VIDYA JYOTHI
INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

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Certificate

This is to certify that the bonafide record of the practical work carried out by

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laboratory during the academic year ..... 2021-2022 .....

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V-I Characteristics of PN Junction Diode

Aim :- To plot the VI characteristics of a PN junction diode in both forward and reverse biased condition. Also, calculate its cut in voltage, forward resistance and reverse resistance.

Apparatus Required :-

Sl.No.	Description	Range / Number / Value	Quantity
1.	Regulated Power Supply	(0-30) V	1
2.	Diode	1N4007	1
3.	DC Ammeter	(0-200) mA, (0-200) μA	1 of each category
4.	DC Voltmeter	(0-20) V	1
5	Resistor	1 kΩ	1
6.	Bread board and connecting wires.		

Theory :-

A PN Junction diode conducts only in one direction. The VI characteristics of the diode are curve between voltage across the diode and current through the diode.

When the external voltage is zero, circuit is open and the potential barrier does not allow the current to flow. Therefore, the circuit current is zero.

When P-type (Anode) is connected to +Ve terminal and n-type (cathode) is connected to -ve terminal of the supply voltage is known as forward bias. The potential barrier is

reduced when diode is in the forward biased condition. At some forward voltage, the potential barrier altogether eliminated and current starts flowing through the diode and also in the circuit. The diode is said to be in ON state. The current increases with increasing forward voltage.

When N-type (Cathode) is connected to +ve terminal and P-type (Anode) is connected to the -ve terminal of the supply voltage is known as reverse bias and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. The diode is said to be in OFF state. The reverse bias current is due to minority charge carriers.

Procedure :

A) Forward Bias :

1. Connections are made as per the circuit diagram.
2. Switch ON the power supply and increases the input voltage (supply voltage) in steps of 0.1V.
3. The forward current (I_f), and the forward voltage (V_f) are observed and then noted in the tabular form.
4. A graph is plotted between Forward Current (I_f) on X-axis and the forward voltage (V_f) on Y-axis.

B) Reverse Bias :

1. Connections are made as per the circuit diagram.
2. Switch ON the power supply and increase the input voltage

(supply voltage) in steps of 1V.

3. The Reverse Current (I_r) and the Reverse Voltage (V_r) are observed and then noted in the tabular form.

4. A graph is plotted between Reverse Current (I_r) on X-axis and Reverse Voltage (V_r) on Y-axis.

Calculations :-

Calculation of Static and Dynamic Resistance for a given diode.

In forward bias Condition :-

Static Resistance $R_S = V_f / I_f$.

Dynamic Resistance $R_D = \Delta V_f / \Delta I_f$

In Reverse bias Condition :-

Static Resistance $R_S = V_R / I_R$

Dynamic Resistance $R_D = \Delta V_R / \Delta I_R$.

Result :-

The forward and reverse characteristics of the PN Junction diode has been plotted.

The static forward resistance of the diode = 0.139130 KΩ

The Dynamic forward resistance of the diode = 0.1 KΩ

The static reverse resistance of the diode = -1.0095652 MΩ

The Dynamic reverse resistance of the diode = -1.02 MΩ

The cut-in voltage of the diode = 0.45 V

27/10/2024

(supply voltage) in steps of 1V.

3. The Reverse Current (I_r) and the Reverse Voltage (V_r) are observed and then noted in the tabular form

4. A graph is plotted between Reverse Current (I_r) on x-axis and Reverse Voltage (V_r) on Y-axis.

Calculations :-

Calculation of Static and Dynamic Resistance for a given diode.

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Result :-

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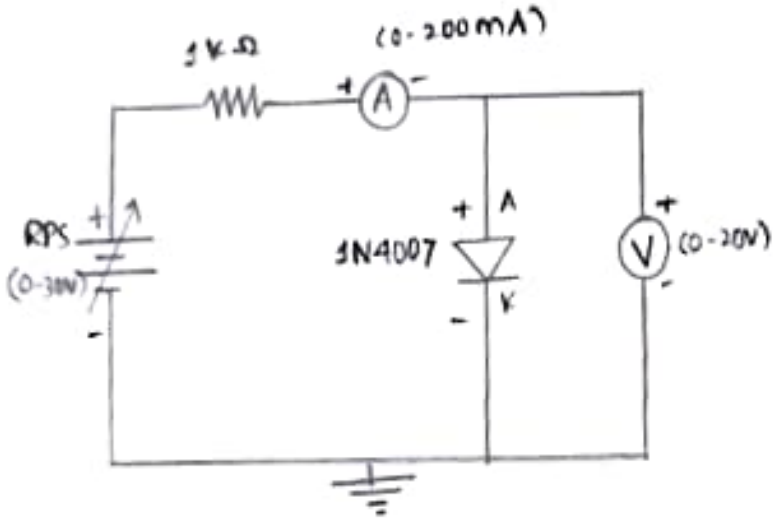
The Dynamic reverse resistance of the diode = -1.02 MΩ

The cut-in voltage of the diode = 0.45 V

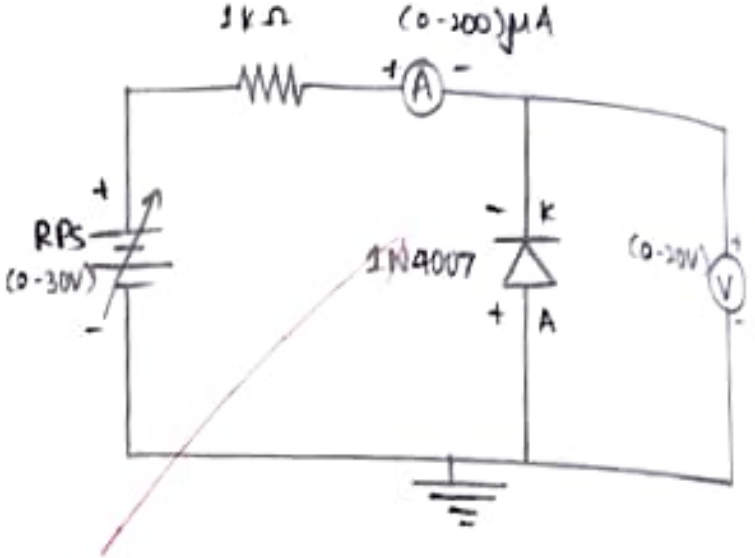
27/10/2024

Circuit Diagram :-

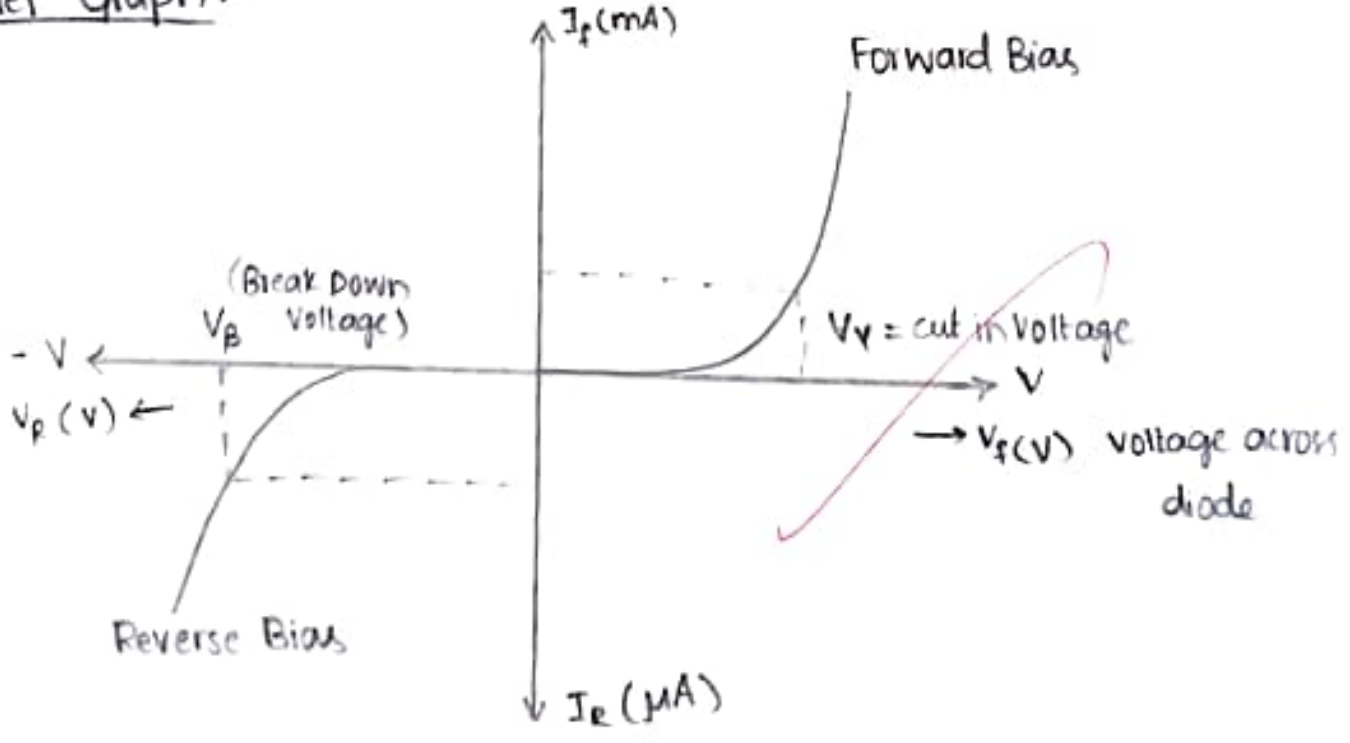
A) Forward Bias



B) Reverse Bias



Model Graph :-



Observations :-

A) Forward Bias :

Sl No	Applied Voltage (V) in volts	Forward Voltage (V_F) in volts	Forward current (I_F) in mA
1.	0.1	0.19	0
2.	0.2	0.31	0
3.	0.3	0.37	0
4.	0.4	0.45	0.1
5.	0.5	0.48	0.2
6.	0.6	0.49	0.28
7.	0.7	0.51	0.3
8.	0.8	0.52	0.4
9.	0.9	0.53	0.5
10.	1.0	0.54	0.6
11.	1.5	0.57	1.1
12.	2	0.59	1.6
13.	2.5	0.6	2.1
14.	3	0.61	2.6
15.	5	0.64	4.6

B) Reverse Bias :

Sl No	Applied Voltage (-V) in volts	Reverse voltage ($-V_R$) in volts	Reverse current (I_R) in mA
1.	1	1.09	1.1
2.	2	2.15	2.1
3.	3	3.17	3.1
4.	4	4.13	4.1
5.	5	5.15	5.1
6.	5.5	5.58	5.6
7.	6	6.12	6.1
8.	6.5	6.63	6.6
9.	7	7.12	7
10.	7.5	7.65	7.6
11.	8	8.08	8
12.	8.5	8.65	8.5
13.	9	9.14	9
14.	9.5	9.59	9.5
15.	11.5	11.61	11.5

Calculations :- Forward Bias

$$R_S = V_F / I_F = \frac{0.64}{4.6 \times 10^{-3}} = 0.139130\ K\Omega$$

$$R_D = \Delta V_F / \Delta I_F = \frac{V_2 - V_1}{I_2 - I_1} = \frac{0.53 - 0.52}{(0.5 - 0.4)\ 10^{-3}} = \frac{0.01}{0.1 \times 10^{-3}} = 0.1K\Omega$$

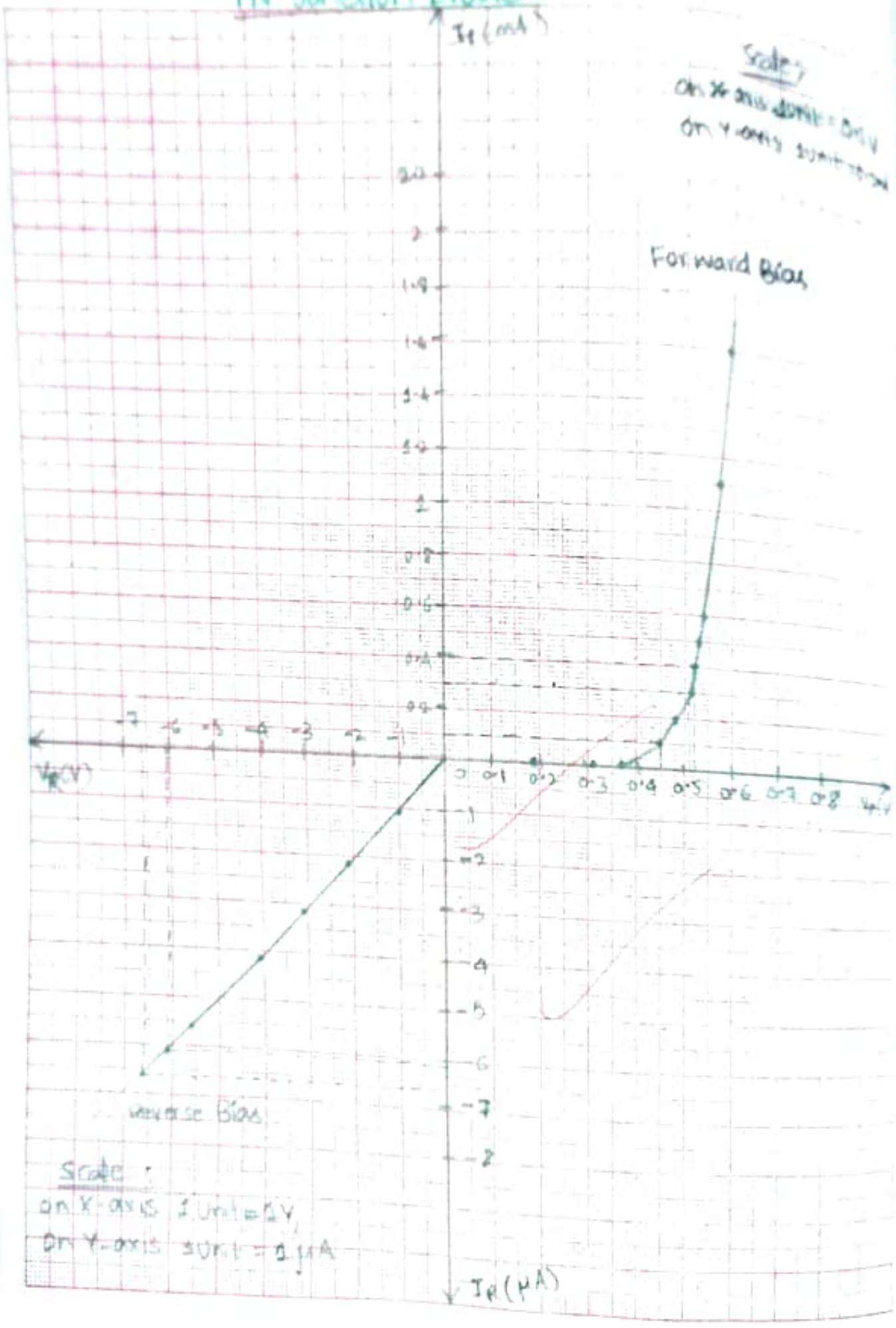
$$= 100\ \Omega$$

Reverse Bias

$$R_S = V_R / I_R = \frac{11.61}{11.5 \times 10^{-6}} = 1.009565 M\Omega$$

$$R_D = \Delta V_R / \Delta I_R = \frac{V_2 - V_1}{I_2 - I_1} = \frac{6.63 - 6.12}{(6.6 - 6.1) \times 10^{-6}} = \frac{0.51}{0.5 \times 10^{-6}} = 1.02\ M\Omega$$

PN Junction Diode



V-I Characteristics of Zener Diode

Aim :- To plot the VI characteristics of a zener diode in both forward and reverse biased condition and find out the zener breakdown voltage.

Apparatus Required :-

Sl.No.	Description	Range / Number / Value	Quantity
1.	Regulated Power Supply	(0-30) V	1
2.	Zener diode	FZ 5.1 V	1
3.	DC ammeters	(0-200) mA	1
4.	DC Voltmeter	(0-1) V, (0-20) V	1 of each category
5.	Resistor	1 kΩ	1
6	Bread board and connecting wires		

Theory:-

A zener diode is heavily doped P-N junction diode, specially made to operate in the sharp break down voltage. A P-N junction diode normally does not conduct when reverse biased. But zener diodes have a good conduction when reverse biased.

When forward biased, its characteristics are just those of ordinary diode.

In reverse bias, if the reverse bias is increased, at a particular voltage it starts conducting heavily. This voltage is called Break down Voltage. The zener diode is not immediately

burnt just because it has entered the breakdown region.

It is mainly used in voltage regulators.

Procedure :-

A) Forward Bias :

1. Connections are made as per the circuit diagram.
2. The regulated power supply voltage is increased in steps.
3. The forward current (I_f) and the forward voltage (V_f) and observed and then noted in the tabular form.
4. A graph is plotted between Forward Current (I_f) on X-axis and the forward voltage (V_f) on Y-axis.

B) Reverse Bias :-

1. Connections are made as per the circuit diagram.
2. Switch ON the power supply and increase the input voltage (supply voltage) in steps of 1 V.
3. The Reverse Current (I_r) and the Reverse Voltage (V_r) are observed and then noted in the tabular form.
4. A graph is plotted between Reverse current (I_r) on X-axis and the Reverse Voltage (V_r) on Y-axis.

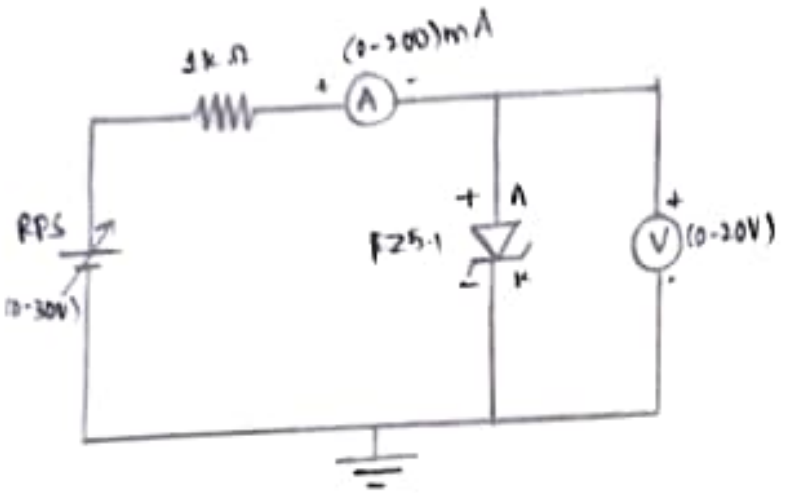
Result :- The forward and reverse characteristics of the zener diode has been plotted.

The breakdown voltage of the zener diode = -7.37 V.

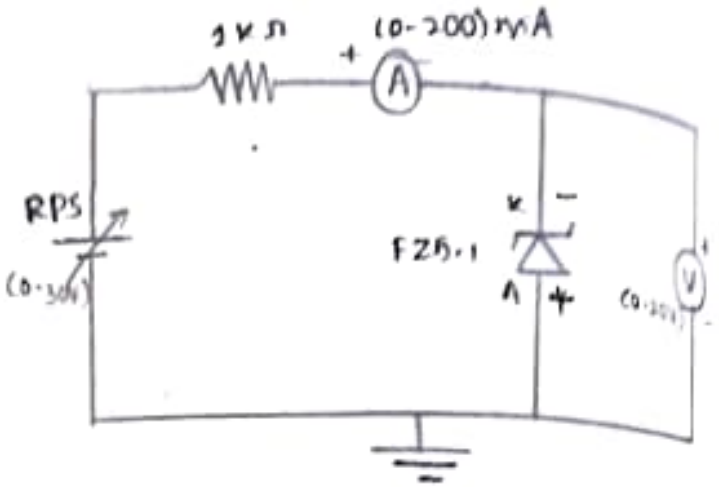
27/10/2021

Circuit Diagram :-

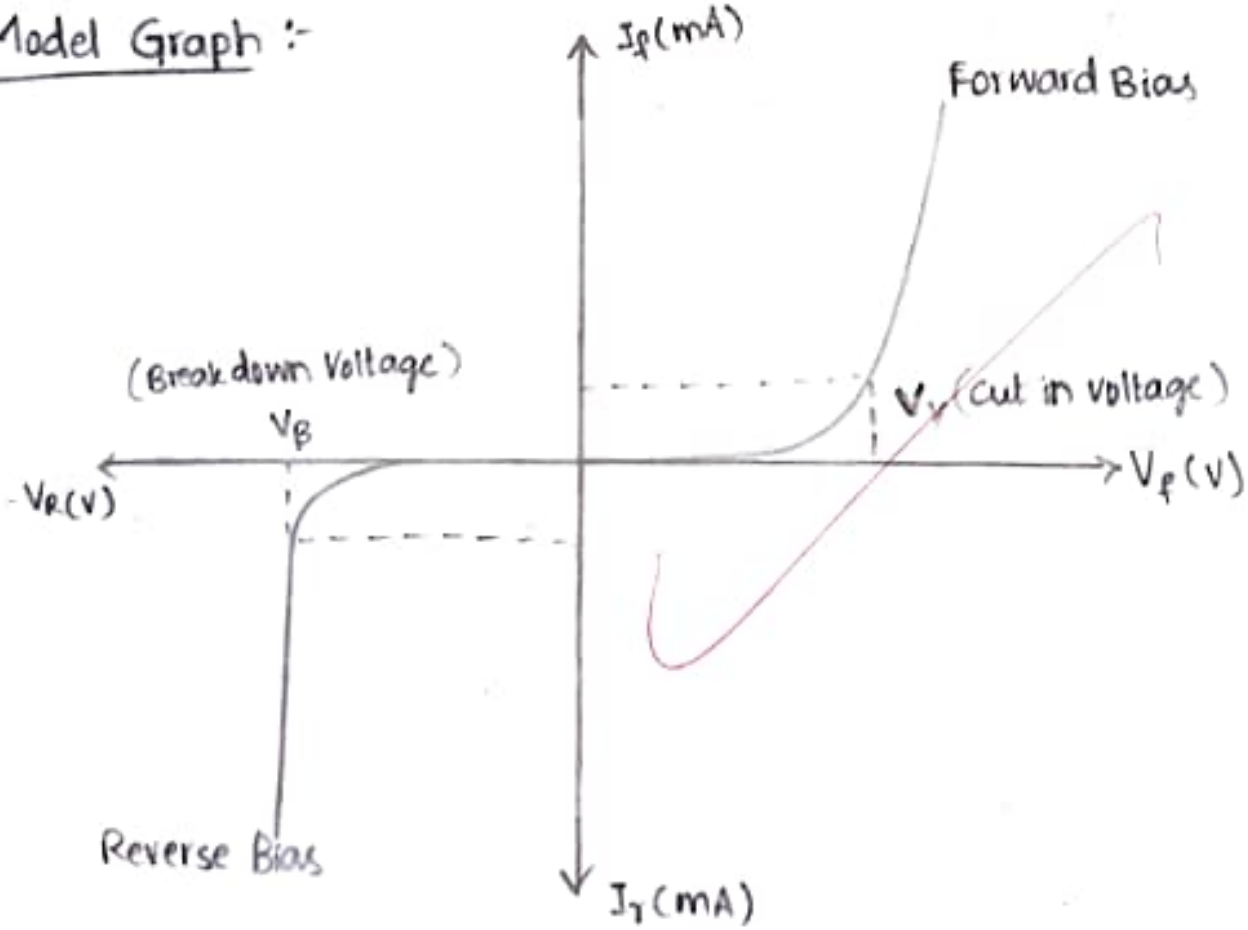
A) Forward Bias :



