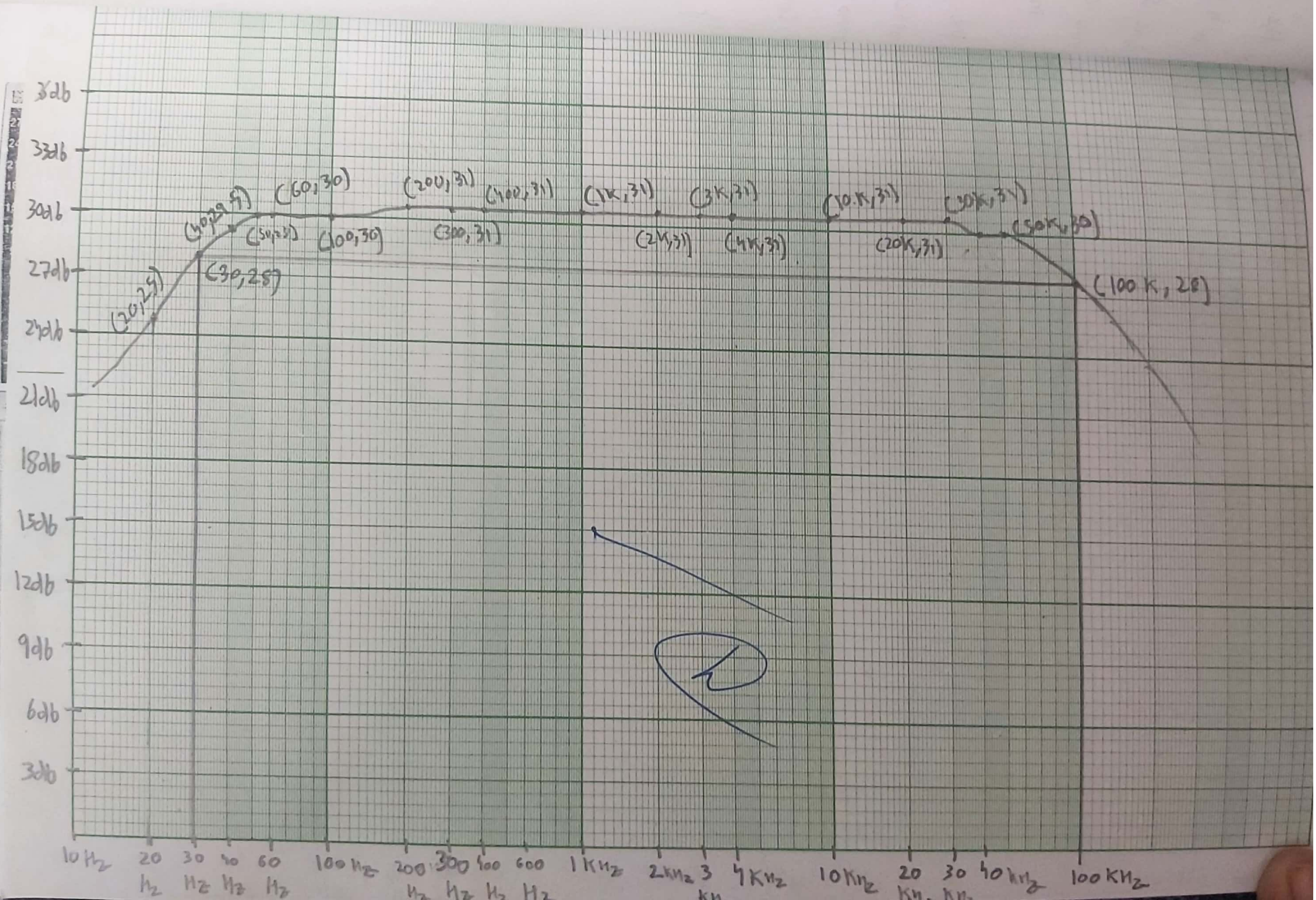
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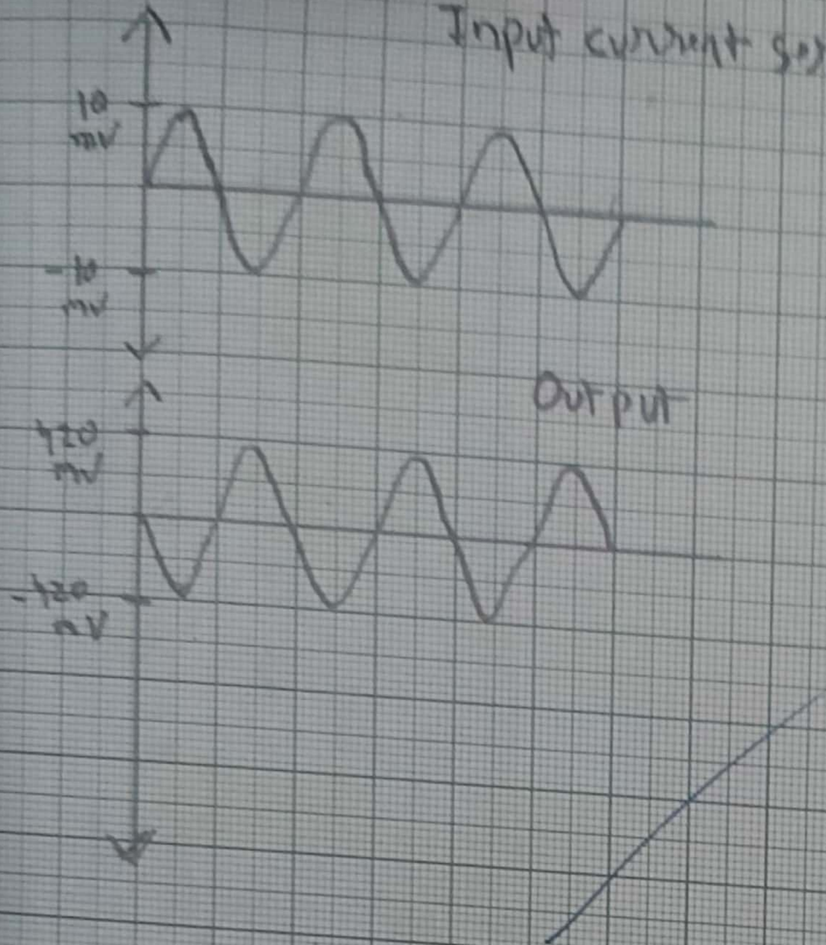
33db
30db
27db
24db
21db
18db
15db
12db
9db
6db
3db
(20,25)
(30,28)
(40,29.5)
(50,31)
(60,30)
(100,30)
(200,31)
(300,31)
(400,31)
(1K,31)
(2K,31)
(3K,31)
(4K,31)
(10K,31)
(20K,31)
(30K,31)
(50K,30)
(100 K, 28)
10 Hz
20 Hz
30 Hz
40 Hz
60 Hz
100 Hz
200 Hz
300 Hz
400 Hz
600 Hz
1 KHz
2 KHz
3
4 KHz
10 KHz
20
30
40 KHz
100 KHz

Input current series Feedback

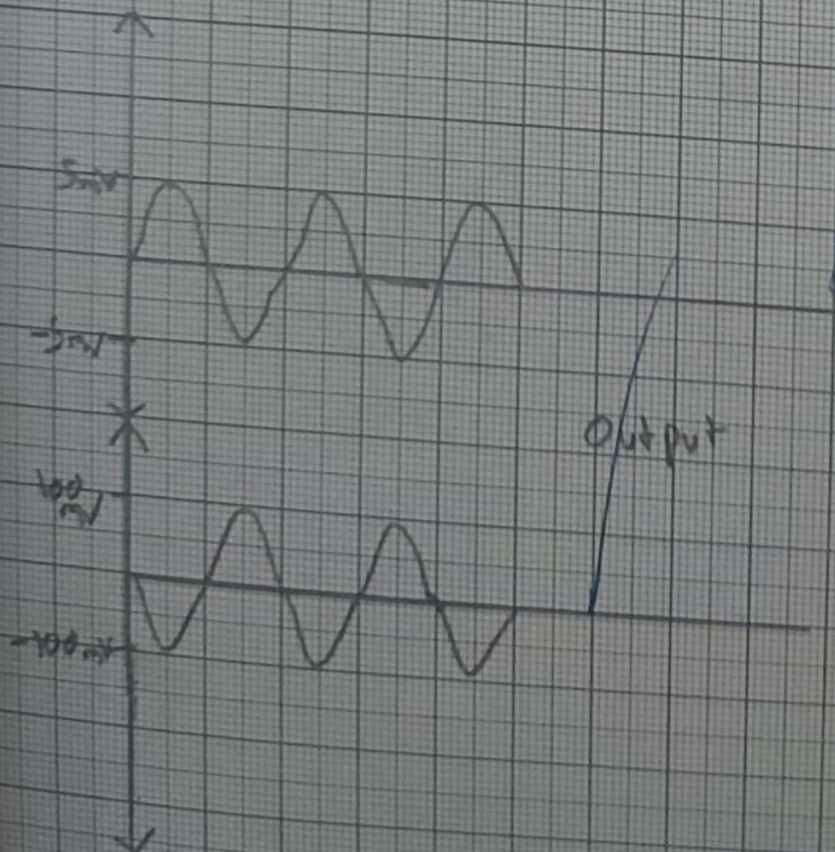


Scale :-

X-axis - 2 unit

Y-axis - 1 unit

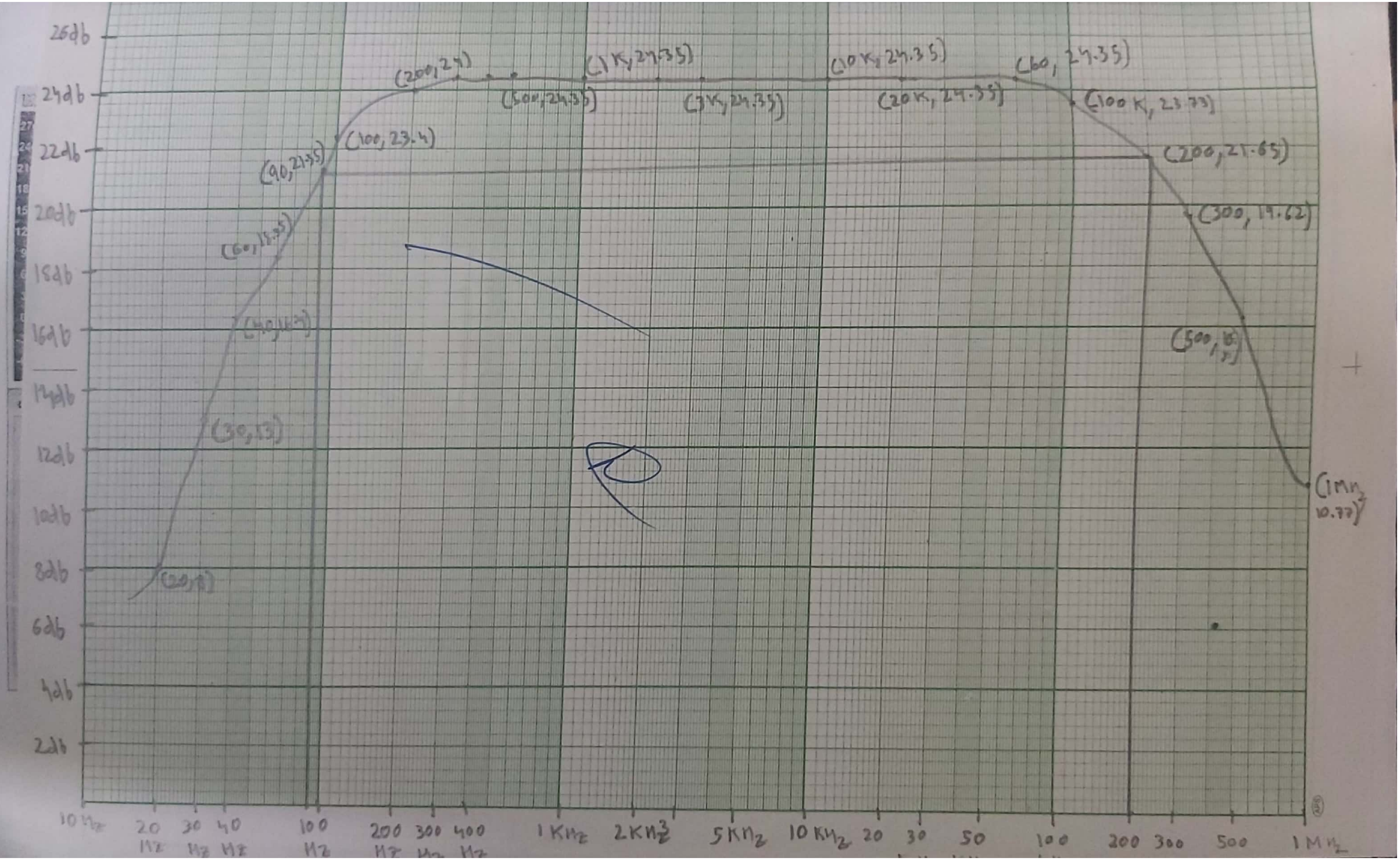
Input Voltage Series Feedback



Scale:-

X-axis - 2 unit

Y-axis - 1 unit



26db
24db
22db
20db
18db
16db
14db
12db
10db
8db
6db
4db
2db
10 Hz
20 Hz
30 Hz
40 Hz
100 Hz
200 Hz
300 Hz
400 Hz
1 KHz
2 KHz
5 KHz
10 KHz
20
30
50
100
200
300
500
1 MHz
(20,8)
(30,13)
(40,16.7)
(60,18.35)
(90,21.35)
(100,23.4)
(200,24)
(500,24.3)
(1K,24.35)
(3K,24.35)
(10K,24.35)
(20K,24.35)
(60,24.35)
(100K,23.73)
(200,21.65)
(300,19.62)
(500,15.7)
(1MHz,10.77)

frequency across R_L. Take atleast 10 readings and tabulate the reading in Table. Plot on a semi log graph sheet the frequency response (voltage gain Vs frequency) curve using the above measurements.

d. From the plot, determine the values of (a) Mid band voltage gain, Av(mid), (b) Lower cut-off frequency,(c) upper cut-off frequency and (d) Bandwidth.

3.8 TABULATION

Transient Analysis

	Amplitude	Frequency	Phase difference
Input signal	100 mV	1K	0
Output signal after 1st transistor	0.1 V	1K	180
Output signal after 1st transistor	13 V	1K	180