B) Reverse Bias :



Model Graph :-



Observations :-

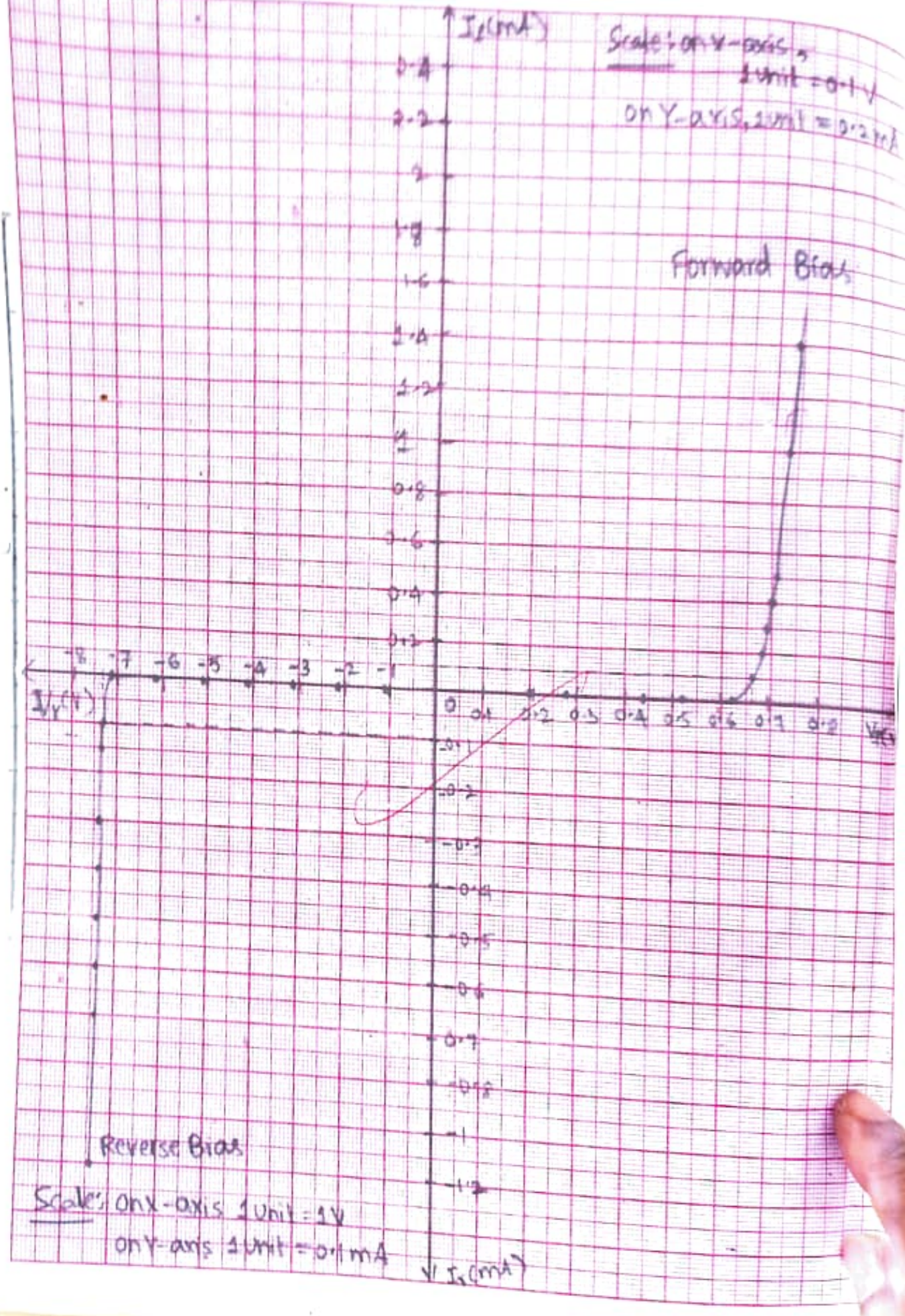
A) Forward Bias :

Sl. No.	Applied Voltage (V) in Volts	Forward Voltage (V_f) in Volts	Forward Current (I_f) in mA
1.	0.1	0.2	0
2	0.2	0.28	0
3.	0.3	0.44	0
4.	0.4	0.52	0
5.	0.5	0.62	0
6.	0.6	0.66	0.1
7.	0.7	0.68	0.2
8.	0.8	0.69	0.3
9.	0.9	0.7	0.4
10.	1	0.71	0.5
11.	1.5	0.73	1
12.	2	0.74	1.4
13.	2.5	0.75	1.9
14.	3	0.76	2.4
15.	3.5	0.77	2.9

B) Reverse Bias :

Sl. No.	Applied Voltage (-V) in volts	Reverse Voltage ($-V_r$) in volts	Reverse Current ($-I_r$) in mA
1.	1	1.14	0
2.	2	2.18	0
3.	3	3.15	0
4.	4	4.16	0
5.	5	5.16	0
6.	6	6.15	0
7.	7	7.14	0
8.	7.4	7.37	0.1
9.	7.5	7.39	0.2
10.	7.6	7.39	0.3
11.	7.7	7.40	0.4
12.	7.8	7.40	0.5
13.	7.9	7.40	0.6
14.	8	7.4	0.7
15	8.5	7.43	1.2

Zener Diode


I_F (mA)
Scale: on x-axis, 1 unit = 0.1 V
on Y-axis, 1 unit = 0.2 mA
Forward Bias
V_R (V)
Reverse Bias
Scale: on x-axis 1 unit = 1 V
on Y-axis 1 unit = 0.1 mA
I_R (mA)

Half Wave Rectifier With And Without Filter

Aim :- To examine the input and output waveforms of half wave rectifier using without and with filter and also calculate its ripple factor.

Apparatus Required :-

Sl.No.	Description	Range / Number / Value	Quantity.
1.	Regulated Power Supply	(0-30) V	1
2.	Diode	1N4007	1
3.	Transformer	0-12V	1
4.	Decade Resistor Box		1
5.	Capacitor	100 μF	1
6.	CRO		1
7.	Bread board and Connecting wires		

Theory :-

When AC Supply is applied at the input, only positive Half cycle appears across the load. whereas, the negative Half cycle is suppressed.

During positive Half Cycle of the input voltage, the diode D is in forward bias and current flows through the load resistor R_L. Hence the current produces an output voltage across the load resistor R_L, which has

the same shape as the +ve half cycle of the input voltage.

During the negative half cycle of the input voltage, the diode is reverse biased and there is no current through the load resistor R_L. so the voltage across R_L is zero.

The net result is that only the +ve half cycle of the input voltage appears across the load.

Procedure :-

A) Without Filter :-

1. Connections are made as per the circuit diagram.
2. Switch ON the transformer and CRO.
3. Vary the load resistance R_L and notedown the value of V_m and find the value of ripple factor.
4. Measure the input at secondary terminal of transformer and output across load resistance R_L.
5. Plot the Input and Output waveforms on graph sheet.

B) With Filter :-

1. Connections are made as per the circuit diagram.
2. Switch ON the transformer and CRO.
3. Vary the load resistance R_L and notedown the value of V_m and find the value of ripple factor.
4. Measure the input at secondary terminal of transformer

and output across load resistance R_L.

5. Plot the Input and Output waveforms on Graph Sheet.

Result :-

The input and output waveforms of half wave rectifier are measured using without and with filter and also calculated its ripple factor.

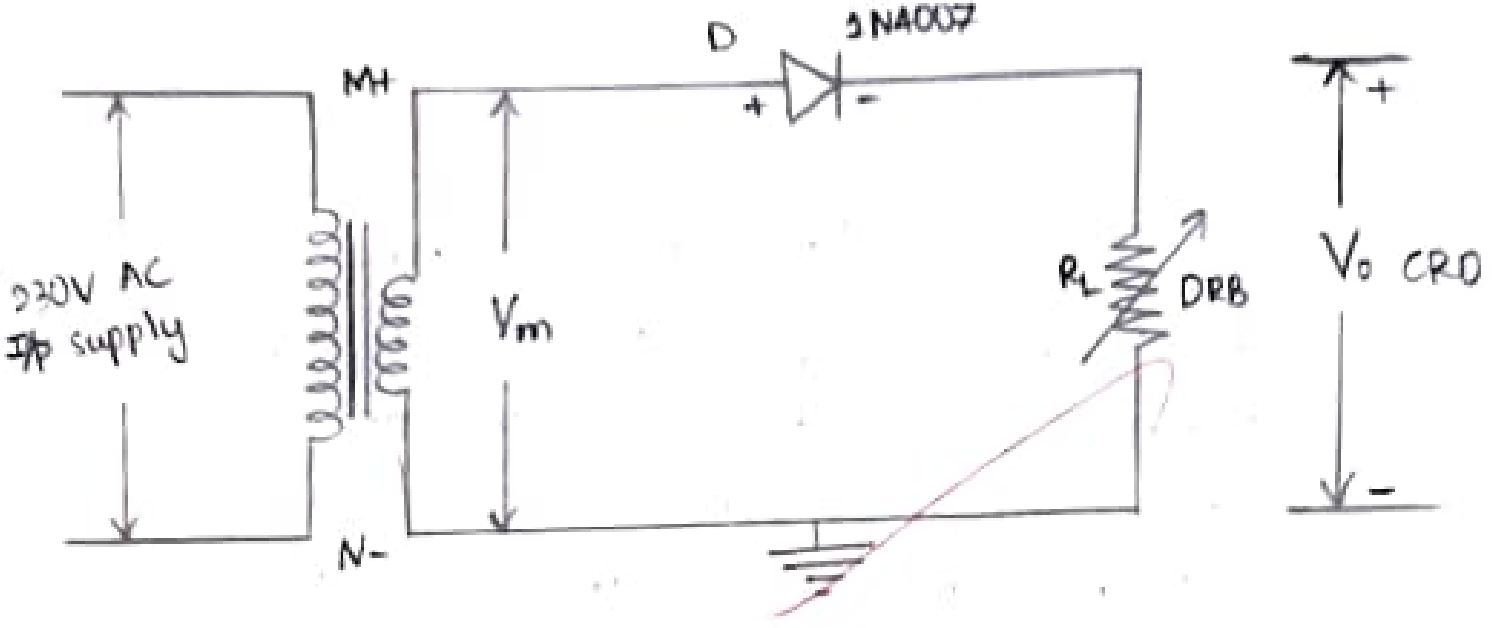
The ripple factor of half wave rectifier using without filter is 1.2.

The ripple factor of half wave rectifier using with filter is 0.2.

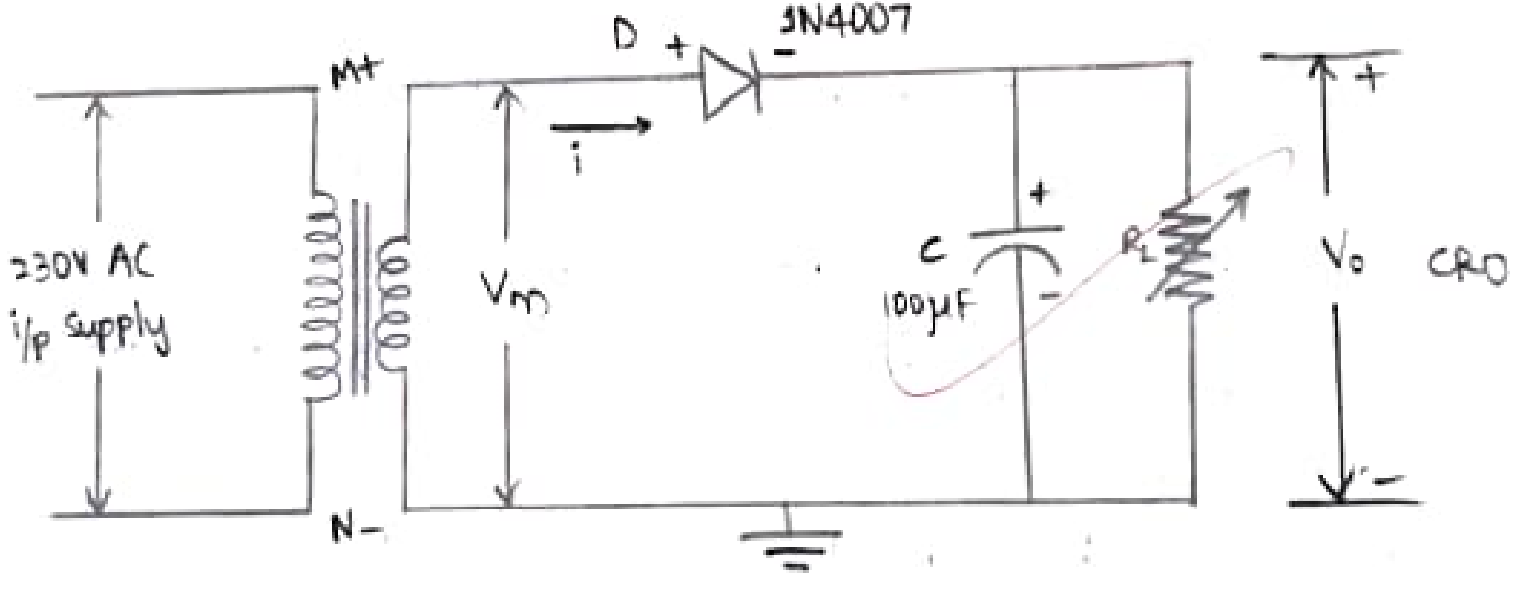
2/11/2021

Circuit Diagram :-

A) Without Filter :



B) With Filter :



Observations :

a) Without Filter

Sl. No.	Load resistance R_L (Ω)	V_m (volts)	$V_{dc} = \frac{V_m}{\pi}$	$V_{rms} = \frac{V_m}{2}$	$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$
1.	0	0·6 ×10	1·9	3	1·2
2.	100	1·4 ×10	4·45	4	1·2
3.	200	1·6 ×10	5·09	8	1·2
4.	500	1·7 ×10	5·41	8·5	1·2

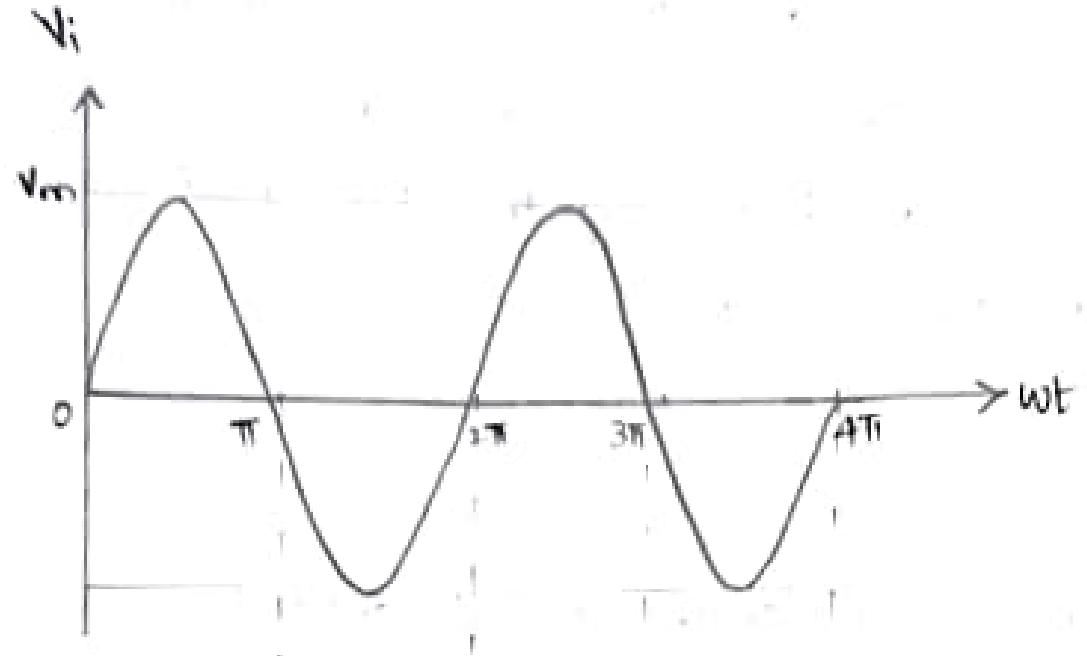
b) With Filter

Sl. No.	Load resistance R_L (Ω)	V_m (volts)	$V_{r(p-p)}$ (volts)	$V_{dc} = V_m - \frac{V_{r(p-p)}}{2}$	$V_{rms} = \frac{V_{r(p-p)}}{2\sqrt{3}}$	$\gamma = \frac{V_{rms}}{V_{dc}}$
1.	0	5	3	3·5	0·86	0·24
2.	100	13	9	8·5	2·59	0·305
3.	500	15	11	9·5	3·17	0·334
4	1000	16	12	10	3·46	0·345

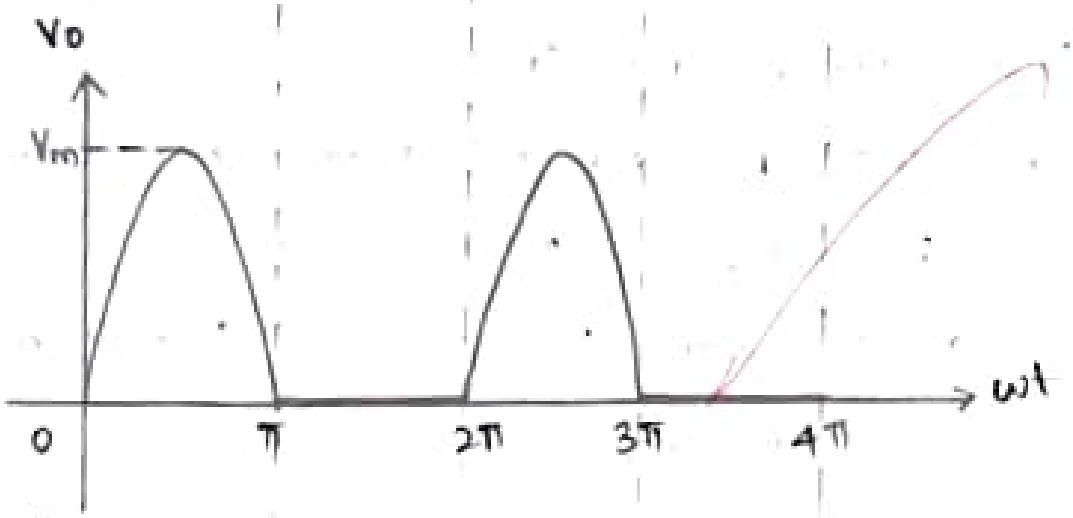
c) Measuring Waveforms.

Type	Timeperiod	Amplitude
Input Waveform	4×5 = 20 milli sec	3·9 × 10 = 39
Output Waveform without filter		0·6 × 10 = 6
Output Waveform with filter		5

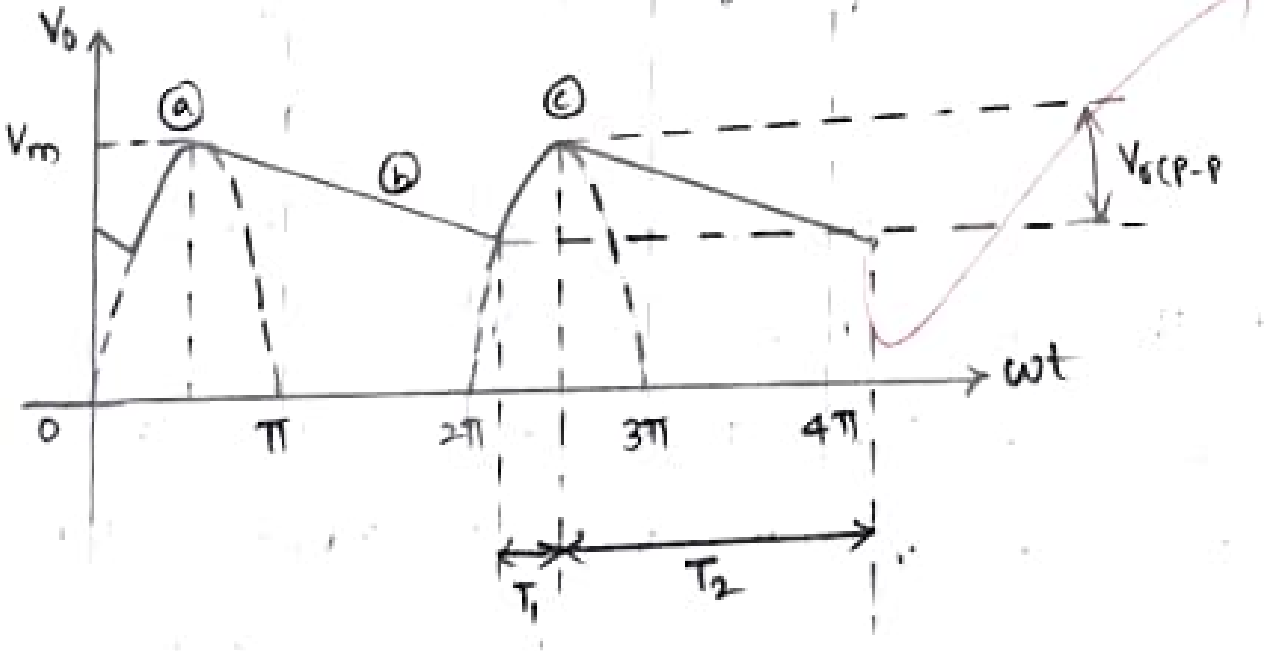
Input & Output Waveforms:



Input Waveform

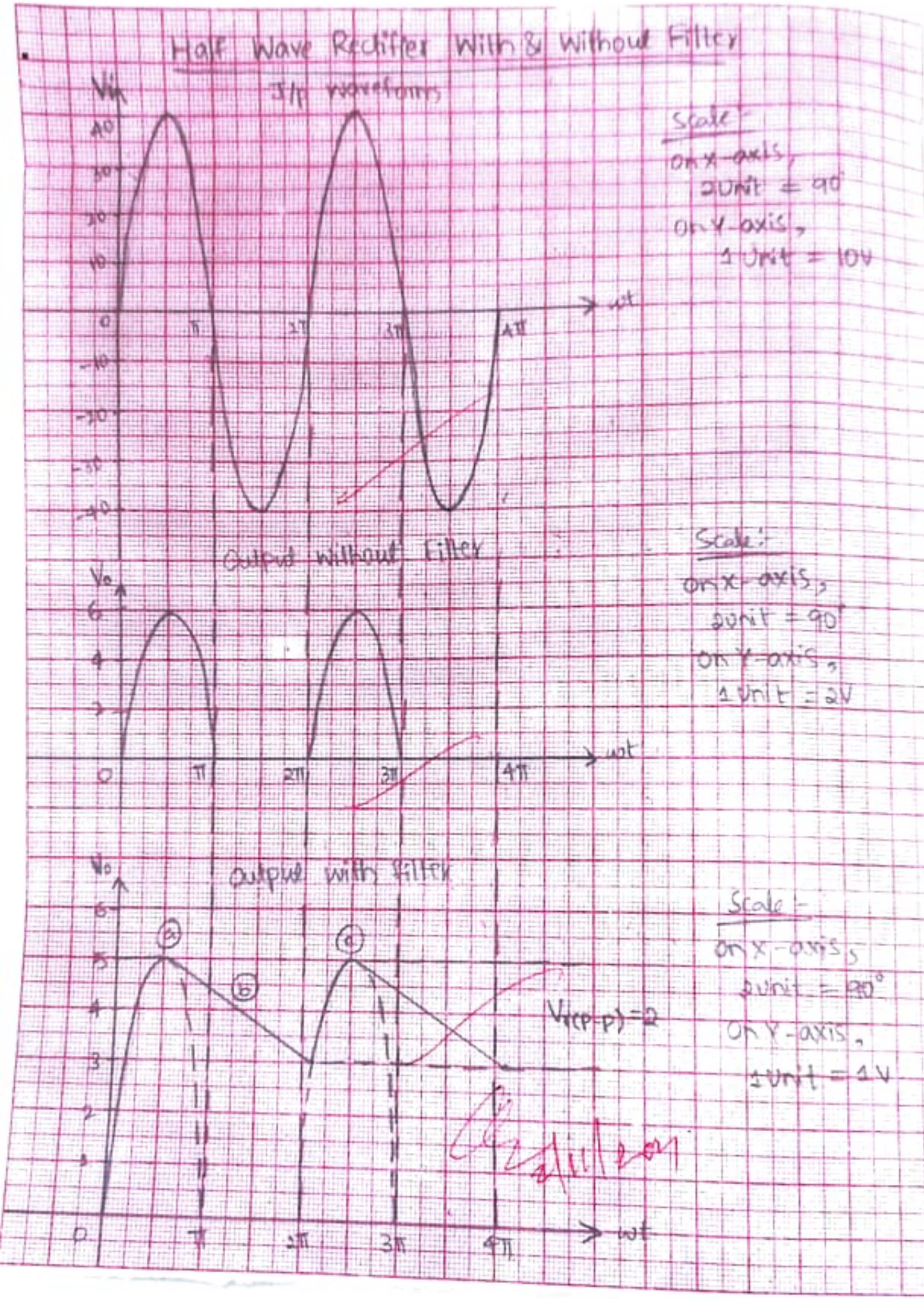


Output Without Filter



Output With Filter

Half Wave Rectifier With & Without Filter



Full Wave Rectifier With and Without Filter.