Frequency Response V_i = 1V V

Frequency	Output Voltage in V (Vo)	Gain	Gain in db $A_v = 20 \log(Vo/Vi)$
10 Hz	4	4	12
20 Hz	8.5	8.5	18
30 Hz	12	12	21.2
40 Hz	14.5	14.5	23.5
100 Hz	24	24	28
200 Hz	28.1V	28.1	29
300 Hz	29 V	29	29.2
1KHz	29.8V	29.8	29.2
2KHz	29.8 V	29.8	29.2
3KHz	29.8V	29.8	29.2

1 MHz	29.8 V	29.8	29.5
2 MHz	29 V	29	29.2
3 MHz	28.1 V	28.1	29
10 MHz	19.5 V	19.5	25.9
20 MHz	12 V	12	21.5

1 MHz	29.8 V	29.8	29.5
2 MHz	29 V	29	29.2
3 MHz	28.1 V	28.1	29
10 MHz	19.5 V	19.5	25.9
20 MHz	12 V	12	21.5

9 PRELAB QUESTIONS

In what ways the Cascode amplifier has advantage over CE amplifier?

Why the analysis of Transistor circuit is split in to AC while keeping all the DC source equal to zero and DC while keeping all the AC source equal to zero.

What does the term small signal imply?

Discuss the construction of Cascode amplifier.

What are the physical meaning of hybrid π parameters r_π , r_o.

10 POSTLAB QUESTIONS

Compare the AC characteristics of CE amplifier and cascade amplifier.

Discuss the general conditions under which the cascade amplifier would be used.

Compare the transient characteristics of input signal and output signal.