Aim :- To examine the input and output waveforms of full wave rectifier using without and with filter and also calculate its ripple factor.

Apparatus Required :-

Sl.No.	Description	Range/Number/value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	Diode	1N4007	2
3.	Transformer	12-0-12 V	1
4.	Decade Resistance Box		1
5.	Capacitor	100 μF	1
6.	CRO		1
7.	Breadboard and Connecting Wires		

Theory :-

When AC supply is applied at the input, output appears across the load for both the cycles of input.

During positive half cycle of secondary voltage the diode D_1 is forward biased and D_2 is reverse biased. So, the diode D_1 conducts and current flows through

load resistance R_L.

During negative half cycle of secondary voltage, the diode D_2 becomes forward biased and D_1 reverse biased. Now D_2 conducts and current flows through load resistor R_L in the same direction. There is a continuous current flow through the load resistor R_L, during the both the half cycles and will get unidirectional current.

A Full Wave Rectifier allows unidirectional current to the load during the entire 360° degrees of the input signal.

Procedure :-

A) Without Filter :-

1. Connections are made as per the circuit diagram.
2. Switch on the transformer and CRO.
3. Vary the load resistance R_L and note down the value of V_m and find the value of ripple factor.
4. Measure the input of secondary terminal of transformer and output across load terminal R_L.
5. Plot the Input and Output waveforms on graph sheet.

Title :

Date : 3-11-21
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B) With Filter :-

1. Connections are made as per the circuit diagram
2. Switch on the transformer and CRO
3. Vary the load resistance R_L and notedown the value of V_m and find the value of ripple factor.
4. Measure the input at secondary terminal of transformer and output across load resistance R_L.
5. Plot the Input and Output waveforms on Graph Sheet.

Result :-

The input and output waveforms of full wave rectifier are measured using without and with filter and also calculated its ripple factor.

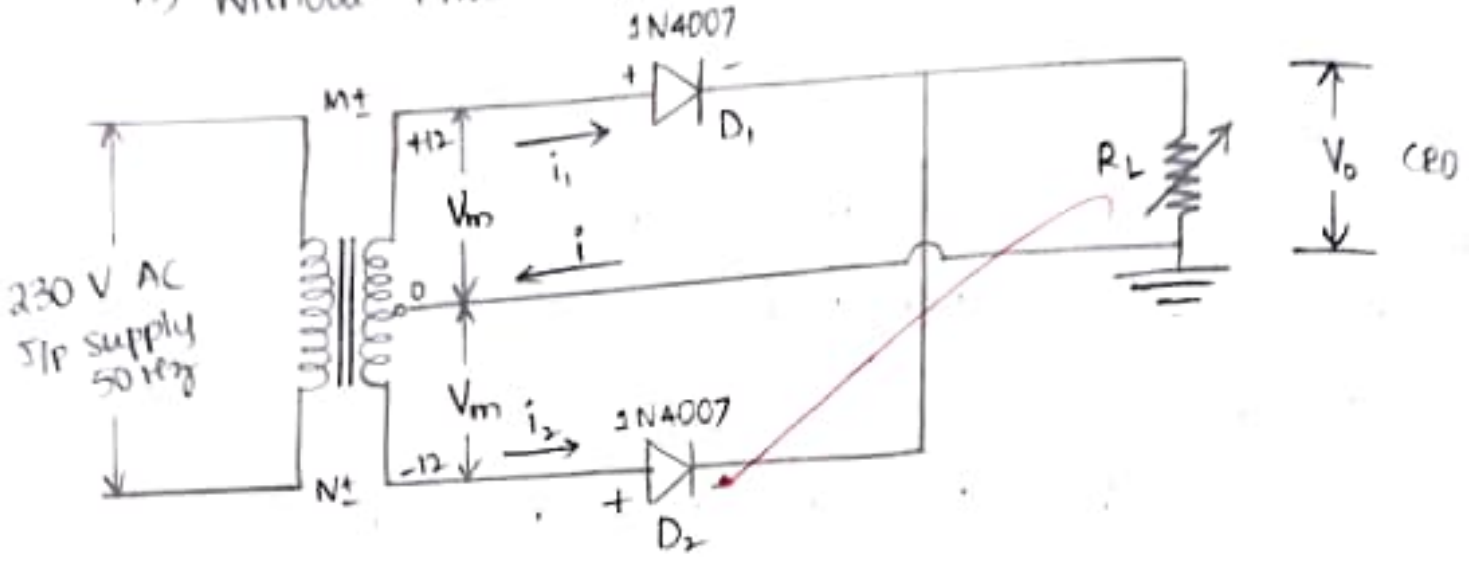
The ripple factor of full wave rectifier using without filter is 0.48

The ripple factor of full wave rectifier using with filter is 0.27.

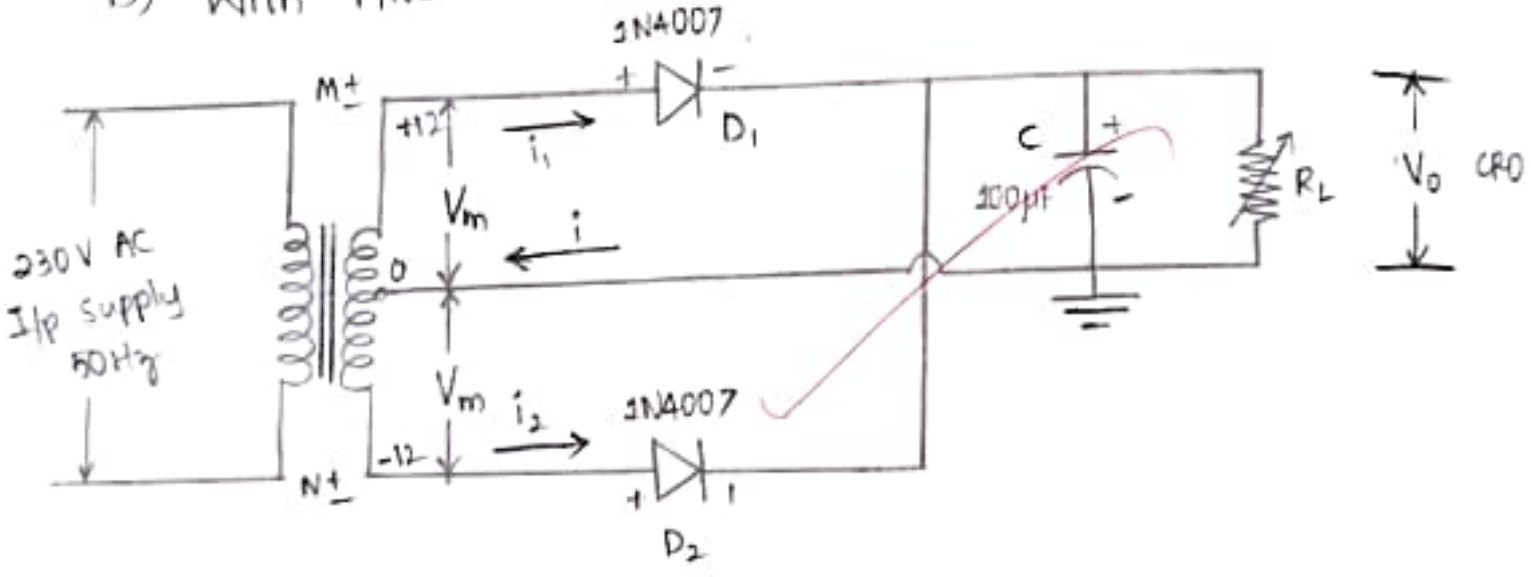
10/4/2024

Circuit Diagram :

A) Without Filter :



B) With Filter :



Observations:-

A) Without filter :

Sl.No.	Load Resistance R_L (Ω)	V_m (volts)	$V_{dc} = \frac{2V_m}{\pi}$	$V_{rms} = \frac{V_m}{\sqrt{2}}$	$\gamma = \sqrt{\frac{V_{rms}}{V_{dc}} - 1}$
1	0	0.6X10 = 6	3.82	4.2A	0.48
2.	100	1.4 X10 = 14	8.9	9.89	0.48
3.	500	1.6 X10 = 16	10.19	11.31	0.48
4.	1K	1.6 X10 = 16	10.19	11.31	0.48
5.	10K	1.6 X10 = 16	10.19	11.31	0.48

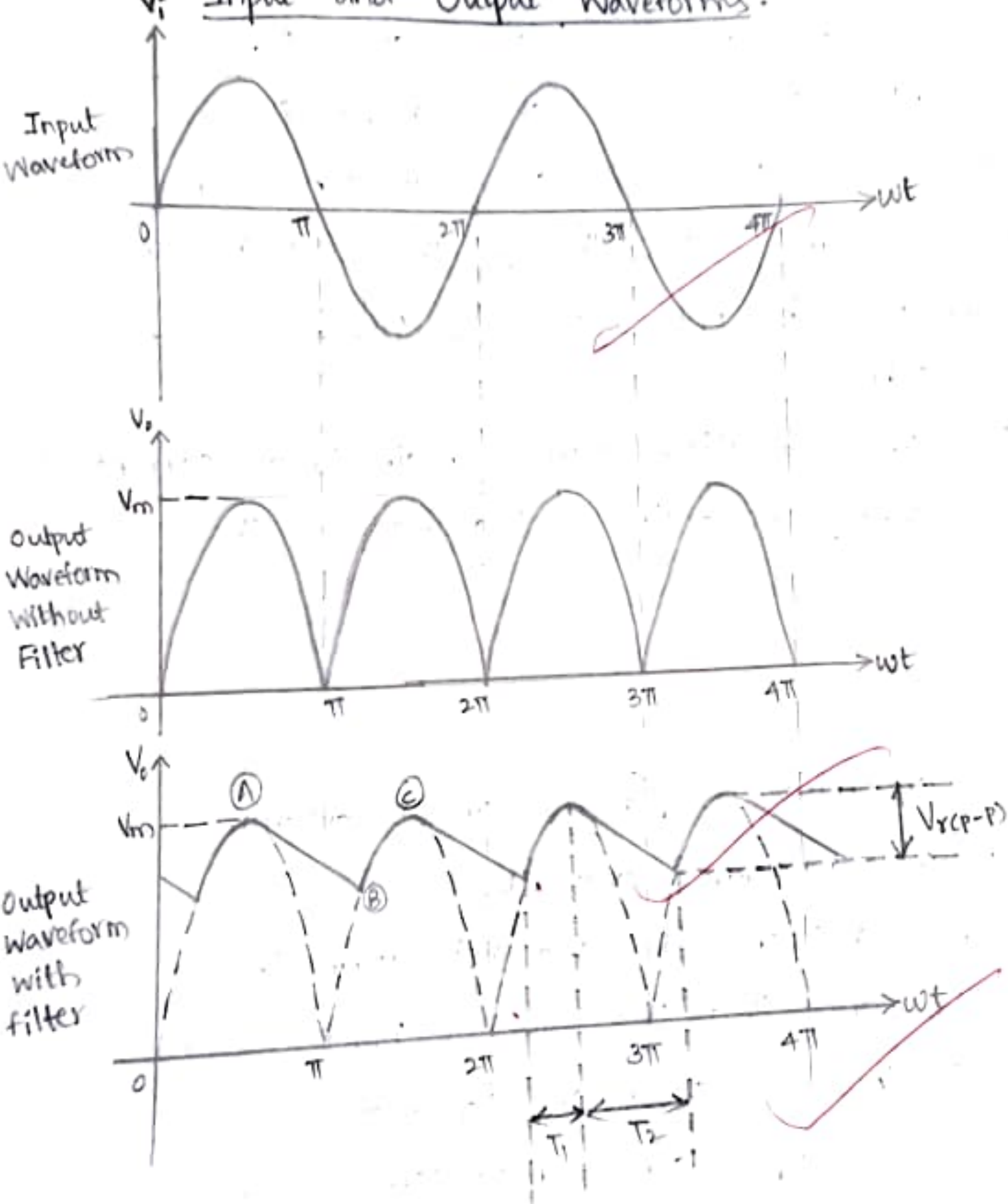
B) With Filter :

Sl.No.	load resistance R_L (Ω)	V_m (Volts)	$V_{r(P-P)}$ (volts)	$V_{dc} = V_m - \frac{V_{r(P-P)}}{2}$	$V_{rms} = \frac{V_{r(P-P)}}{2}$	$\gamma = \frac{V_{rms}}{V_{dc}}$
1.	100	1.4X10=14	0.6X10=6	11	6/2 = 3	0.27
2.	500	1.6X10=16	0.2X10=2	16	2/2 = 1	0.062
3.	1K	1.2X10=12	0.2X10=2	12	2/2 = 1	0.083
4.	10K	12X10=12	0	12	0	0

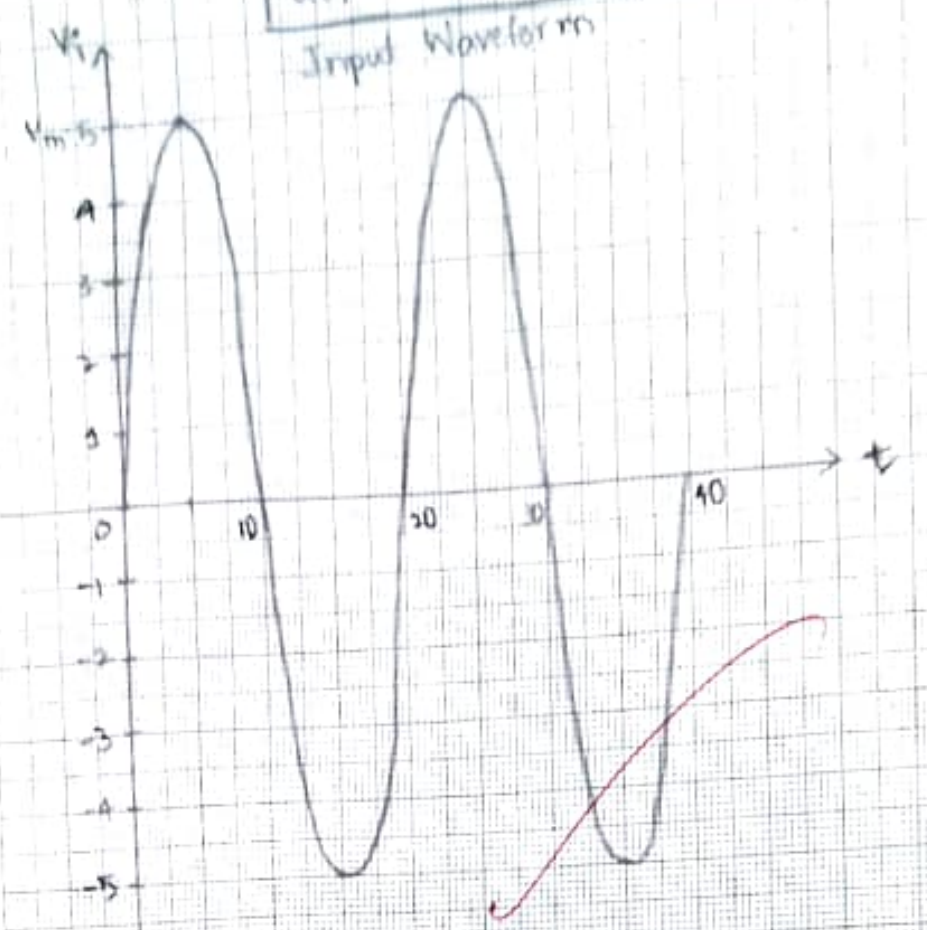
c) Measuring Waveforms :

Type	Timeperiod	Amplitude
Input Waveform	4X5ms = 20ms	1 X10 = 10V
o/p waveform Without Filter		0.6X10 = 6V
o/p waveform with filter		1.4 X 10 = 14V

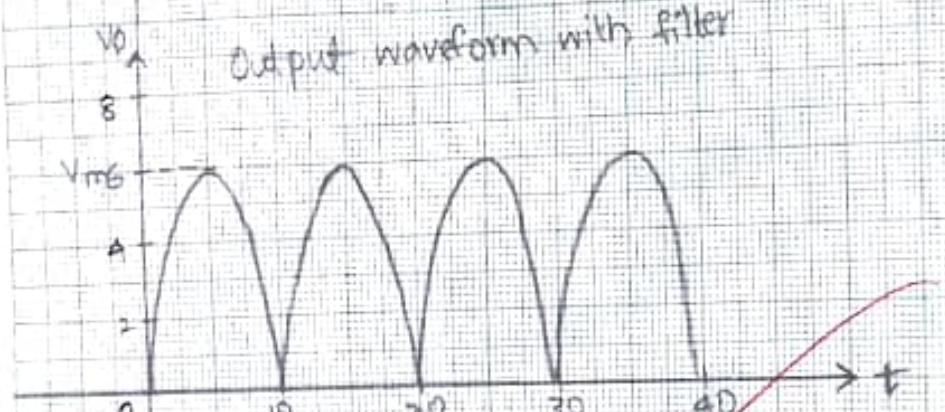
Input and Output Waveforms:



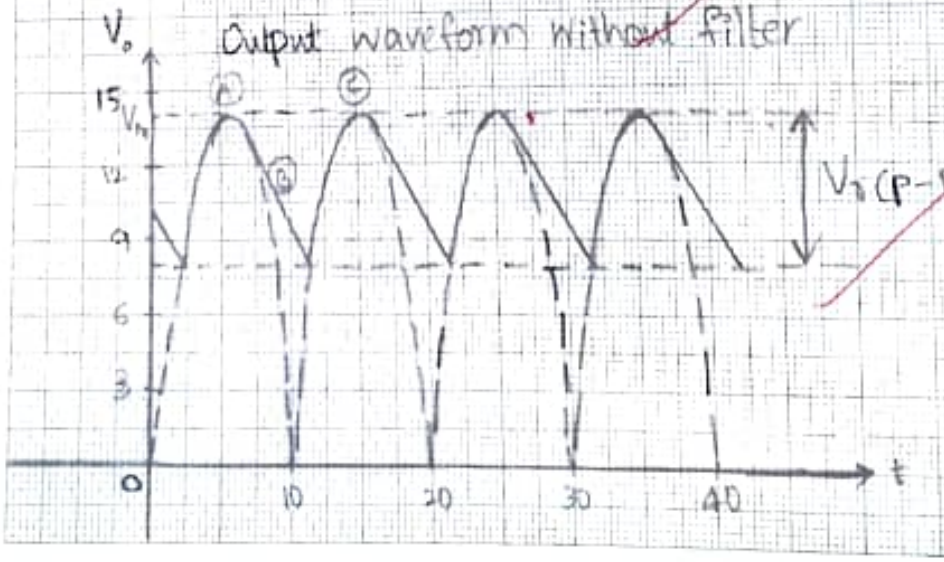
Full Wave Rectifier With & Without Filter



Scale :-
on X-axis;
2 Unit = 10msec
on Y-axis;
1 unit = 1V



Scale :-
on X-axis,
1 unit = 5msec
on Y-axis,
1 unit = 1V



Scale :-
on X-axis,
1 Unit = 5msec
On Y-axis,
1 Unit = 3V

Input and Output Characteristics of Transistor in CB Configuration

Aim :- To plot the input and output characteristics of a transistor connected in common base configuration and to find the h-parameters from the characteristics.

Apparatus Required :-

Sl.No.	Description	Range / Number / value	Quantity.
1.	Regulated Power Supply.	(0-30)V	1
2.	Transistor	BC107	1
3.	DC Ammeter	(0-200) mA	2
4.	DC Voltmeter	(0-20) V	2
5.	Resistor.	1K Ω	2
6.	Breadboard and connecting wires.		

Theory :-

A transistor is a three terminal active device. The terminals are emitter, base, collector. ~~For normal operation~~, In CB configuration the base is common to both input (emitter) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased.

This transistor configuration provides low input impedance while offering high output impedance. Although the voltage is

high, the current gain is low and the overall power gain is is also low when compared to the other transistor configurations. The other salient feature of this configuration is that the input and output are in phase.

Procedure :-

A) Input Characteristics :-

1. Connections are made as per the circuit diagram.
2. Keep V_{CE} and V_c knob in minimum position before turn on the regulated power supply.
3. Set $V_{CB} = 1V$ by varying V_{cc}.
4. Then vary the V_{EE} smoothly with fine control and noted down the value of emitter current I_E & base emitter voltage V_{EB} and put it in tabular form.
5. Repeat the experiment by keeping $V_{CB} = 2V$ and $4V$.
6. Draw a graph between V_{EB} (V_s) V_E against V_{CB} = constant.

B) Output Characteristics :-

1. Connections are made as per the circuit diagram.
2. Keep V_{EE} and V_c knob in minimum position before turn on the regulated power supply.
3. Set $I_E = 5\ mA$ by varying V_{EE}.
4. Then vary the V_{cc} smoothly with fine control and noted down the value of emitter current I_c and base collector voltage V_{CB} and put it in tabular form.
5. Repeat the experiment by keeping $I_E = 10\ mA$ and $20\ mA$.

6. Draw a graph between V_{CB} Vs I_C against I_E = constant.

To find the h-parameters :

Calculation of h_{ib} :

Mark two points on the Input characteristics for constant V_{CB}. Let the coordinates of these two points be (V_{EB1}, I_{E1}) & (V_{EB2}, I_{E2})

$$h_{ib} = \frac{V_{EB2} - V_{EB1}}{I_{E2} - I_{E1}}$$

Calculations of h_{rb} :

Draw a horizontal line at some constant I_E value on the input characteristics. Find V_{CB2}, V_{CB1} & V_{EB2}, V_{EB1}.

$$h_{rb} = \frac{V_{EB2} - V_{EB1}}{V_{CB2} - V_{CB1}}$$

Calculations of h_{fb} :

Draw a vertical line on the output characteristics at some constant V_{CB} value. Find I_{C2}, I_{C1} & I_{E2}, I_{E1}

$$h_{fb} = \frac{I_{C2} - I_{C1}}{I_{E2} - I_{E1}}$$

Calculations of h_{ob} :- Mark two points on input characteristics for constant I_E. Let coordinates of these points be (V_{CB2}, I_{C2}) & (V_{CB1}, I_{C1})

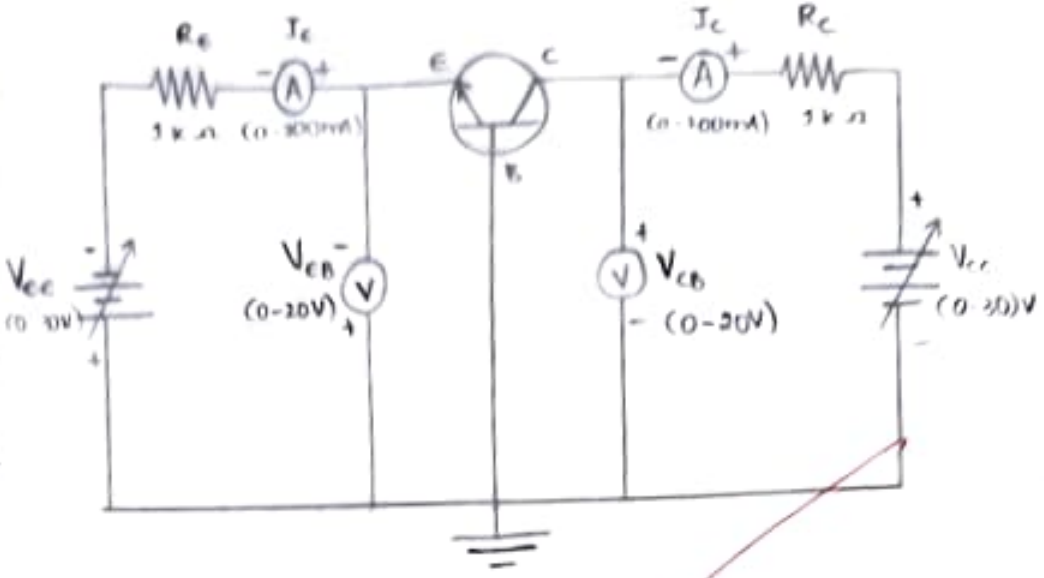
$$h_{ob} = \frac{I_{C2} - I_{C1}}{V_{CB2} - V_{CB1}}$$

Result :- The input and output characteristics of transistor in CB configuration are drawn on the graph and h parameters are calculated : $h_{ib} = 48\ \Omega$ $h_{rb} = -0.06$

$h_{ob} = 1$ $h_{fb} = 0.995$ mho

6/11/2014

Circuit Diagram:



Pin Assignment

1 : Emitter

2 : Base

3 : Collector

Observation:

A) Input Characteristics :-

RPS V_{EE} (V)	V_{CB} = 1 V		V_{CB} = 2V	
	V_{EB} (V)	I_E (mA)	V_{EB} (V)	I_E (mA)
0·1	0·2	0	0·18	0
0·2	0·3	0	0·32	0
0·3	0·45	0	0·44	0
0·4	0·52	0	0·49	0
0·5	0·55	0·1	0·54	0·1
0·6	0·56	0·1	0·56	0·1
0·7	0·58	0·3	0·58	0·2
0·8	0·59	0·3	0·59	0·3
0·9	0·60	0·4	0·6	0·4
1	0·61	0·5	0·61	0·5
1·5	0·62	1·0	0·62	1·0
2	0·64	1·5	0·62	1·5
2·5	0·66	1·9	0·64	2·0
3	0·69	2·4	0·65	2·5
3·5	0·72	2·9	0·66	2·9

B) Output Characteristics :-

RPS	I_E = 1mA		I_E = 2mA	
V_{cc} (V)	V_{CB} (V)	I_C (mA)	V_{CB} (V)	I_C (mA)
0.1	-0.59	0.8	-0.69	0.9
0.2	-0.57	0.9	-0.68	1.0
0.3	-0.55	1.0	-0.68	1.1
0.4	-0.46	1.0	-0.67	1.2
0.5	-0.37	1.0	-0.67	1.3
0.6	-0.29	1.0	-0.66	1.4
0.7	-0.19	1.1	-0.65	1.5
0.8	-0.15	1.1	-0.64	1.6
0.9	-0.01	1.1	-0.63	1.7
1	0.11	1.1	-0.62	1.8
1.5	0.56	1.1	-0.39	2.1
2	1.04	1.1	0.08	2.1
2.5	1.57	1.1	0.56	2.1
3	2.06	1.1	1.04	2.1
3.5	2.57	1.1	1.56	2.1

Calculation of h_{ib} ⇒ $h_{ib} = \frac{V_{EB2} - V_{EB1}}{I_{E2} - I_{E1}} = \frac{0.72 - 0.6}{(2.9 - 0.4)10^{-3}}$

(V_{EB1}, I_{E1}) & (V_{EB2}, I_{E2})

$(0.6, 0.4)$ $(0.72, 2.9)$

$= \frac{0.12 \times 10^3}{2.5} = 0.048 \times 10^3$

$= 48\ \Omega$

Calculation of h_{rb} ⇒ $h_{rb} = \frac{V_{EB2} - V_{EB1}}{V_{CB2} - V_{CB1}}$

(V_{CB2}, V_{CB1}), (V_{EB2}, V_{EB1})

$(1, 2)$ $(0.72, 0.66)$

$= \frac{0.72 - 0.66}{1 - 2} \Rightarrow \frac{0.06}{-1} = -0.06.$

Calculation of h_{fb} ⇒ $h_{fb} = \frac{I_{C2} - I_{C1}}{I_{E2} - I_{E1}} = \frac{(2.1 - 1.1)10^{-3}}{(2 - 1)10^{-3}} = 1$

(I_{C2}, I_{C1}), (I_{E2}, I_{E1})

calculation of h_{ob} ⇒ $h_{ob} = \frac{I_{C2} - I_{C1}}{V_{EB2} - V_{EB1}}$

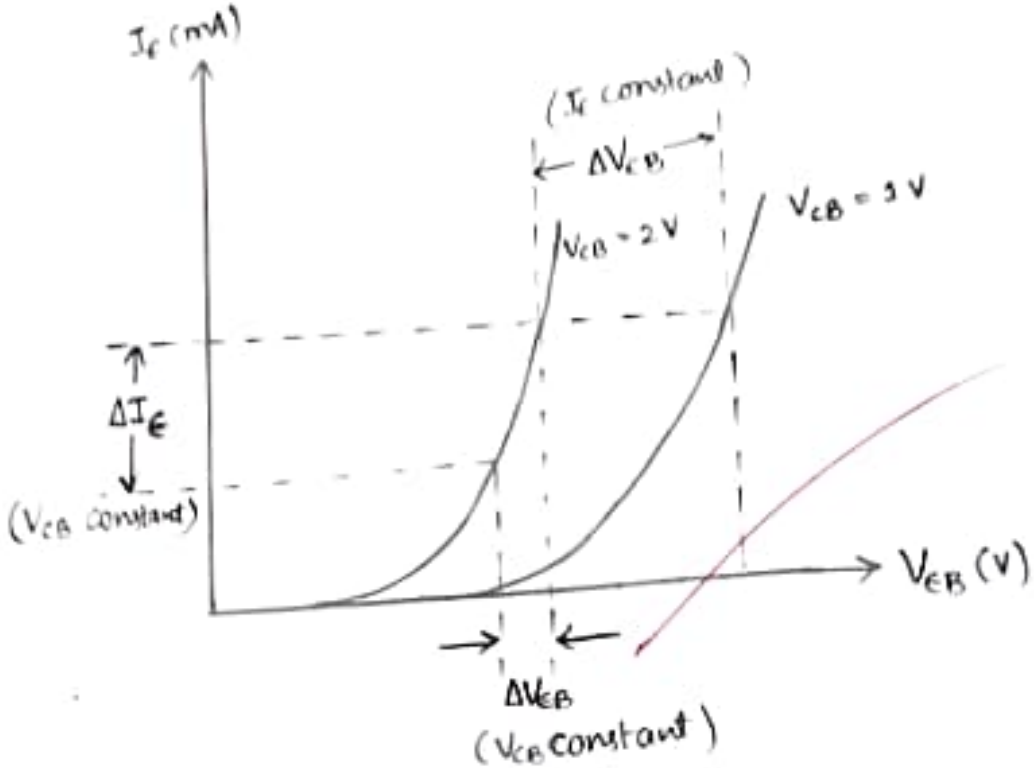
(V_{CB2}, I_{C2}), (V_{EB1}, I_{C1})

$0.56 \quad 2.1 \quad -0.65 \quad 1.5$

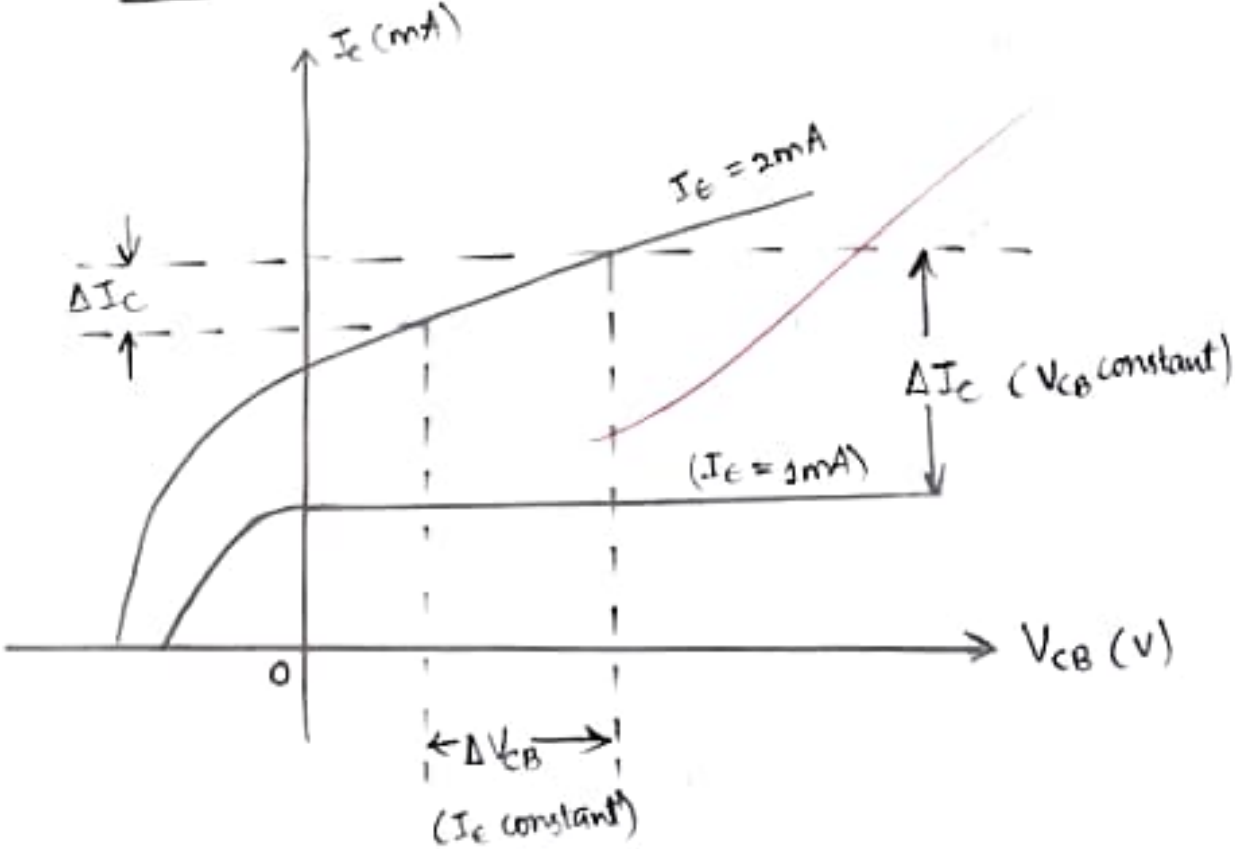
$= \frac{(2.1 - 1.5) \times 10^{-3}}{(0.56) - (-0.65)} \Rightarrow \frac{0.6}{1.21} \times 10^{-3} \Rightarrow 0.495\ mv$

Model Graph :-

A) Input Characteristics :-

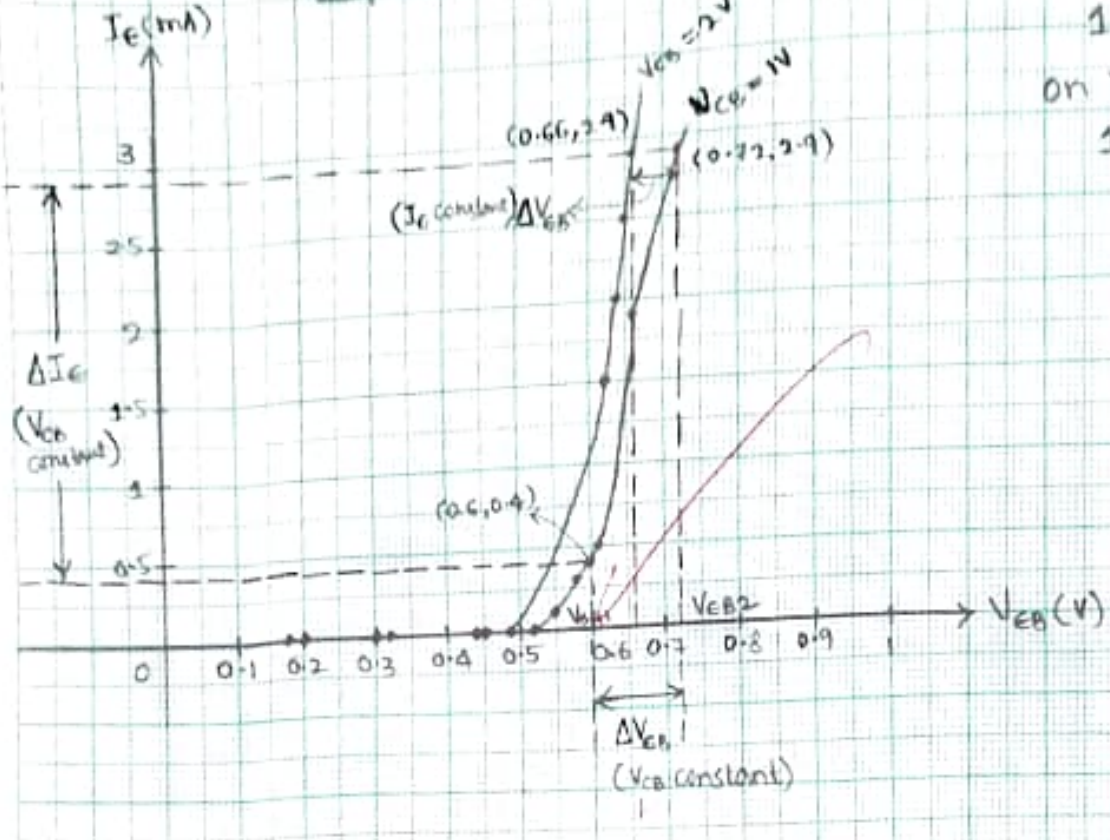


B) Output Characteristics :-



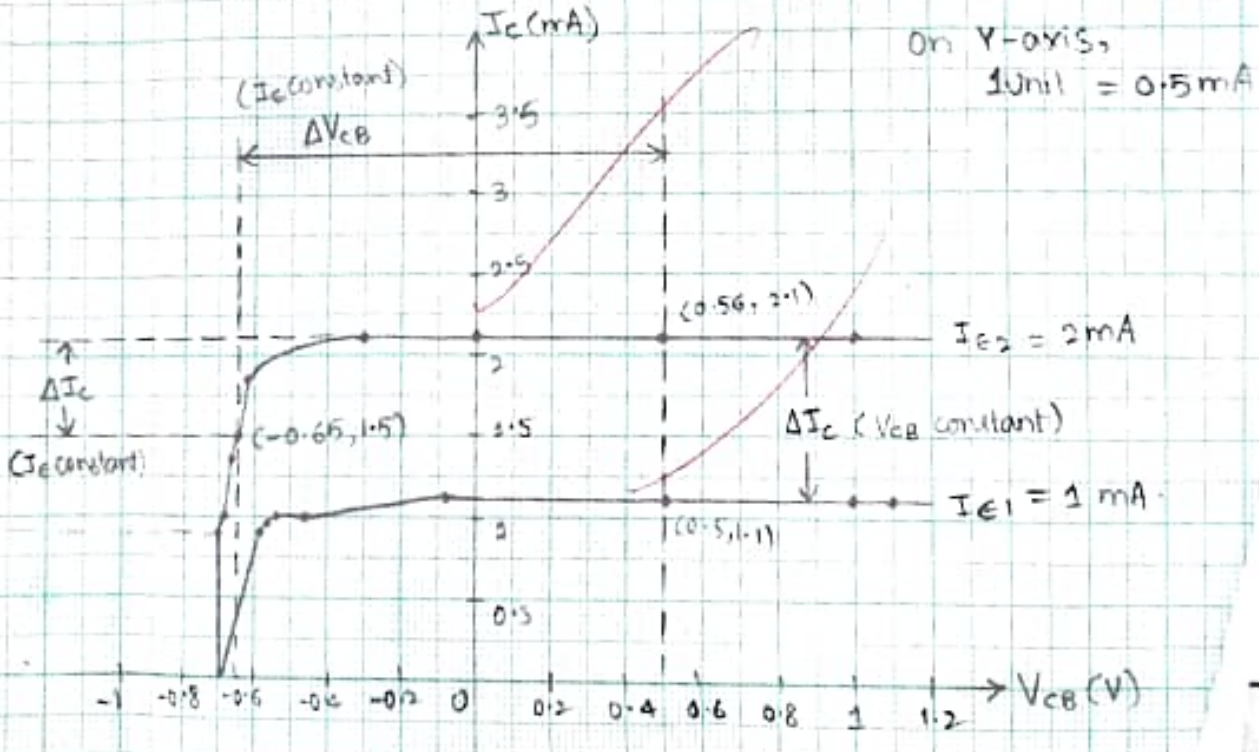
Common Base Configuration

Input Characteristics



Scale:-
on X-axis:
1 Unit = 0.1V
on Y-axis:
1 Unit = 0.5 mA

Output Characteristics



Scale:-
on X-axis,
1 Unit = 0.2 V
On Y-axis,
1 Unit = 0.5 mA

Input and Output Characteristics of Transistor

CE Configuration

Aim:- To plot the Input and output characteristics of a transistor connected in common Emitter configuration and to find the h-parameters from the characteristics.

Apparatus Required :-

Sl.No.	Description	Range / Value	Quantity
1.	Regulated Power Supply	(0-30) V	1
2.	Transistor	BC107	1
3.	DC Ammeter	(0-200) mA, (0-200) μA	1 of each
4.	DC Voltmeter	(0-20) V	2
5.	Resistor	100 KΩ, 1 KΩ	1 of each.
6.	Bread board and connecting wires		

Theory :-

A transistor is a three terminal active device. The terminals are emitter, base, collector. In CE configuration, the emitter is common to both input (base) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased.

The output characteristics resemble that of a forward biased diode curve due to the Base - Emitter junction of the transistor is forward biased. The input resistance of CE

circuit is higher than that of CB circuit.

The Output Characteristics are drawn between I_C and V_{CE} at constant I_B. The collector current varies with V_{CE} in to few volts only. After this the collector current becomes almost constant, and independent of V_{CE}. The value of V_{CE} up to which the collector current changes with V_{CE} is known as Knee Voltage. The transistor always operated in the region above Knee voltage, I_C is always constant and is approximately equal to I_B. The other salient feature of this configuration is that the input and output are out of phase.

Procedure :-

A) Input Characteristics :

1. Connections are made as per the circuit diagrams.
2. Keep V_{BB} and V_{CC} knob in minimum position before turn on the regulated power supply.
3. Set $V_{CE} = 1V$ by varying V_{CC}.
4. Then vary the V_{BB} smoothly with fine control and note down the value of base current I_B & base emitter voltage V_{BE} and put it in tabular form.
5. Repeat the experiment by keeping $V_{CE} = 2V$ & $4V$.
6. Draw the graph between V_{BE} Vs I_B against V_{CE} equal to constant.

B) Output Characteristics

1. Connections are made as per the circuit diagram.
2. Keep V_{BB} and V_{cc} knob in minimum position before turn on the regulated power supply.
3. Set $I_B = 10\,\mu A$ by varying V_{BB}.
4. Vary the V_{cc} smoothly with fine control and note down the value of collector current I_C & Emitter collector voltage V_{CE} and put it in tabular form.
5. Repeat the experiment by keeping $I_E = 20\,\mu A$ and $30\,\mu A$
6. Draw a graph between V_{CE} Vs I_C against, I_B = constant.