11 RESULT

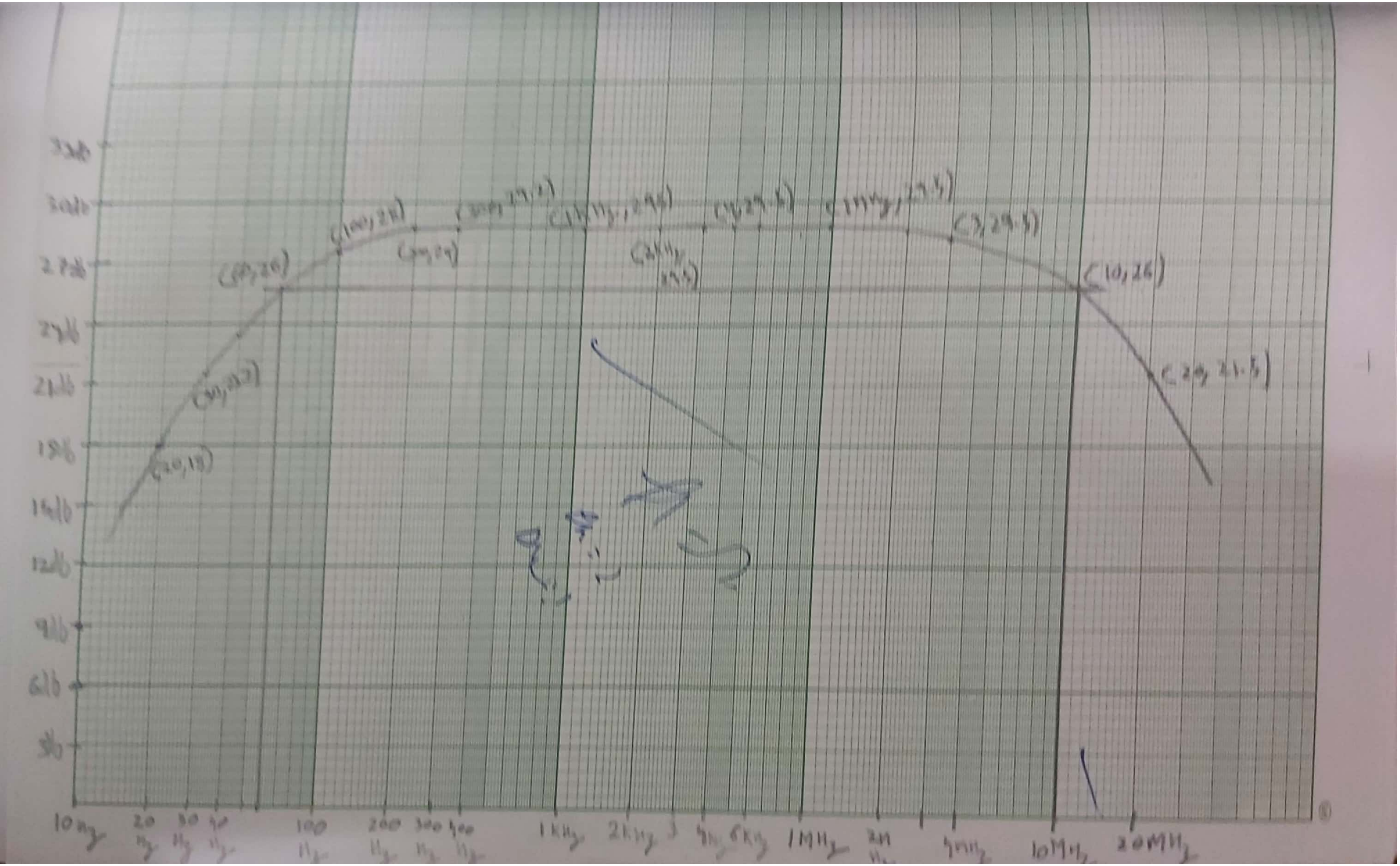
a. The phase difference between the input and output voltage waveform is 180°

b. The Mid-band voltage gain = 26.2 db

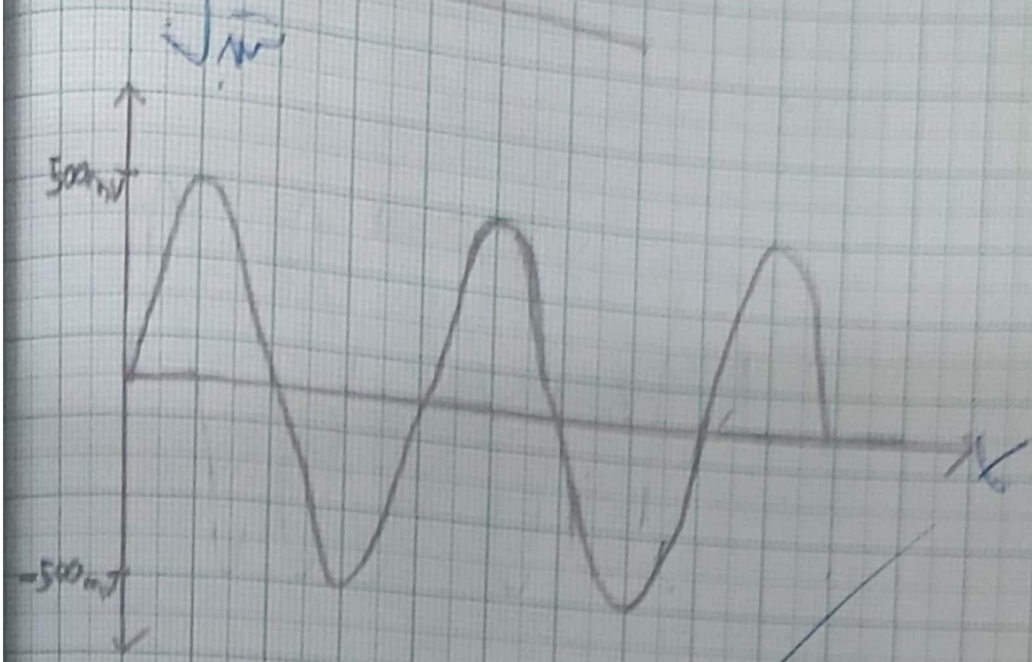
c. The Lower cutoff frequency = 60 Hz

d. The Upper cutoff frequency = 9 kHz

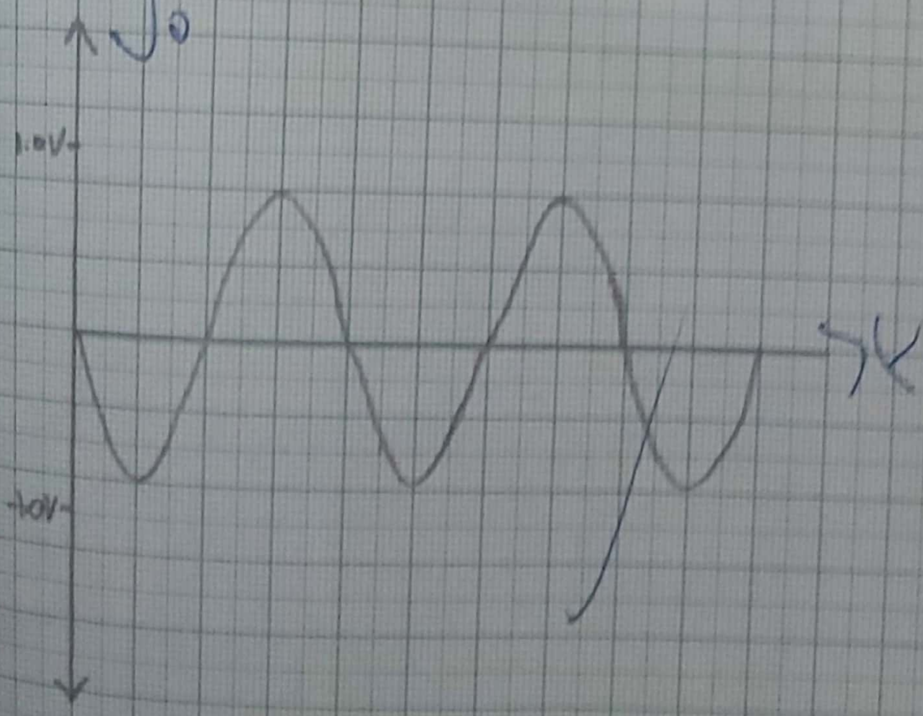
e. Bandwidth= 9k - 60Hz ≃ 9kHz


33db
30db
27db
24db
21db
18db
15db
12db
9db
6db
3db
10 Hz
20 Hz
30 Hz
40 Hz
100 Hz
200 Hz
300 Hz
400 Hz
1 KHz
2 KHz
1 MHz
10 MHz
20 MHz
(20,18)
(50,26)
(100,28)
(10,26)

Input Waveform



Output Waveform



$$1.5KHz = \frac{1}{2\pi R * 0.1\mu F * \sqrt{6}}$$

R = 3.3 KΩ

4.5.1 Design Constraints

1. Frequency of oscillation is proportional to $f = \frac{1}{2\pi RC\sqrt{2N}}$, where N is the number of stages. Thus RC phase shift oscillator at higher frequencies have high phase noise which results in instability in frequency as number of stages increases.

2. It requires very small resistor value which is difficult to realize on chip.

4.6 PROCEDURE

1. Connections are made as shown in the circuit diagram.
2. The DC power supply is switched ON.
3. The output waveform is displayed on the CRO.
4. The peak to peak Amplitude and time period of the sine wave is noted.
5. The graph of output waveform is drawn.

4.7 TABULATION

	Amplitude (Volts)	Time period(sec)	Frequency (Hz)
Practical value	3.8 x2 = 7.6V	1 ms	1 KHz
Theoretical value	7.6V	0.5ms	1.5 ~~2~~ KHz

o/p Verified

4.8 PRE LAB QUESTIONS

1. What is Phase shift oscillator?
2. What is the difference between RC phase shift oscillator and LC oscillator?
3. What is the condition for sustained oscillation in RC phase shift oscillator?
4. What is the equation for RC phase shift oscillator?
5. What are the applications of RC phase shift oscillators?

4.9 POST LAB QUESTIONS

1. Why we need a phase shift between input and output signal?
2. Why RC oscillators cannot generate high frequency oscillations?

3. What difference will the number of sections(R&C) in the oscillator circuit make?
4. How is phase angle determined in RC phase shift oscillator?
5. How can we get a maximum phase angle of 90° in RC phase shift oscillator?
6. What is the maximum frequency for which a RC phase shift oscillator can be designed without any distortion in phase?

4.10 RESULT

Thus an RC phase shift oscillator is designed, constructed and tested. Frequency of oscillation Theoretical f_T= 7.6V , Practical f_P= 7.6V