To find the h-parameters :

Calculation of hie :

Mark two points on the Input characteristics for constant V_{CE}. Let the coordinates of these 2 points be (V_{BE1}, I_{B1}) & (V_{BE2}, I_{B2})

$$h_{ie} = \frac{V_{BE2} - V_{BE1}}{I_{B2} - I_{B1}}$$

Calculation of h_{re} :

Draw the horizontal line at some constant I_B value on the Input characteristics. Find V_{CE2}, V_{CE1} & V_{BE2}, V_{BE1}

$$h_{re} = \frac{V_{BE2} - V_{BE1}}{V_{CE2} - V_{CE1}}$$

Calculation of h_{fe} :

Draw a vertical line on the output characteristics at some constant V_{cc} value. Find I_{C2}, I_{C1} & I_{B2}, I_{B1}

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$$h_{fe} = \frac{I_{C2} - I_{C1}}{I_{B2} - I_{B1}}$$

Calculation of h_{oe} :-

Mark two points on the Input Characteristics for constant I_B. Let the coordinates of these two points be (V_{cc2}, I_{c2}) and (V_{cc1}, I_{c1})

$$h_{oe} = \frac{I_{c2} - I_{c1}}{V_{cc2} - V_{cc1}}$$

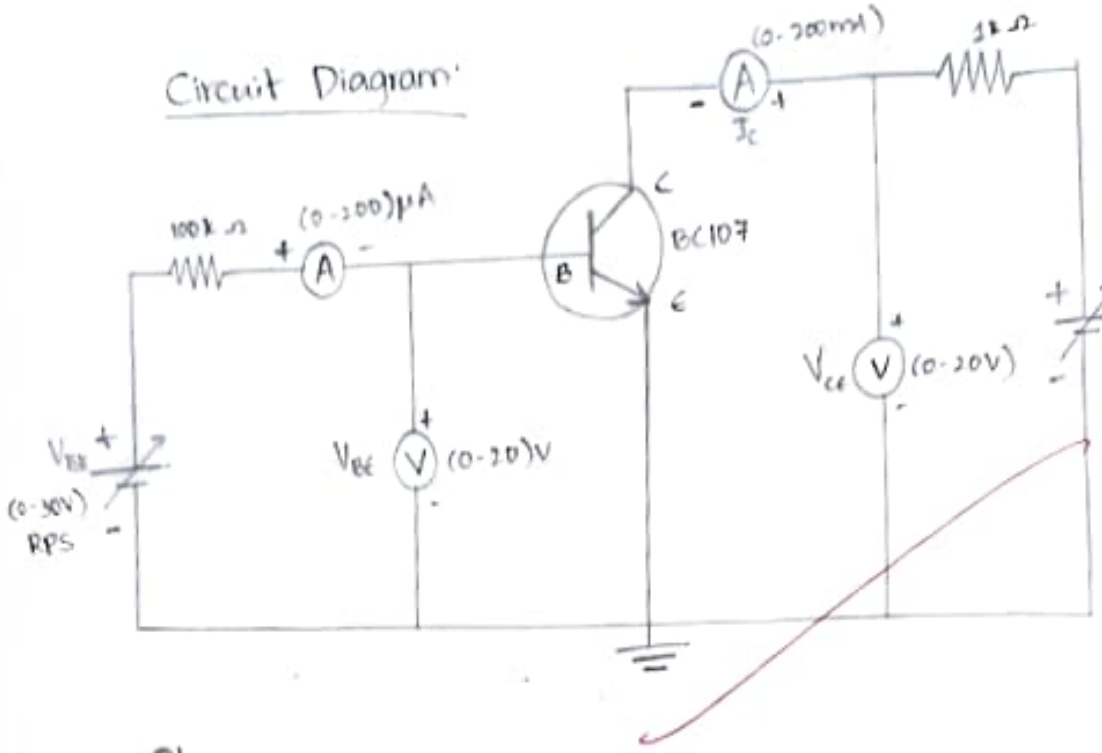
Result :-

The Input and Output Characteristics of transistor in CE configuration are drawn on the graphs and the h-parameters are calculated: $h_{ie} = 1.3k\Omega$ $h_{re} = -0.01$

$h_{oe} = 1 m\mho$ $h_{fe} = 150$

8/12/2024

Circuit Diagram:



1. Emitter
2. Base
3. collector

Observation :-

A) Input Characteristics

S.NO.	RPS V_{EE}(V)	V_{CE} = 2V		V_{CE} = 4 V	
		V_{BE} (V)	I_B (μA)	V_{BE} (V)	I_B (μA)
1.	0·3	0·30	1·3	0·32	1·4
2.	0·5	0·4	2·0	0·41	2·3
3.	1·0	0·58	5·9	0·57	6·2
4.	1·5	0.62	10·3	0·62	10·2
5.	1·8	0·64	13·6	0·63	13·1
6.	2·0	0·64	15·3	0·64	15·5
7.	2·2	0·65	17·2	0·64	17·6
8.	2·5	0·65	20·2	0·64	20·0
9.	2·8	0·66	23·6	0·64	22·9
10.	3·0	0·66	25·7	0·65	25·3
11.	3·5	0·67	30·7	0·66	30·8
12.	4·0	0·67	35·1	0·66	35·7

B) Output Characteristics

S.No	PTS V_{cc} (V)	I_B = 10 μA		I_B = 20 μA	
		V_{CE} (V)	I_C (mA)	V_{CE} (V)	I_C (mA)
1	0.3	[illegible]	0.2	0.05	0.4
2	0.5	0.14	0.6	0.06	0.6
3	1	0.25	1.0	0.08	1.1
4	1.5	0.36	1.4	0.12	1.7
5	1.6	0.47	1.6	0.12	2.0
6	2	0.56	1.8	0.14	2.3
7	2.2	0.62	1.9	0.15	2.5
8	2.5	0.80	2.1	0.17	2.8
9	2.8	1	2.2	0.20	3.1
10	3	1.12	2.2	0.22	3.3
11	3.2	1.3	2.2	0.23	3.5
12	3.5	1.56	2.2	0.28	3.6
13	4	1.96	2.2	0.34	4.3

Calculations :-

$$h_{ie} = \frac{0.67 - 0.65}{(35.1 - 20.2)10^{-6}} = 1342.281 = 1.3\,K\Omega$$

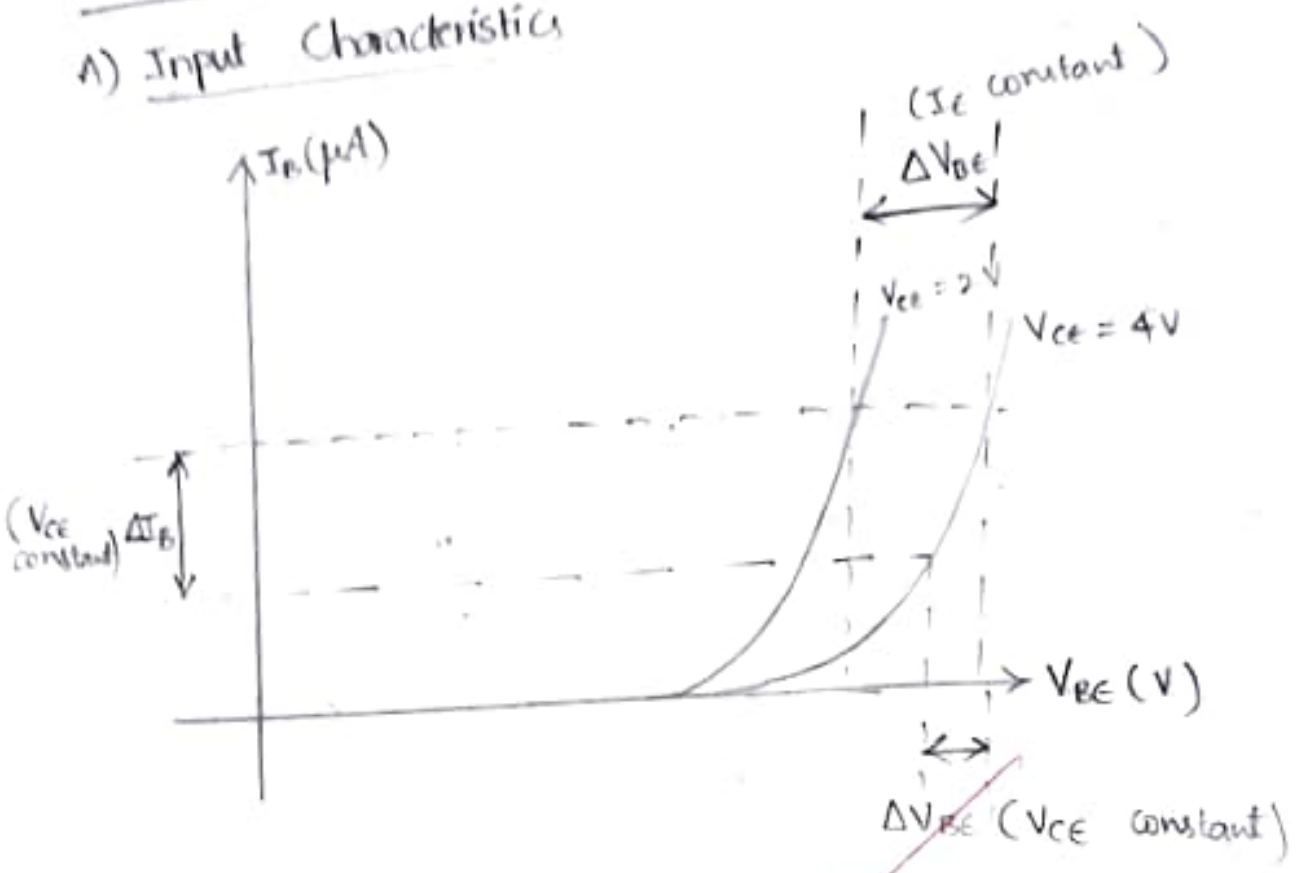
$$h_{re} = \frac{0.65 - 0.64}{1 - 2} = -0.01$$

$$h_{fe} = \frac{3.6 - 2.1}{20 - 10} \times \frac{10^{-3}}{10^{-6}} = 150$$

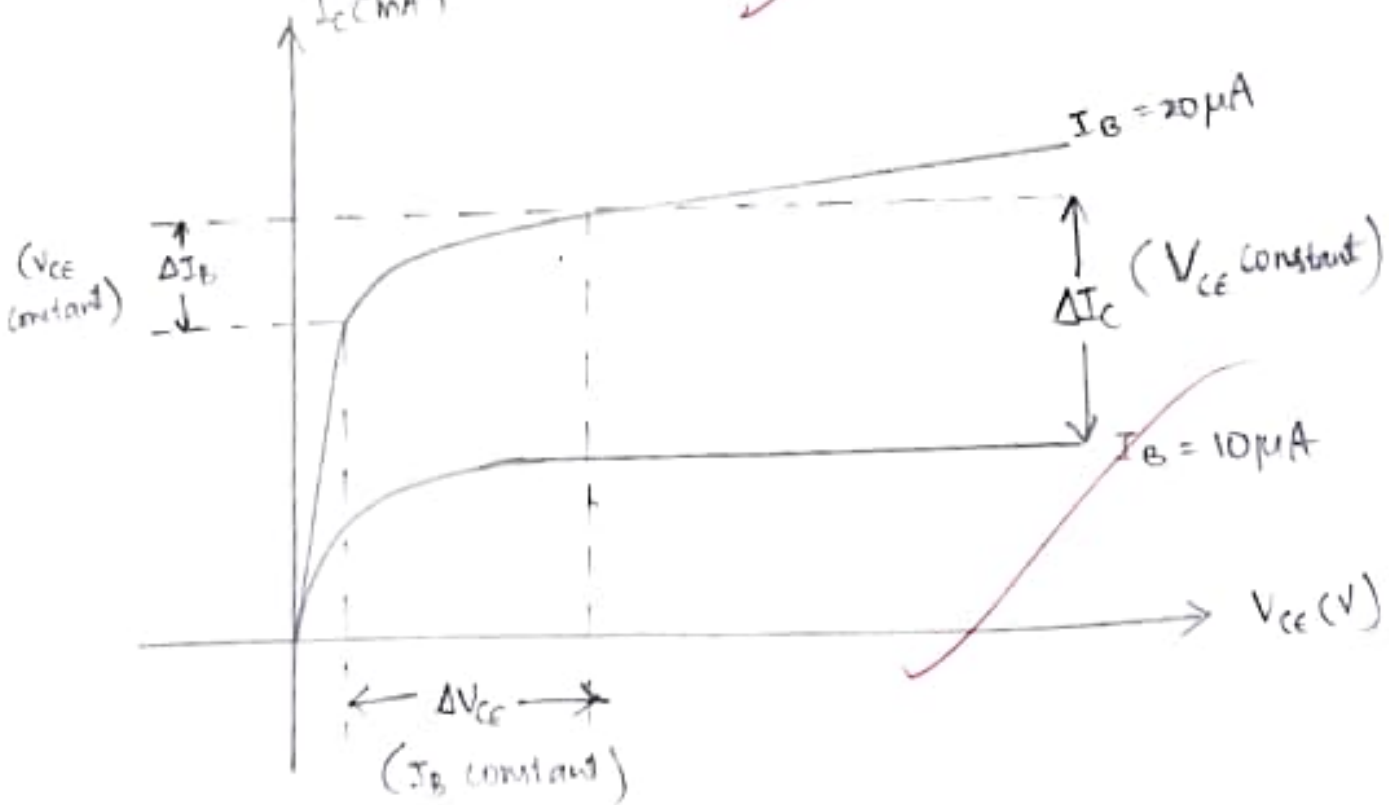
$$h_{oe} = \frac{(3.6 - 3.1)10^{-3}}{0.25 - 0.2} = 10 \times 10^{-3} = 10\,m\mho$$

Model Graph :-

A) Input Characteristics

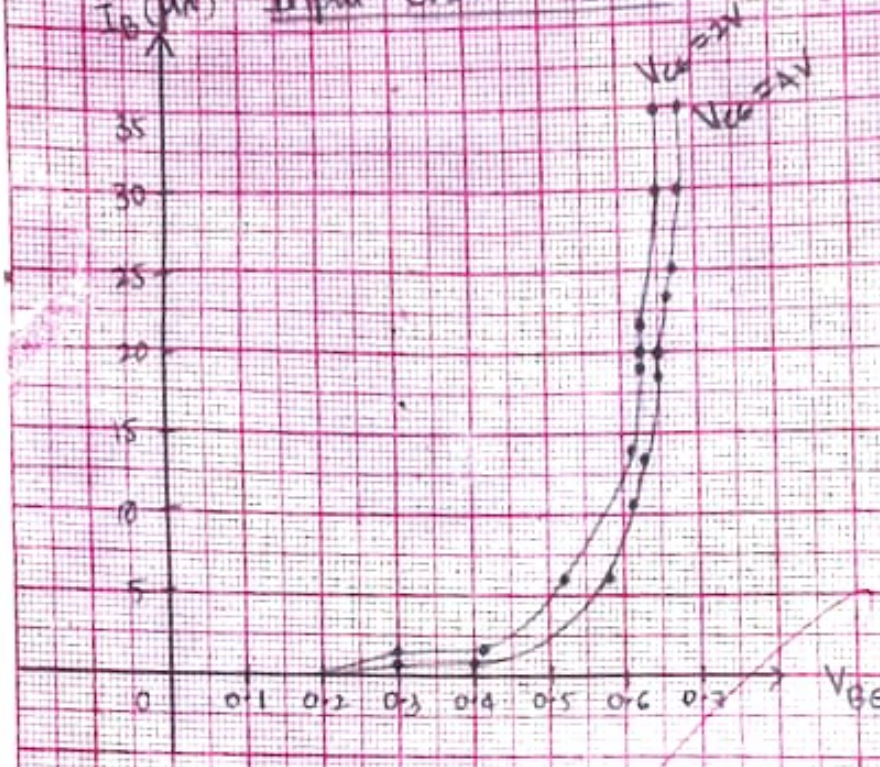


B) Output Characteristics



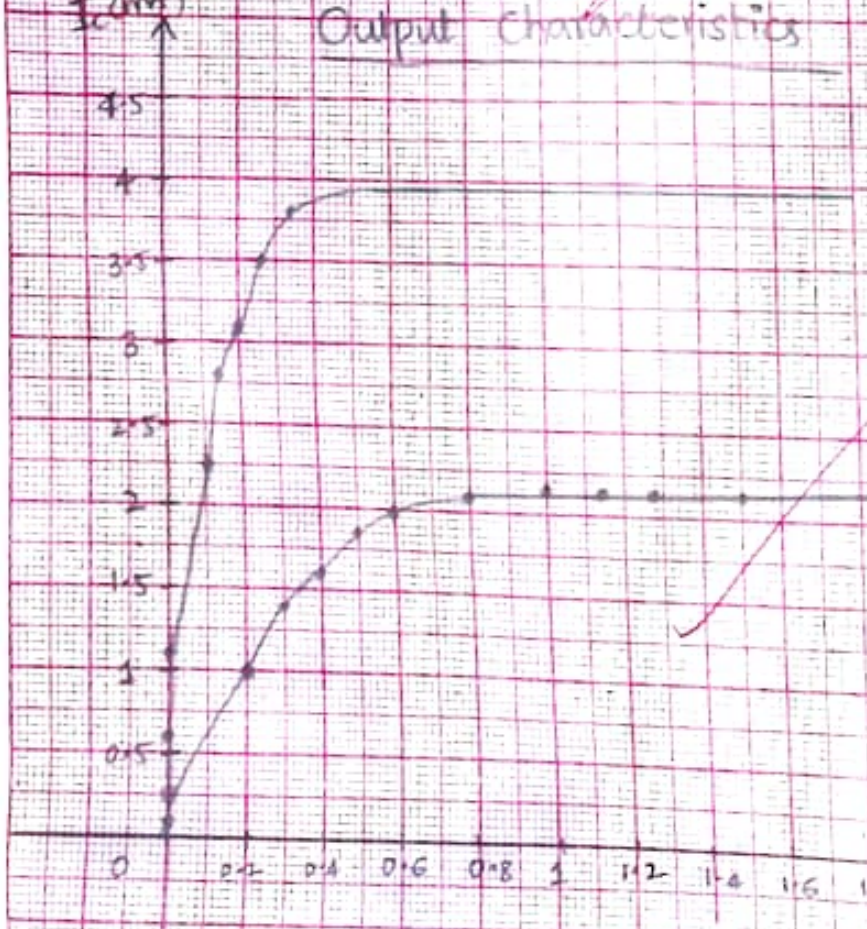
CE Configuration

Input Characteristics



Scale:
On X-axis,
1 Unit = 0.1 V
On Y-axis,
1 Unit = 5 μA

Output Characteristics



Scale:
On X-axis,
1 Unit = 0.2 V
On Y-axis,
1 Unit = 0.5

Clippers

Aim :- To construct and test the shunt and series clipping circuits and also verify the transfer characteristics of it

Apparatus Required :-

Sl.No	Description	Range / Number / Value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	Diode	1N4007	1
3.	Resistors	2.2KΩ	1
4.	Signal Generators	(0-1 MHz)	1
5.	Dual Trace CRO	20 MHz	1
6.	Breadboard and connecting wires		

Theory :

Clipping circuits basically limit the amplitude of the input signal either below or above certain voltage level. They are referred to as voltage limiters, Amplitude selectors or slicers. A clipping circuits is one, in which a small section of input waveform is missing or cut or truncated at the output section.

Clipping circuits are constructed using a combination of resistors, diodes or transistor and reference voltage. Clipping circuits are classified based on the position of diode as

i. Series diode Clipper

ii. Shunt diode Clipper.

Procedure :-

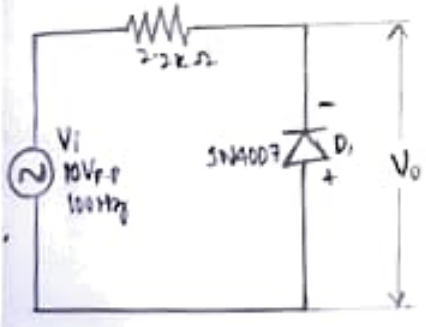
1. Connect the circuit as shown in the figures
2. In each case, apply 10 V_{p-p}, 1 KHz sine wave as Input using a signal generator.
3. Observe the Input and Output waveforms on CRO and plot the waveforms and mask the values without and with reference voltage V_R.
4. Obtain the transfer characteristics of clipper circuit, by keeping CRO in X-Y mode.
5. Repeat the above steps for all the clipping circuits.

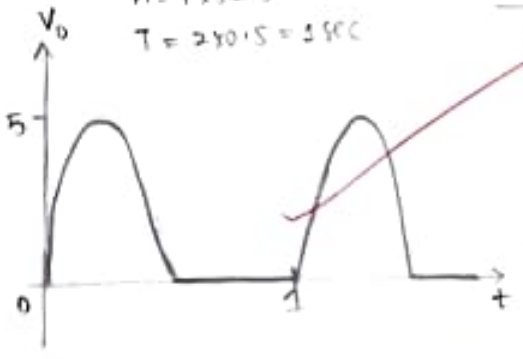
Procedure for Transfer Characteristics :-

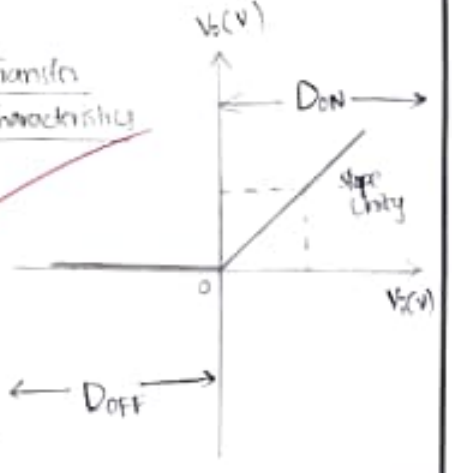
- To find the transfer characteristics, apply input to the X-channel, Output to Y-channel, adjust the dot at the center of the screen when CRO is in X-Y mode. Both the channels must be in ground, then remove ground and plot the transfer characteristics.
  Set the CRO output channel in DC mode always.