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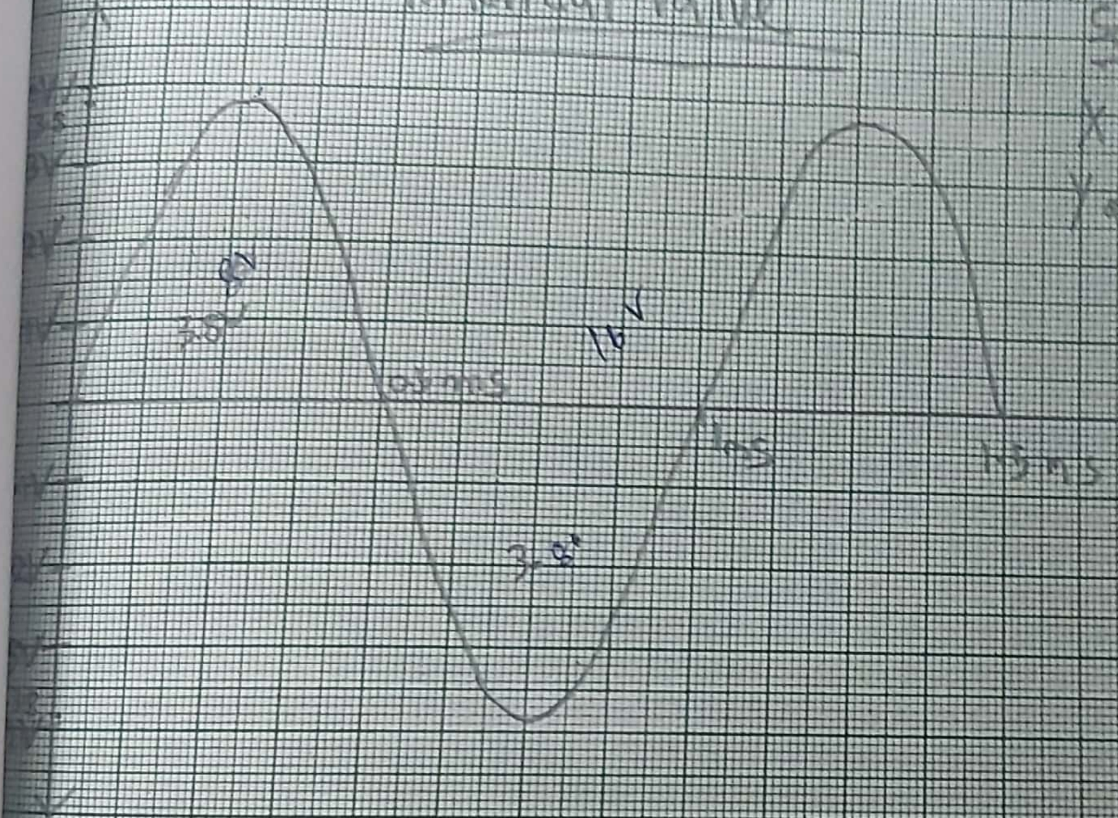
Practical Value

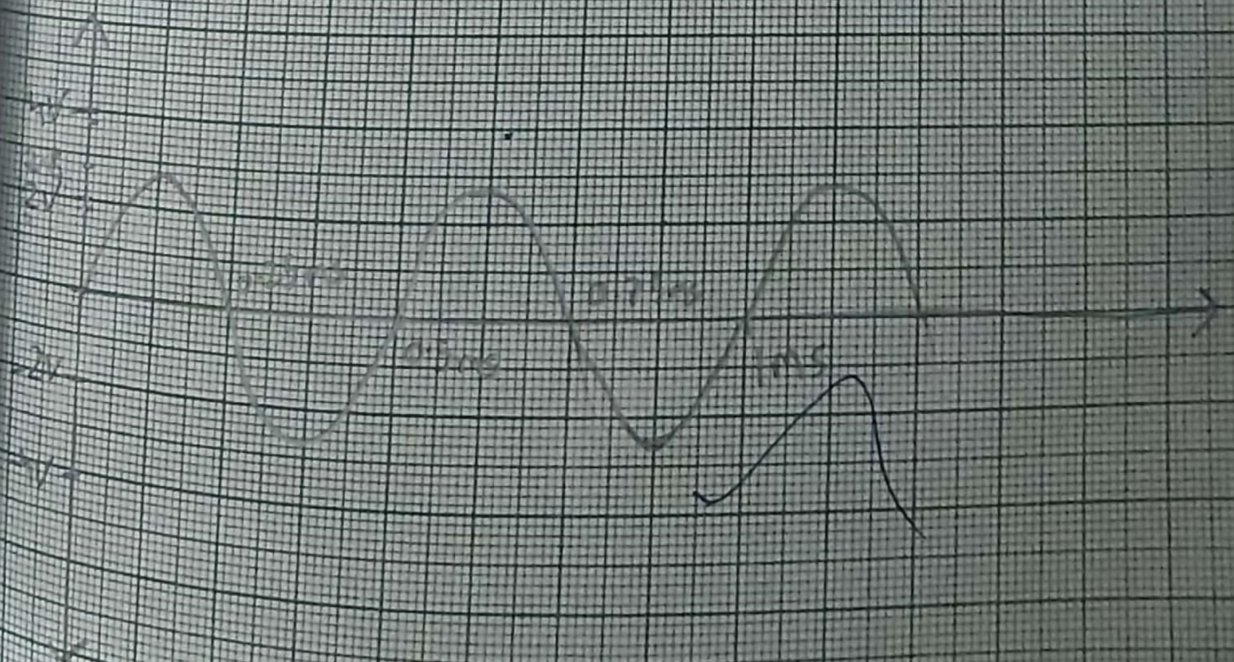
Scale

X axis - 8 unit = 1ms

Y axis - 1 unit = 1V



Theoretical Value



6.6

6. Calculate the common mode rejection ratio CMRR=A_d/A_c.

5.6 TABULATION

Input and Output Voltage Signal Measurements

Mode	Input Voltage	Output Voltage	Frequency	Voltage Gain	Phase Difference
Differential Mode	V_{in1} = 50mV V_{in2} = 0V	V_{01} = 1.6×2=3.2 V_{02} = 1.4×2 ⇒2.8 $V_0 = V_{01} - V_{02}$ = 0.4	1KHz	120	180°
Common Mode	V_{in1} = 50mV V_{in2} = 50mV	V_{01} = 280mV V_{02} = 280mV $V_0 = V_{01} - V_{02}$ = 0	1KHz	0	0°

$$CMRR = \frac{\textit{Differential Mode Gain}}{\textit{Common Mode Gain}} =$$

Frequency Response

Vi = 50mV

Frequency	Output Voltage (Vo)	Gain	Gain in db Av = 20 log(Vo/Vi)
30	V_{01} = -1.8 V_{02} = 1.6 } V_0=-3.2	64	36.12
69	V_{01} = 2.6 V_{02} = 2.2 } V_0=4.8	96	39.64
180	V_{01} = -3.2 V_{02} = 2.8 } V_0 = 6.0	120	41.58
74.9KHz	V_{01} = -2.6 V_{02} = 2.2 } V_0=4.8	96	89.69

130 KHz V_{01} = -2, V_{02} = 1.6 } V_0 = -3.6 72 33.14

4. A change ... emitter resistance R_E in a differential amplifier

(a) affects the difference mode gain A_d (b) affects the common mode gain A_c

(c) affects both A_d and A_c (d) does not affect either A_d and A_c

5. Find the CMRR if differential voltage gain and common mode voltage gain of a differential amplifier are 48db and 2 db respectively.