B) Shunt Clipper :

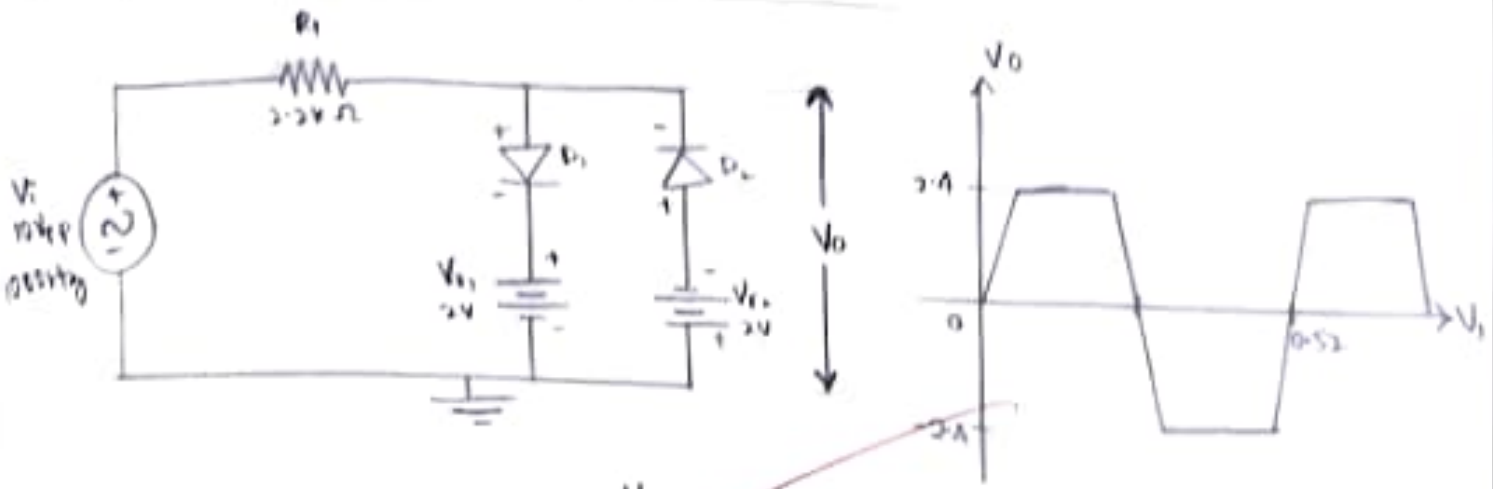
a) Shunt Negative Clipper :



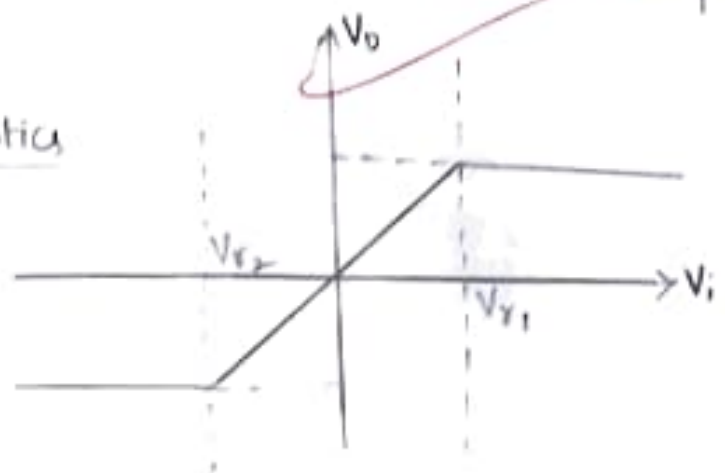




e) clipping at two independent levels :



Transfer characteristics



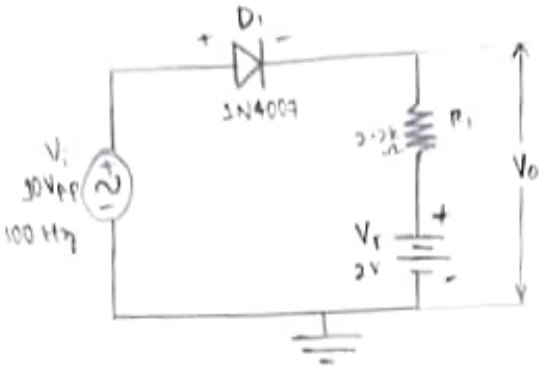
Result :- Different types of shunt and series clipping circuits are constructed and tested and also verified the transfer characteristics of it.

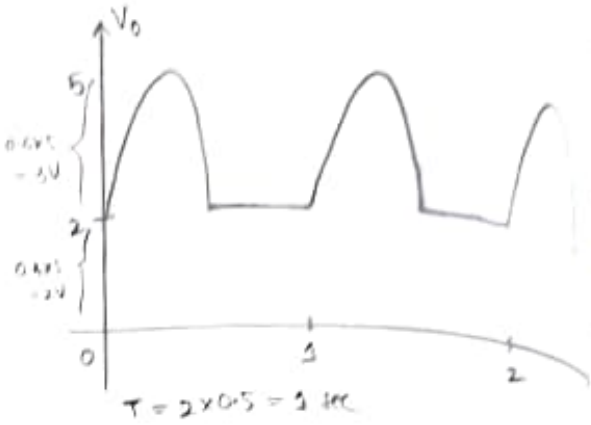
8/12/2014

Circuit Diagram

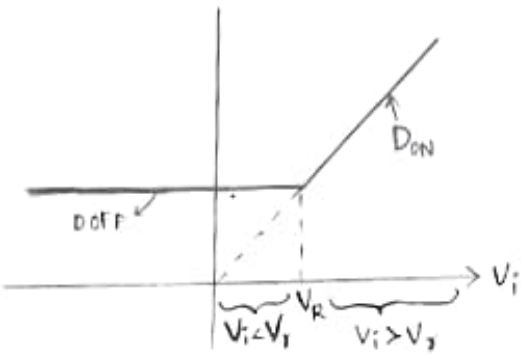
A) Series Clipper

c) Series Negative Clipper with Positive Reference

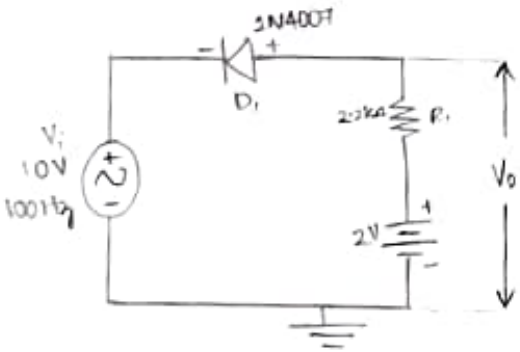


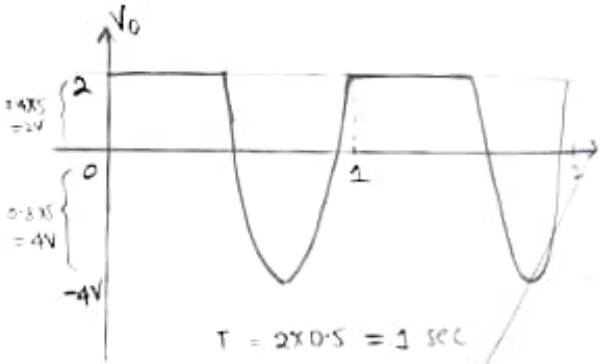


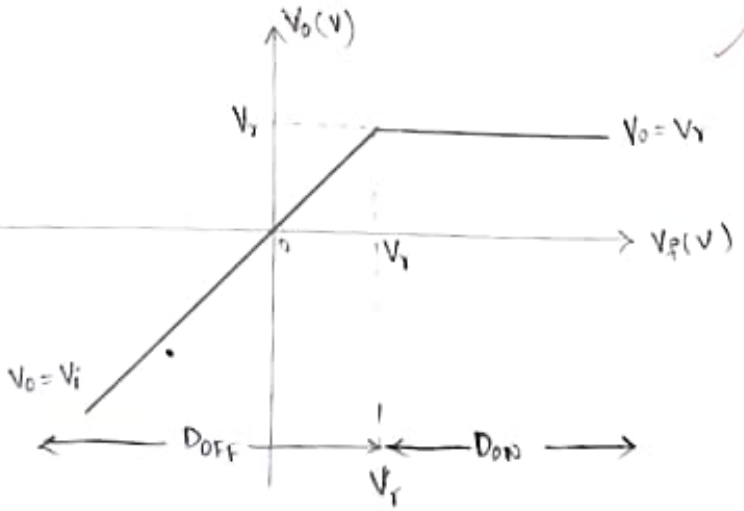
Transfer Characteristics



d) Series Positive Clipper with Positive Reference



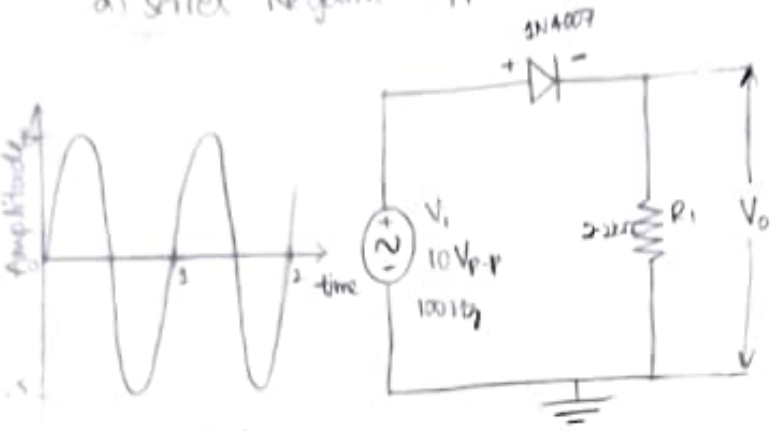


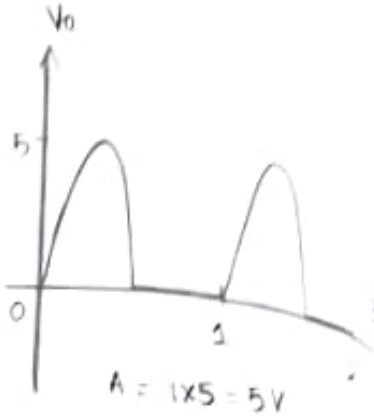


Circuit Diagram:

A) Series Clipper

a) Series Negative Clipper



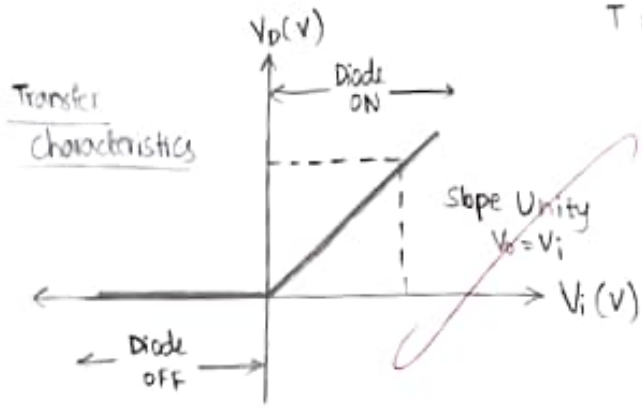


A = 2×5 = 10V

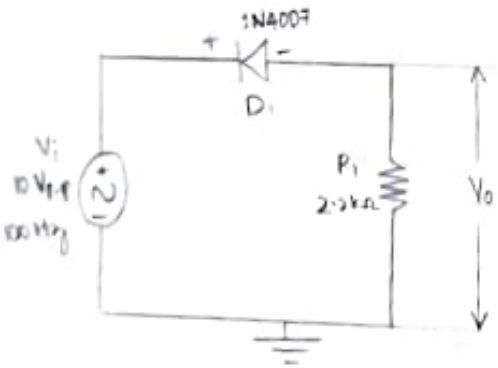
T = 2×0.5 = 1sec

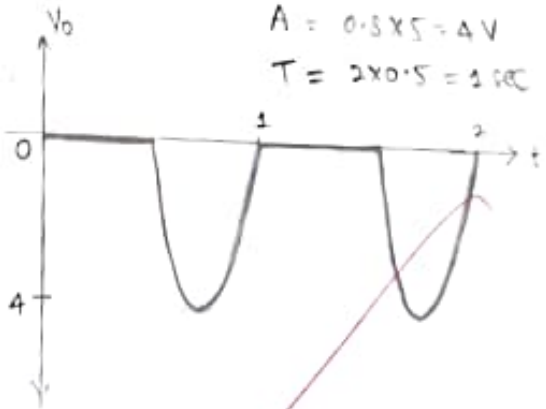
A = 1×5 = 5V

T = 2×0.5 = 1 sec



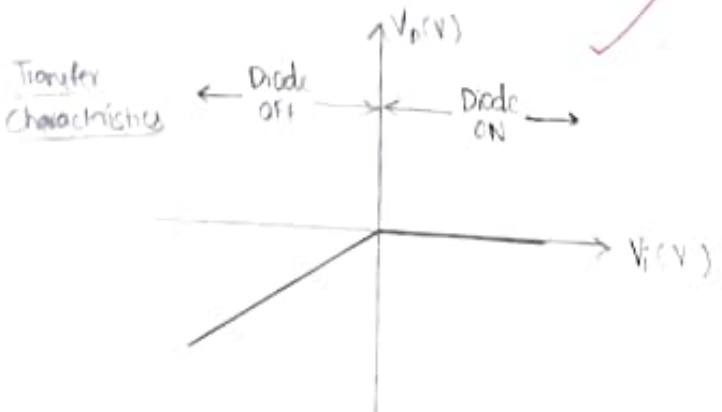
b) Series Positive Clipper



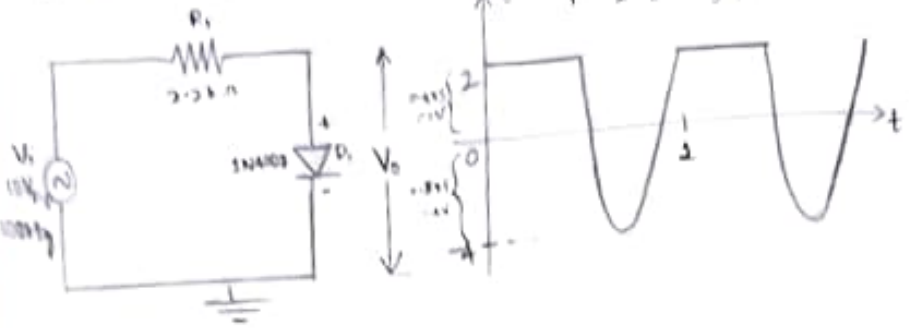


A = 0.5×5 = 4V

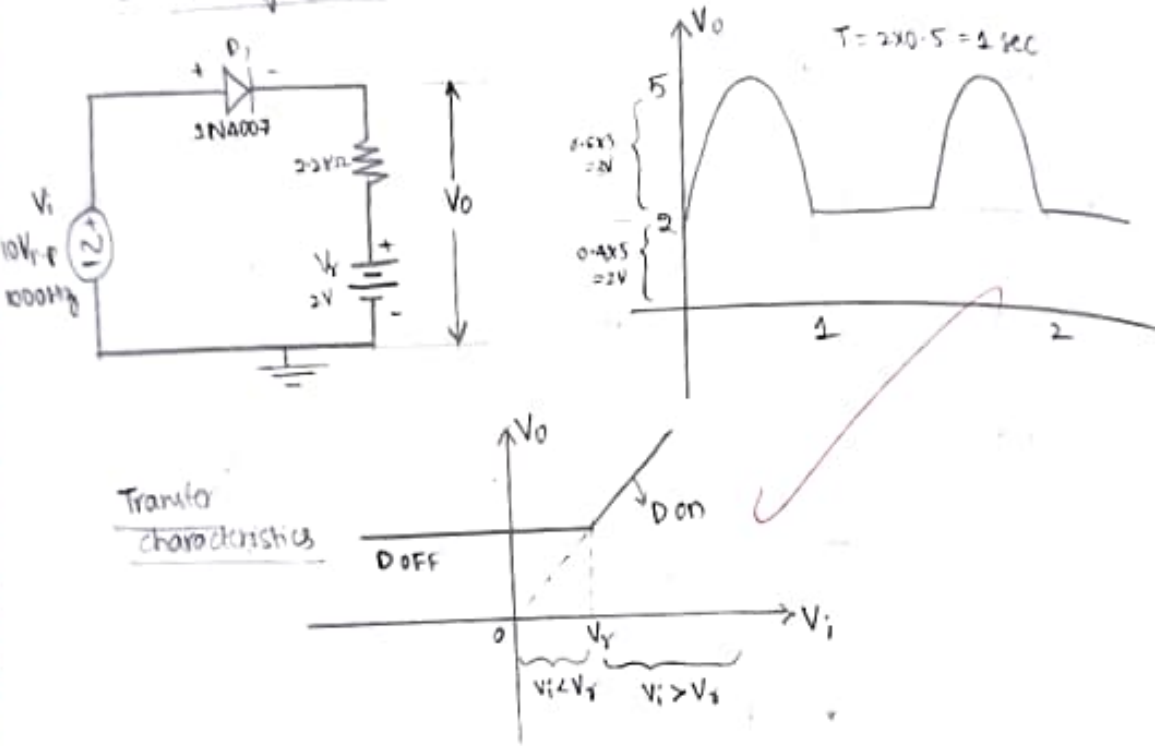
T = 2×0.5 = 1 sec



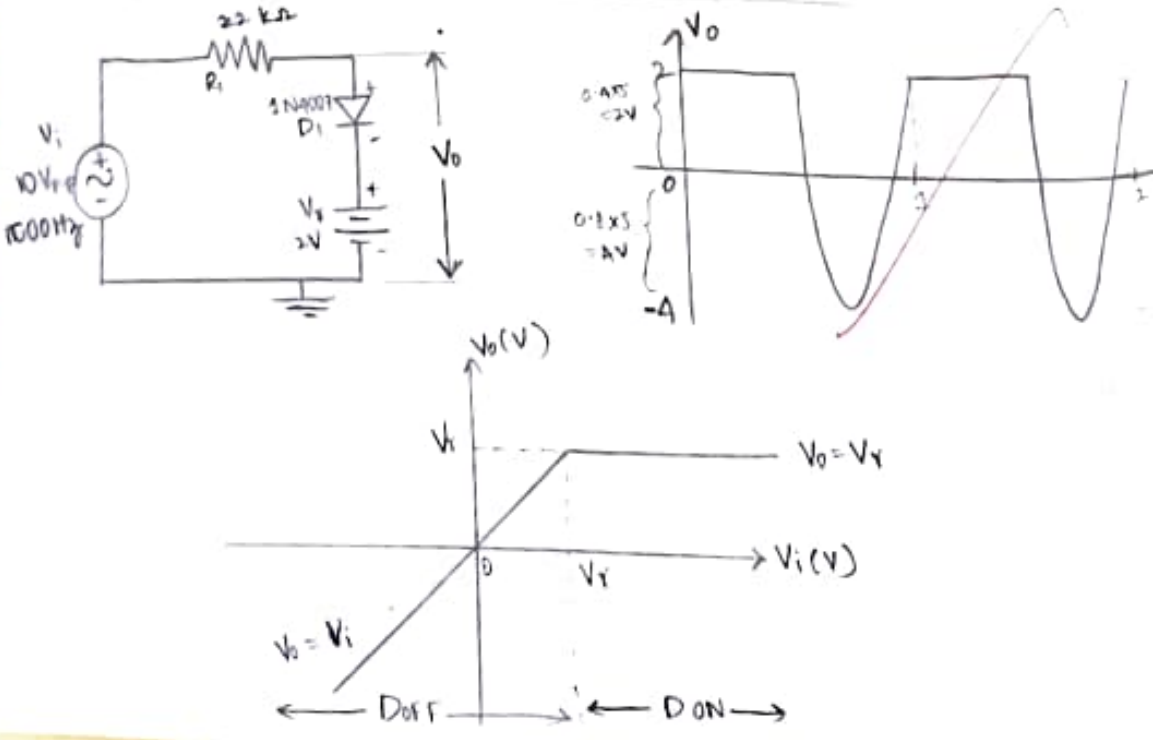
b) Shunt Positive Clipper



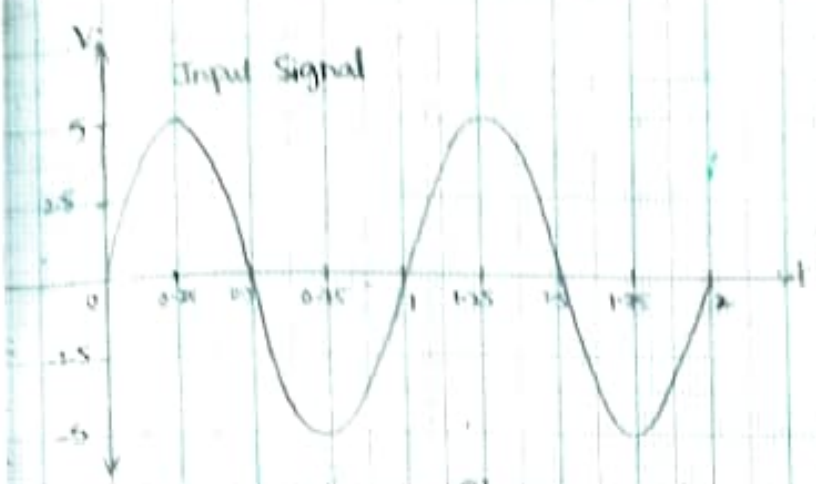
c) Shunt Negative clipper with Reference



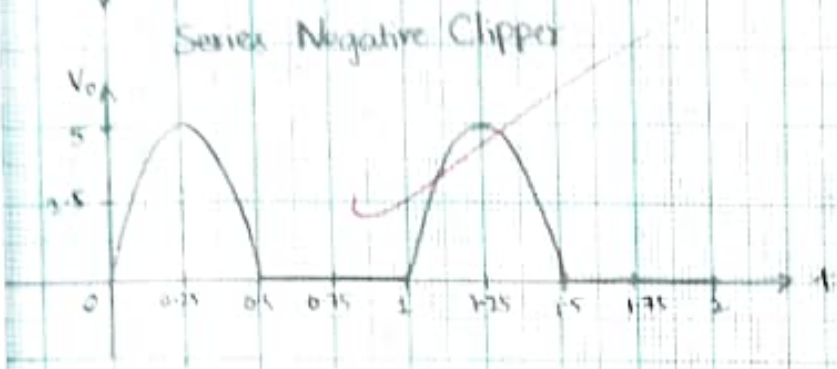
d) Shunt Positive Clipper with Positive reference



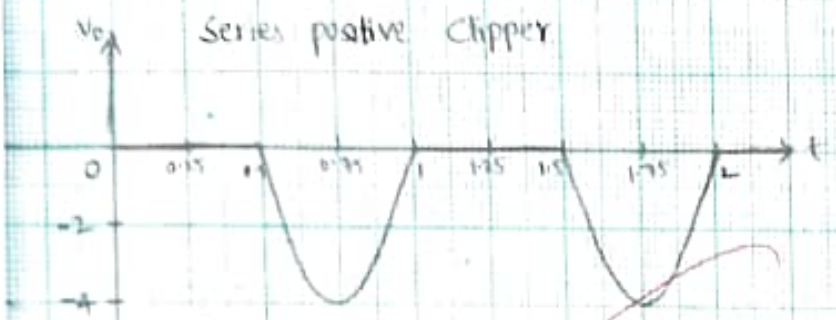
Series Clipper



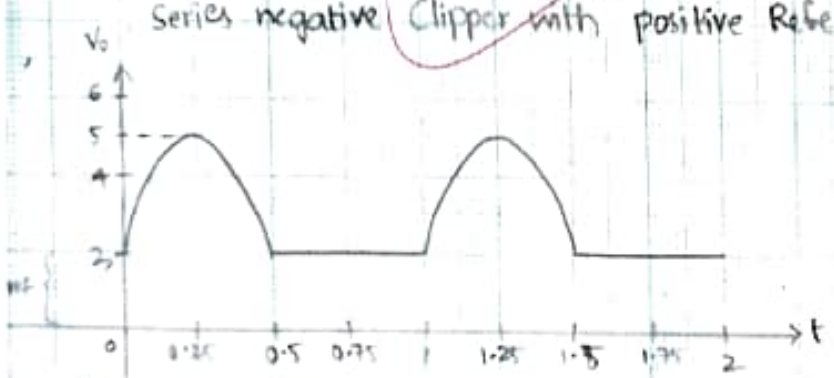
Scale:-
On x-axis;
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2.5 V



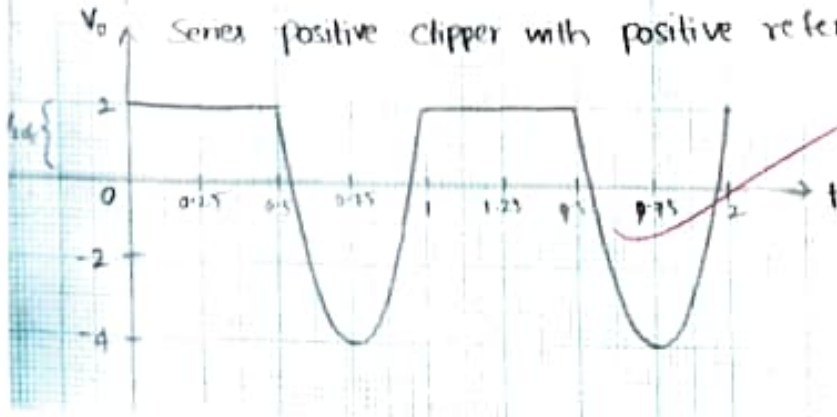
Scale:-
On Y-axis,
1 Unit = 0.25 sec
On Y-axis,
1 unit = 2.5 V



Scale:-
On x-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2 V



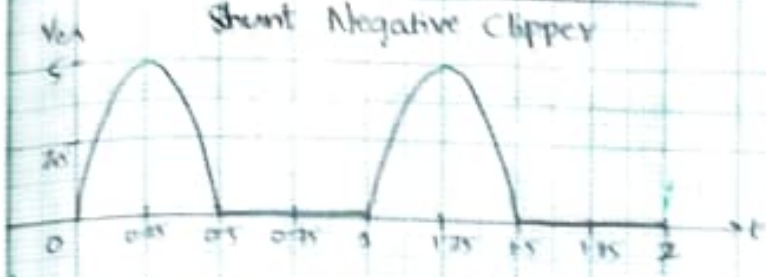
Scale:
On x-axis,
1 unit = 0.25 sec
On Y-axis,
1 Unit = 2V



Scale:
On x-axis,
1 unit = 0.25 sec
On Y-axis,
1 Unit = 2V

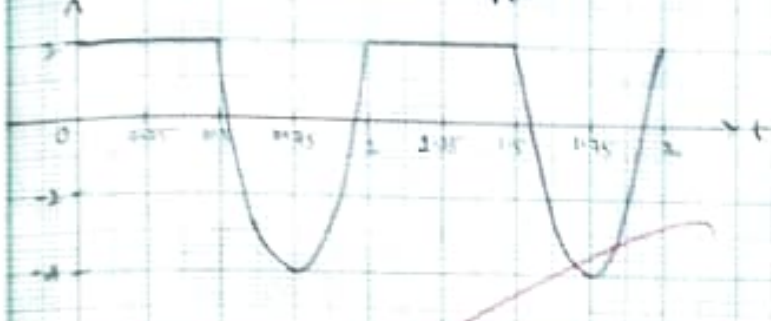
SHUNT CLIPPER

Shunt Negative Clipper



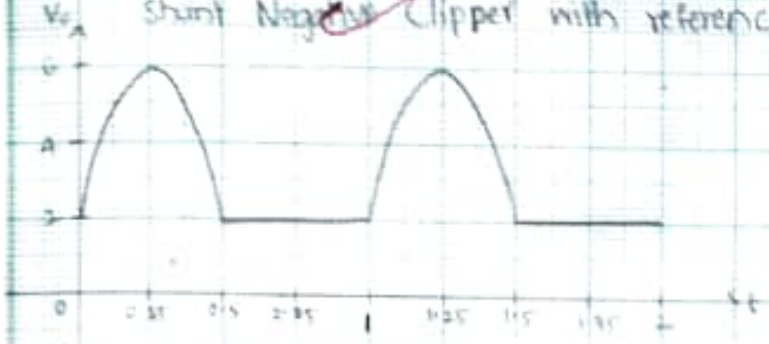
Scale :-
On x-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2.5 V

Shunt Positive Clipper



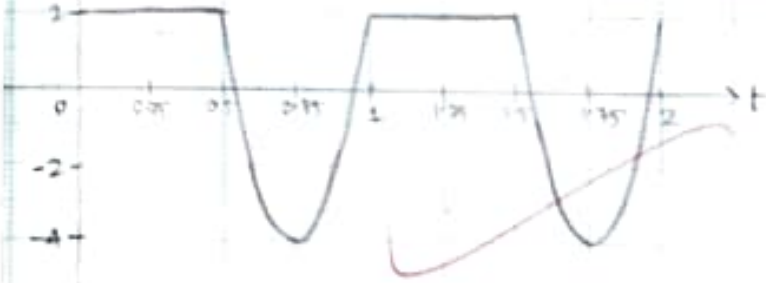
Scale :-
On x-axis,
1 Unit = 0.25 sec
1 Y-axis,
1 Unit = 2 V

Shunt Negative Clipper with reference



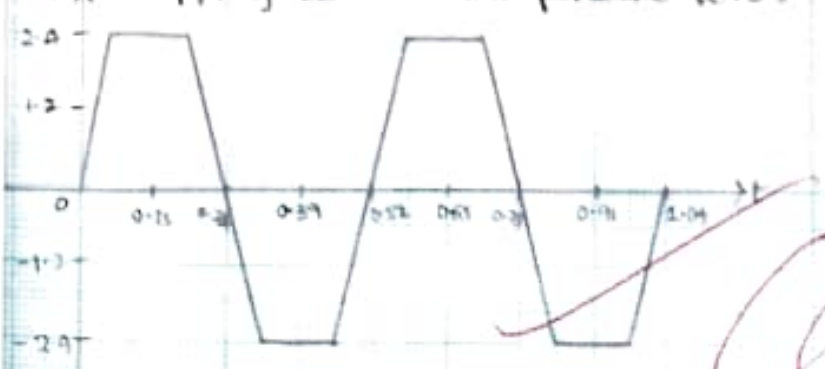
Scale :-
On X-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2V

Shunt Positive clipper with positive reference



Scale :-
On X-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2V

Clipping at two independent levels



Scale :-
On x-axis,
1 Unit = 0.13 sec
On Y-axis,
1 Unit = 1.2 V.

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Title :

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Clampers

Aim :- To construct and test the positive and negative clamping circuits

Apparatus Required :-

S.No.	Description	Range / value	Quantity
1.	Regulated Power Supply RPS	(0-30)V	1
2.	Diode	IN4007	1
3	Resistor	100 kΩ	1
4.	Capacitor	0.1 μF	1
5.	Signal Generator	0 - 1 MHz	1
6.	Dual Trace CRO	20 MHz	1
7.	Breadboard and connecting wires		

Theory :-

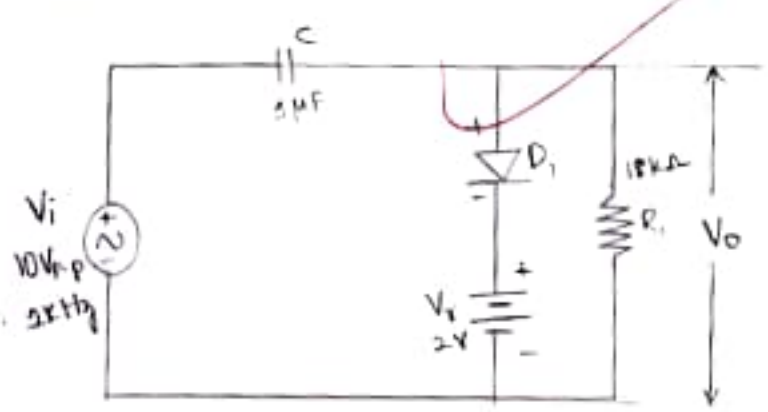
Clamping circuits add a DC level to an AC signal. A clamper is also referred to as DC restorer or DC inserter. The clamper clamp the given waveform either above or below the reference level, which are known as positive or negative clampers respectively. Clamping circuits are classified as 2 types : 1) Negative clampers.

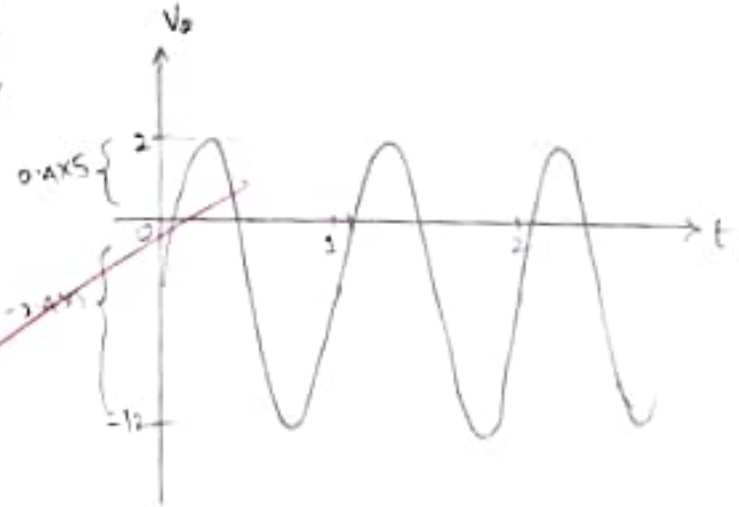
2) Positive clampers

Procedure :-

1. Connect the circuit as shown in figure
2. Apply a sine wave of 10 V_{p-p}, 1KHz at the input terminals with the help of signal generator.
3. Observe the Input and Output waveforms on CRO and plot the waveforms and mask the values without and with reference voltage.
4. Output is taken across the load R_L.
5. Repeat the above steps for all clamping circuits as shown in figure.

Negative clamper with positive reference voltage





Input Signal

Amplitude = 2×5 V = 10 V

Timeperiod = 2×0.5 ms = 1 ms

Result :-

Different types of positive and negative clamper circuits are constructed and tested.

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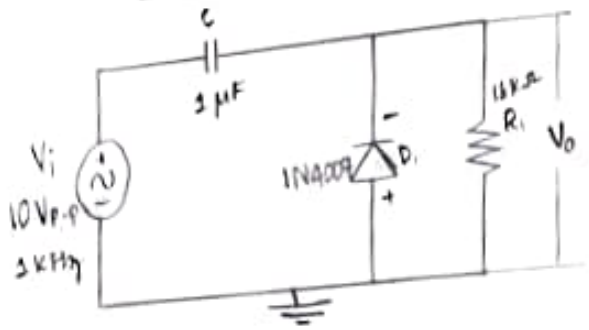
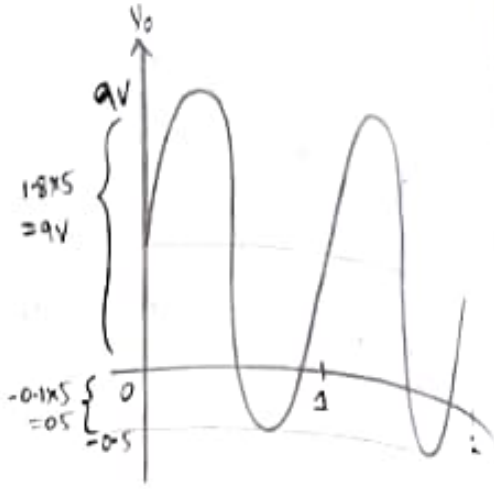
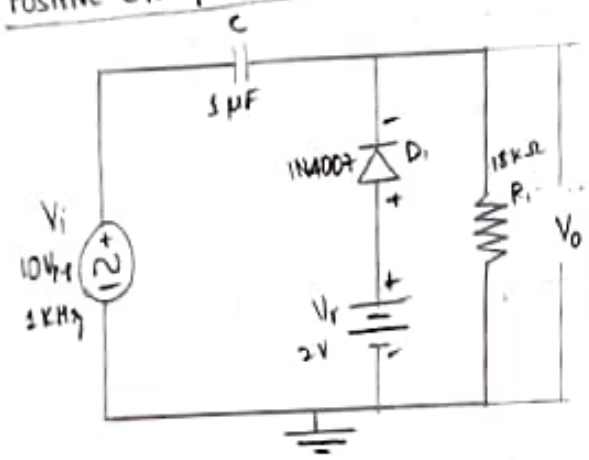
Circuit Diagram :-

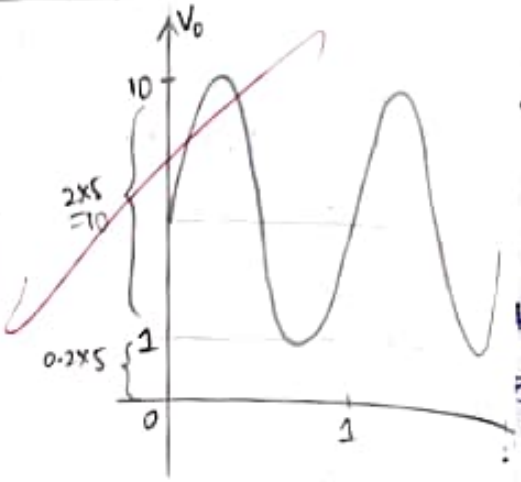
Positive Clamper



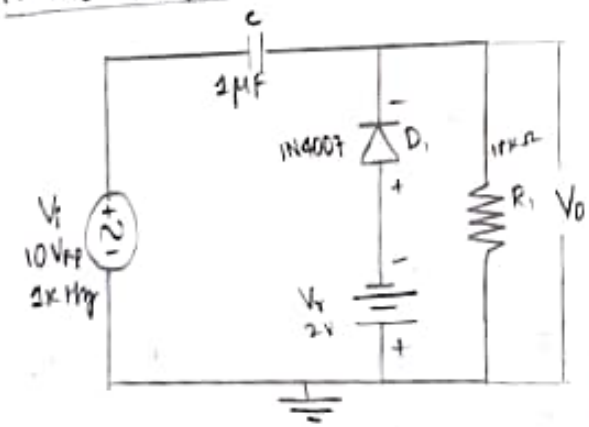


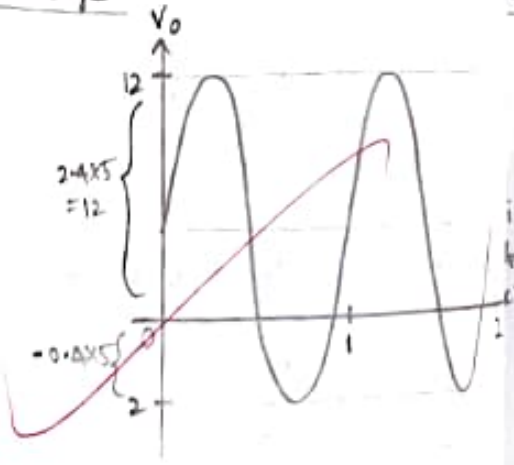
Positive clamper with Positive reference Voltage



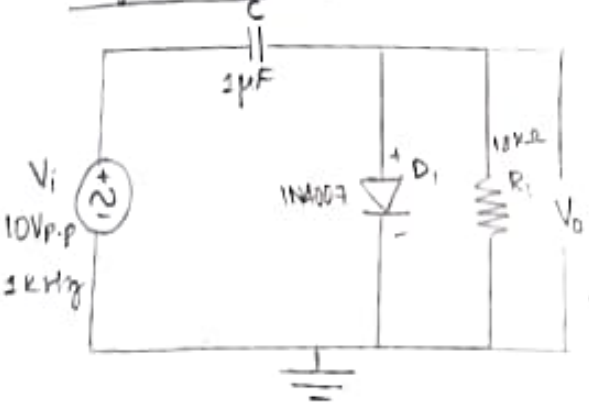


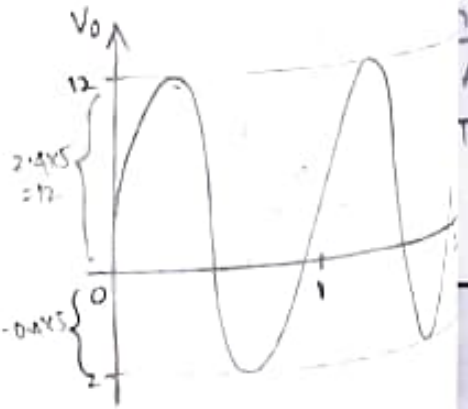
Positive clamper with Negative reference voltage



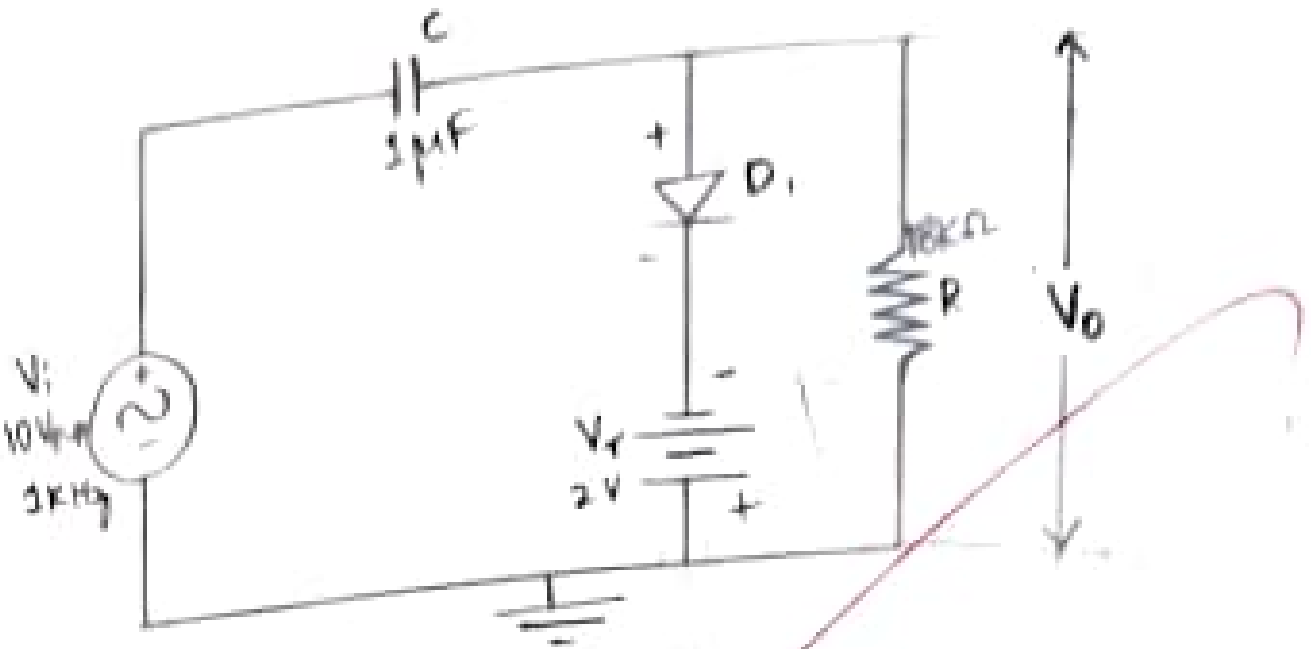


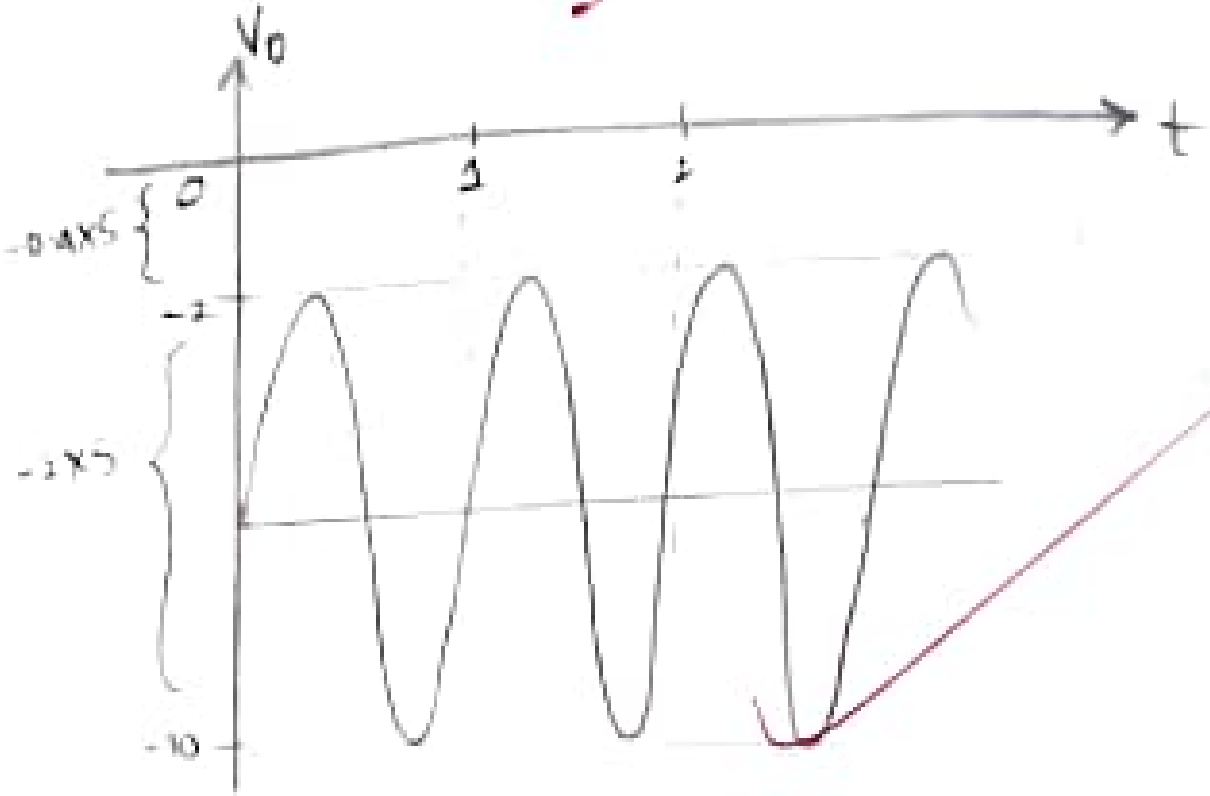
Negative Clamper





Negative clamper with negative reference voltage



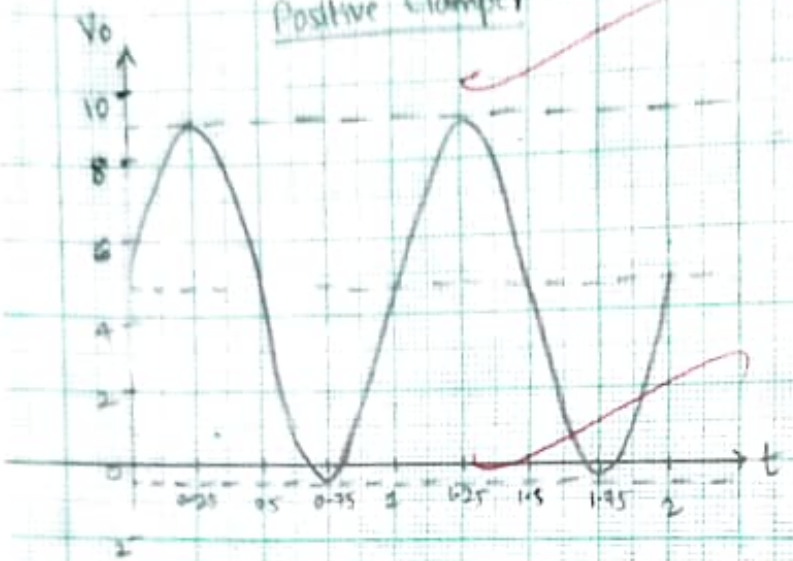


CLAMPERS

Input Signal

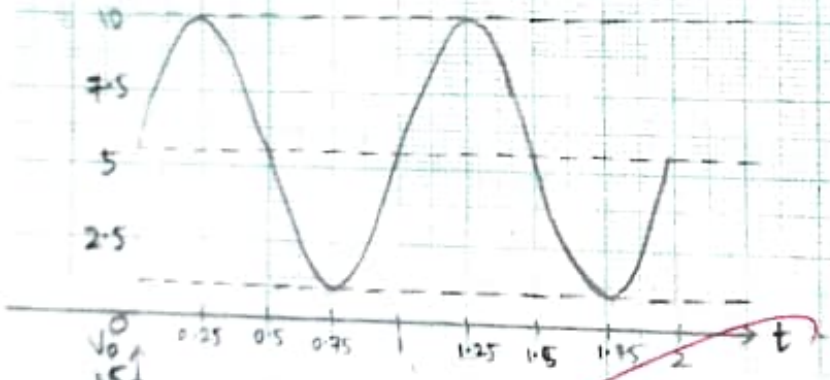
Scale :-
on x-axis,
1 Unit = 0.25 sec
on Y-axis,
1 Unit = 2.5 V