6.9 RESULT

Thus the differential amplifier was constructed and dc collector current for the individual transistor is determined. The CMRR is calculated as ∞

1/6/22

3. Connect an oscilloscope. Adjust the output of the sine-wave generator until undistorted. Maximum signal output is obtained.
4. Observe and measure the peak-to-peak amplitude of input and output signal and record the values in the tabulation provided.
5. Now, sweep the input signal frequency in the range 30Hz to 1 MHz by adjusting the sine wave generator output.
6. For each setting of input frequency, measure the output signal voltage.
7. Draw the frequency response curve on a semi-log graph sheet. From this plot, obtain the values of mid-band voltage gain, upper and lower cut-off frequency and BW (fh-fl).

Frequency Response of Amplifier without Negative Feedback

1. Remove Rf from the circuit and connect RE and CE directly to the emitter terminal.
2. Measure and record in the table, the frequency response of this circuit without Rf by repeating steps 5 through 6.

7.7TABULATION

Measurement of frequency response of current series feedback amplifier

V_{in}= 50mV

Frequency (in Hz)	V_0 (Volts)	Gain= V_0/V_{in}	Gain (dB) = 20 log(V_o/V_{in})
10	0.23	4.6	13.2
20	0.32	6.4	16.12
80	0.34	6.8	16.65
100	0.35	7	16.90
1 K	0.35	7	16.90
30k	0.35	7	16.90
100 K	0.35	7	16.90
350 K	0.35	6.4	16.90
470 k	0.32	5.6	16.12

500	0.28	5.6	14.96
760	0.24	4.8	13.62
900	0.22	4.4	12.86

Measurement of frequency response of amplifier without feedback

V_{in}= 50mV

Frequency (in Hz)	V_0 (Volts)	Gain= V_0/V_{in}	Gain (dB) = 20 log(V_0/V_{in})
50	3.6	72	37.146
110	4.8	96	39.64
250	5.2	104	40.34
800	5.6	112	40.98
10 K	5.6	112	40.98
14 K	5.6	112	40.98
19K	5.6	112	40.98
22K	5.4	108	40.34
60 K	5.2	104	39.64
200K	4.4	88	38.04
600 K	2.4	48	32.04
900 K	2	40	30.10
1600 K	1.2	24	27.60

7.8 PRELAB QUESTIONS:

1. What do you understand by feedback in amplifiers?

... the input impedance of the

3. What is the formula for input resistance of a current series feedback amplifiers?
4. What is the effect of negative feedback on the bandwidth of an amplifiers?
5. What are the fundamentals assumptions that are made in feedback amplifiers?

7.10 RESULT:

4. The current series feedback amplifier was designed, constructed and its frequency response was plotted.
5. The following parameters were observed.

Frequency response data	Current series feedback Amplifier	Current series Amplifier without feedback
Mid_band Voltage Gain	40.98 8	16.90
Bandwidth	10K-110Hz	400K-12Hz

2. The DC power supply is switched ON.
3. The output waveform is displayed on the CRO.
4. The peak to peak Amplitude and time period of the sine wave is noted.
5. The graph of output waveform is drawn.

8.8 TABULATION

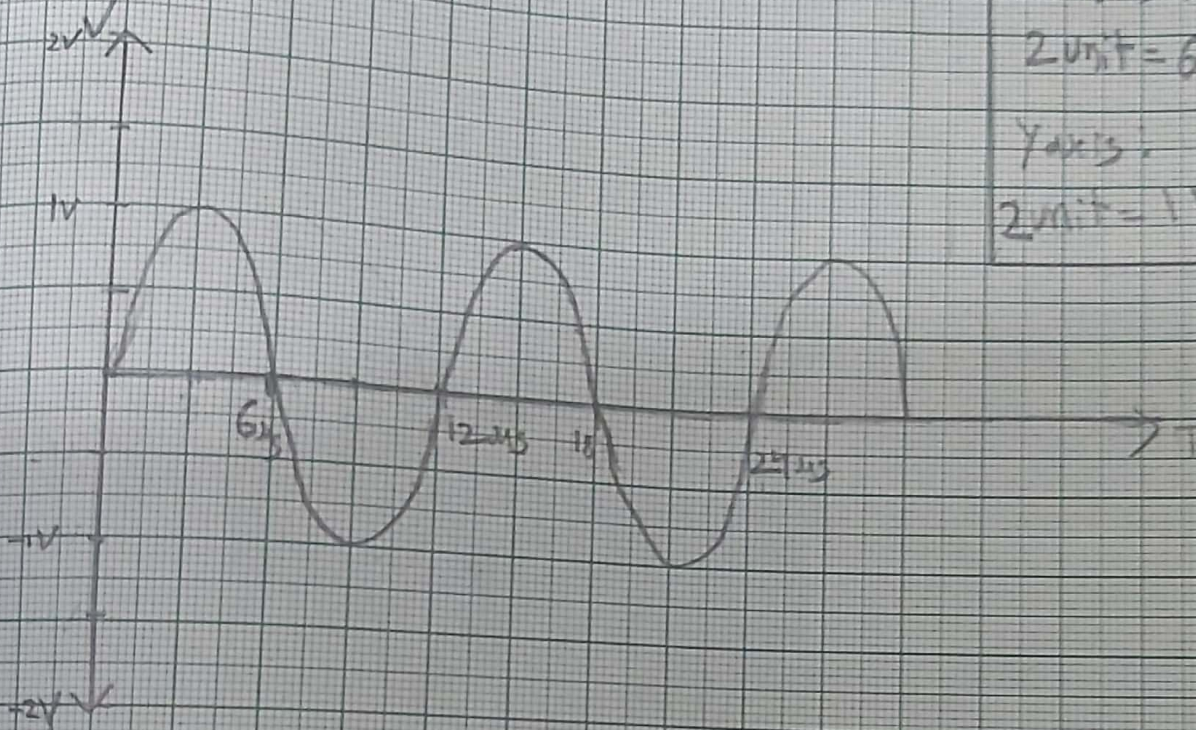
	Amplitude (Volts)	Time period(sec)	Frequency (Hz)
Practical value	2V	12µs	83.33KHz
Theoretical value	2V	10µs	100.1KHz

O/P Verified

?/5/22

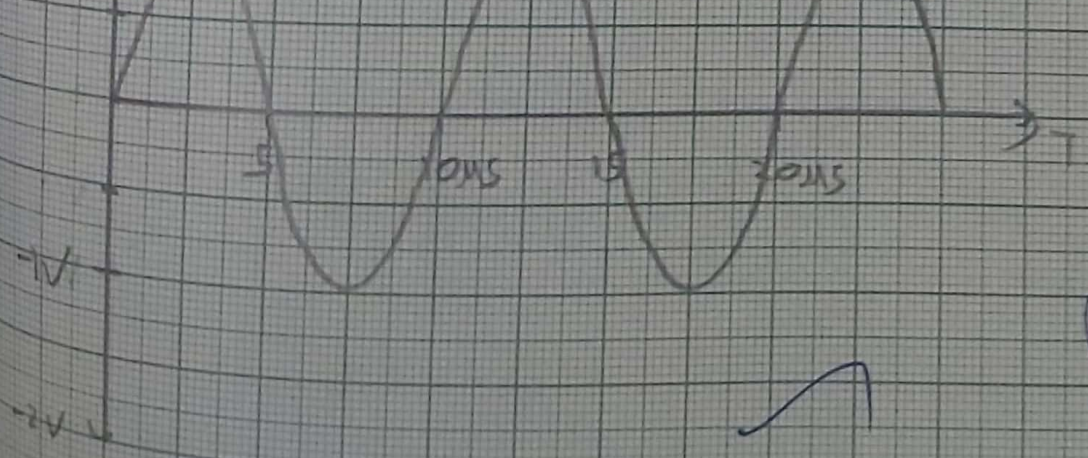
Practical

Scale
x axis:
2 unit = 6 μs
Y axis:
2 unit = 1V



Theoretical

Scale:
x axis: 2 unit = 5 μs
Y axis: 2 unit = 1V



Exp 9

I_1	I_{G_1}
1.9 mA	1.91 mA
2.8 mA	2.8 mA
3.7 mA	3.7 mA
4.6 mA	4.6 mA
5.5 mA	5.5 mA

O/P Verified.

11/5/22.

I_1	I_G
1.9 mA	1.92 mA
2.8 mA	2.85 mA
4 mA	4 mA
4.5 mA	4.55 mA
5 mA	5.1 mA

Exp-10

26/05/

11

Wilson Current Mirror

I_{C1}	I_{C2}
1.2 mA	1.24 mA
1.6 mA	1.61 mA
1.8 mA	1.81 mA
2.2 mA	2.23 mA
2.6 mA	2.63 mA
3.6 mA	3.7 mA
4.5 mA	4.6 mA

Cascode Current Mirror

I_{C1}	I_{C2}
1.2 mA	1.24 mA
1.6 mA	1.61 mA
.8 mA	1.81 mA
.2 mA	2.23 mA
.6 mA	2.63 mA

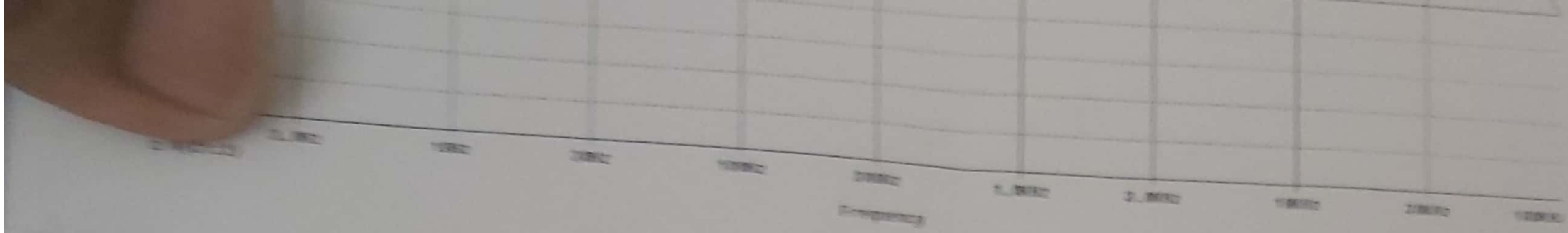


Fig 12.5 Output frequency response plot

12.6 TABULATION

V_i = 1000 mV = 1 V

~~S.No~~ Freq	V_o(volts)	Gain=V_o/V_i	Gain in dB
1Hz	11.05	11.05	20.6
2Hz	17.79	17.79	25.18
3Hz	22.25	22.25	27.02
6Hz	27.49	27.49	28.78
30Hz	30.22	30.22	29.6
50Hz	30.22	30.22	29.6
70Hz	30.22	30.22	29.6
10KHz	30.22	30.22	29.6
12.1KHz	29.9	29.9	29.52
40KHz	26.9	26.9	28.59
70KHz	22.0	22.0	27.97
100KHz	18.59	18.59	25.34

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