Positive Clamper

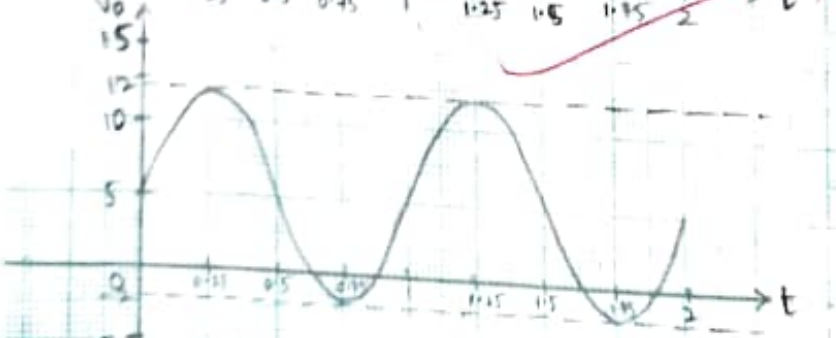


Scale :-
on x-axis,
1 Unit = 0.25 sec
on Y-axis,
1 Unit = 2 V

V_o, Positive Clamper with Positive reference voltage



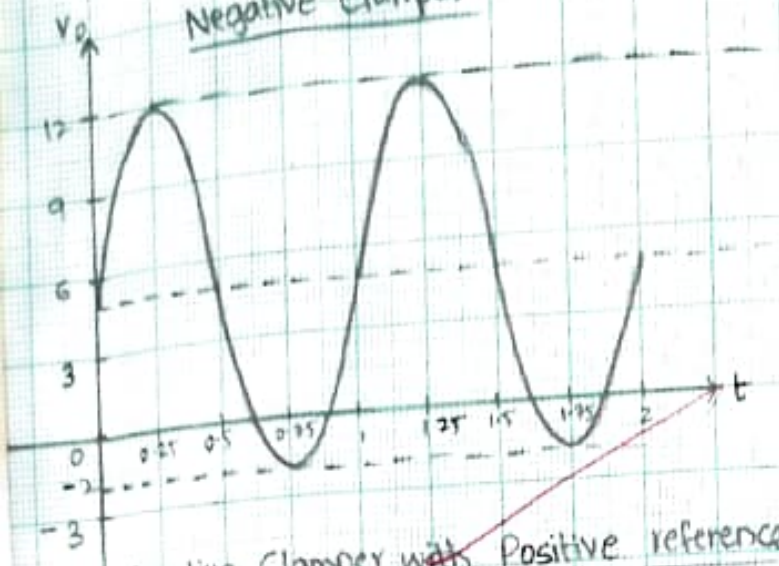
Scale :-
On x-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 2.5 V



Scale :-
On x-axis,
1 Unit = 0.25 sec
On Y-axis,
1 Unit = 5 V

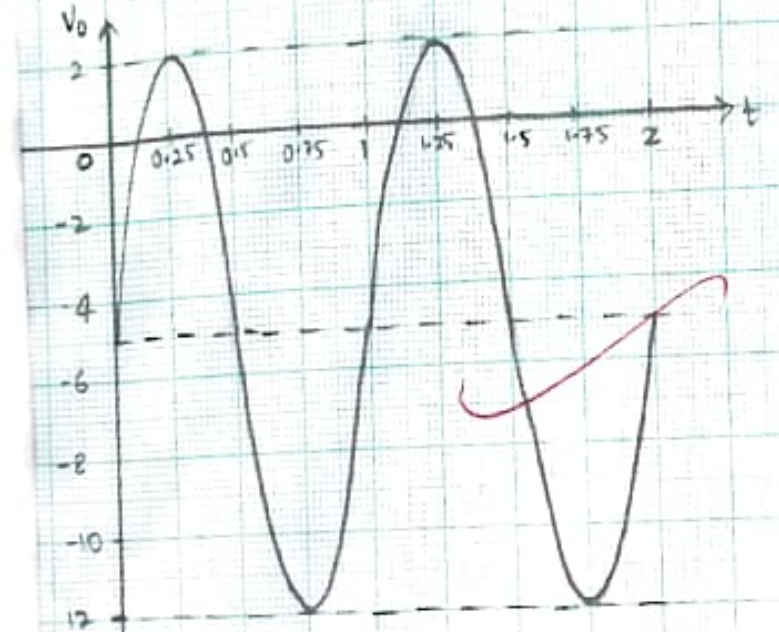
Positive Clamper with negative reference

Negative Clamper



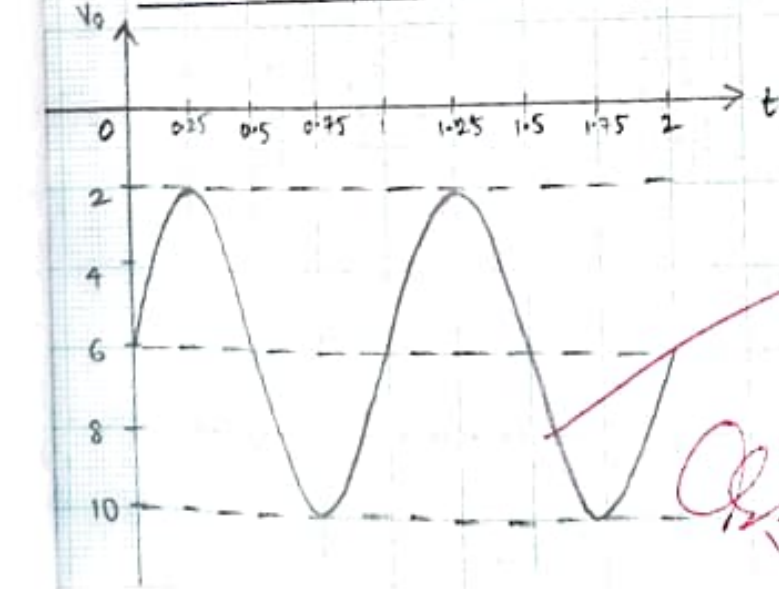
Scale:-
on x-axis,
1 unit = 0.25 sec
on y-axis,
1 unit = 3V

Negative Clamper with Positive reference



Scale:-
on x-axis,
1 unit = 0.25 sec
on y-axis,
1 unit = 2 V

Negative clamper with negative reference



Scale:-
on x-axis,
1 unit = 0.25 sec
on y-axis,
1 unit = 2V

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Characteristics of UJT

Aim :- To obtain the V-I characteristics of UJT.

Apparatus Required :-

Sl.No.	Description	Range / Number / Value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	UJT	2N2646	1
3.	DC ammeter	(0-200)mA	1
4.	DC Voltmeter	(0-20)V	2
5.	Resistor	1 KΩ	2
6.	Breadboard and connecting wires		

Theory :-

The UJT junction is a 3-terminal solid state device. The device has only one PN Junction and hence it is known as UNI-JUNCTION transistor.

When no voltage is applied between B1 and B2 with emitter open, the inter base resistance is given by $R_{BB} = R_{B1} + R_{B2}$

When a voltage V_{BB} is applied between B1 and B2 with emitter open, voltage will divide up across R_{B1} and R_{B2}.

$$V_{RB1} = \frac{R_{B1}}{R_{B1} + R_{B2}} \times V_{BB}$$

η = the Intrinsic stand-off ratio $= \frac{V_{RB1}}{V_{BB}} = \frac{R_{B1}}{R_{B1} + R_{B2}}$.

The emitter conductivity characteristics are such that as I_E increases the emitter to base (B1) voltage decreases. At peak points to V_P and the valley point V_V, the slope of the emitter characteristics is 0.

Procedure :-

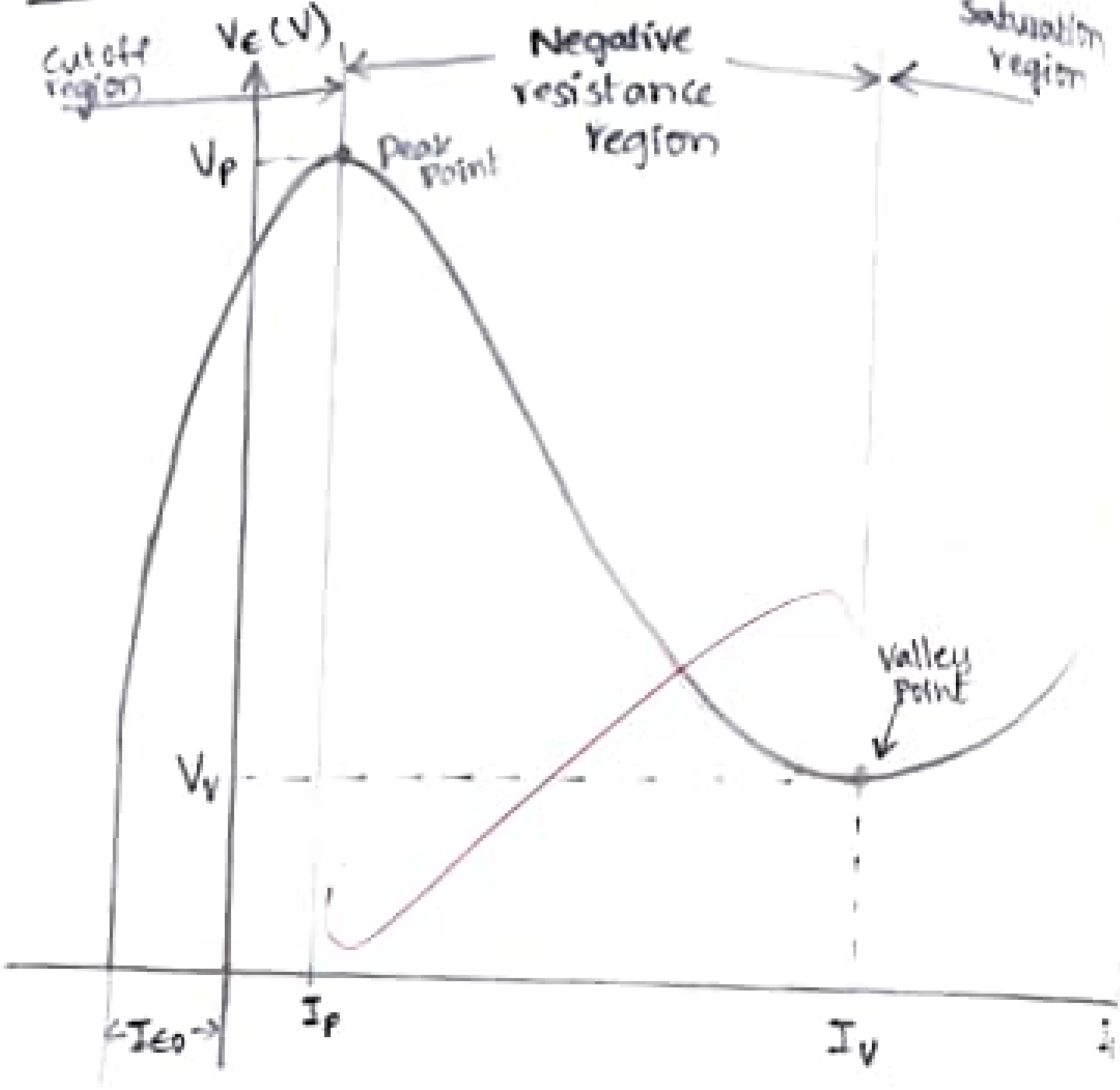
1) Connect the circuit as shown in the circuit diagram.
2) Set output voltage $V_{BB1} = 5V$ by varying V_{BB}
3) Varying V_{EE} gradually, notedown both emmitter current I_E and emitter voltage (V_E).
4) Step size is not fixed because of non-linear curve. Initially, vary V_{EE} in steps of 1V. Current I_E remains zero. As voltage is varied further, current starts increasing while voltage V_E drops. Notedown the readings V_E and I_E.
5) Repeat above procedure (step 3) for $V_{BB1} = 10V$
6) Draw the graph between V_E Vs I_E by keeping V_{BB} constant.

Result :-

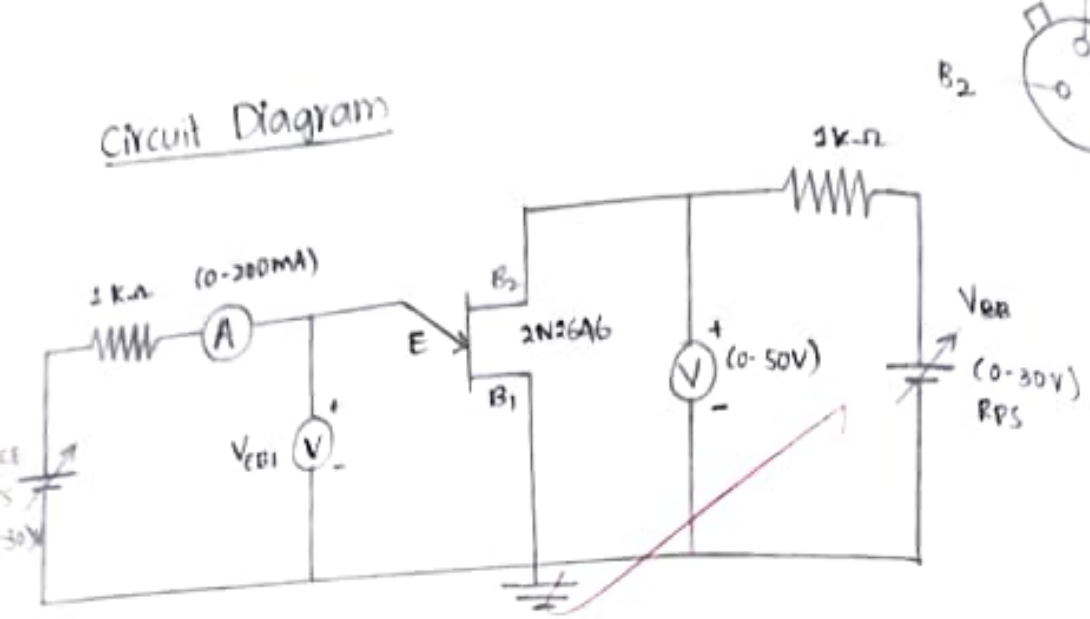
The V-I characteristics of UJT are obtained.

22/12/2014

Model Graph :-

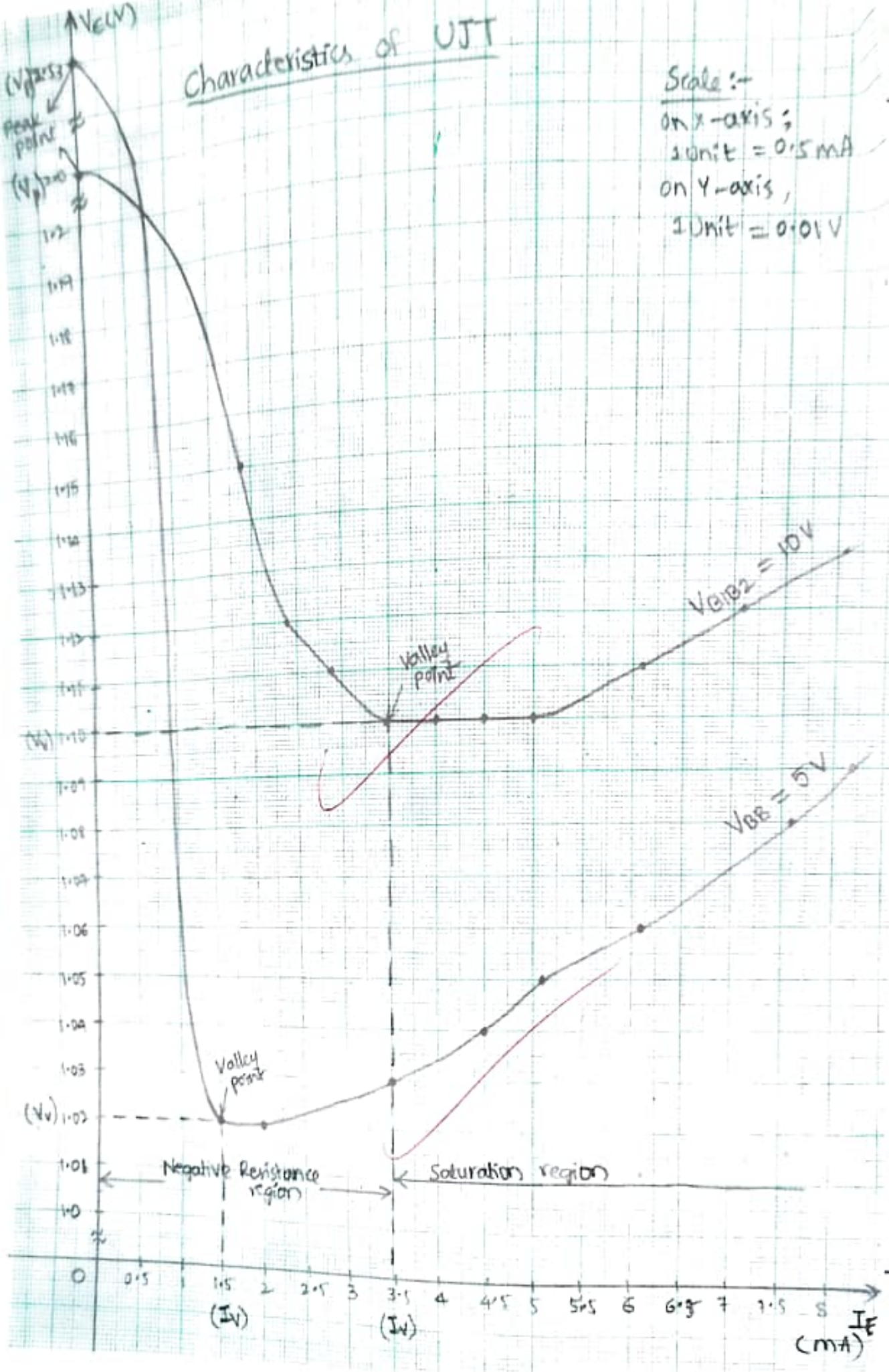

Cut off region
V_E (V)
Negative resistance region
Saturation region
V_P
Peak Point
Valley Point
V_V
I_{EO}
I_P
I_V

Circuit Diagram



Observations :-

RPS V_{EE} (V)	V_{BB_2} = 5V		V_{BB_2} = 10V	
	V_E (V)	I_E (mA)	V_E (V)	I_E (mA)
1	1·04	0	1·04	0
1·5	1·51	0	1·51	0
2	2·07	0	2·02	0
2·5	1·02	1·5	2·53	0
3	1·02	2·0	1·15	1·9
3·5	1·02	2·5	1·12	2·4
4	1·02	3·0	1·11	2·9
4·5	1·03	3·5	1·10	3·5
5	1·04	4·1	1·10	4·0
5·5	1·04	4·5	1·10	4·5
6	1·05	5·1	1·10	5·0
6·5	1·06	5·6	1·11	5·6
7	1·06	6·1	1·11	6·1
7·5	1·07	6·6	1·12	6·6
8	1·08	7·1	1·12	7·1
8·5	1·08	7·6	1·12	7·6
9	1·09	8·2	1·13	8·1
9·5	1·09	8·7	1·13	8·6
10	1·10	9·2	1·14	9·1


Characteristics of UJT
Scale :-
on X-axis ;
1 Unit = 0.5 mA
on Y-axis ,
1 Unit = 0.01 V
V_E(V)
$(V_p)_{max}$
peak point
$(V_p)_{min}$
(V_v)
Valley point
Valley point
V_{BB2} = 10V
V_{BB} = 5V
Negative Resistance region
Saturation region
(I_V)
(I_W)
I_E (mA)

Title :

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Frequency Response of CE Amplifier

Aim:- To plot the frequency response of common Emitter amplifier and calculate its Bandwidth

Apparatus Required :-

Sl.No	Description	Range / Value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	Transistor	BC107	1
3.	Resistors	1KΩ	2
4.	Resistor	100kΩ, 33kΩ, 3.3kΩ	Each 1
5.	Capacitors	10μF	3
6.	Signal Generator	(0-1 MHz)	1
7.	Dual Trace CRO	20 MHz	1
8.	Breadboard & Connecting Wires		

Theory :-

The common emitter configuration is widely used as a basic amplifier as it has both voltage and current amplification. Resistors R1 and R2 form a voltage divider across the base of the transistor.

The function of this network is to provide necessary bias condition and ensure that emitter-base junction is operating in the proper region. In order to operates transistor as an amplifier,

biasing is done in such a way that the operating point is in the active region. For an amplifier the Q-point is placed so that the loadline is bisected.

The coupling and bypass capacitors cause the fall of he signal in the low frequency response of the amplifier because heir impedance becomes large at low frequencies. The stray :apacitances are effectively open circuits.

In the mid frequencies range large capacitors are ffectively short circuits and the stray capacitors are open circuits, o that no capacitors appears in the mid frequency range. lence, the mid band frequency gain is maximum.

At the high frequencies, the bypass and coupling .apacitors are replaced by short circuits. The stray capacitors nd the transistor determine the response.

Procedure :-

Connect the circuit as shown in the circuit diagram.
Set source voltage $V_s = 50$ mV (say) at 1 KHz frequency using the function generator. Observe the phase difference input and output by giving these two signals to the dual channels of CRO.
Keeping input voltage constant, vary the frequency from 50 Hz to 1 M Hz in regular steps and note down the corresponding output voltage. Calculate gain in dB as

shown in the tabular column.

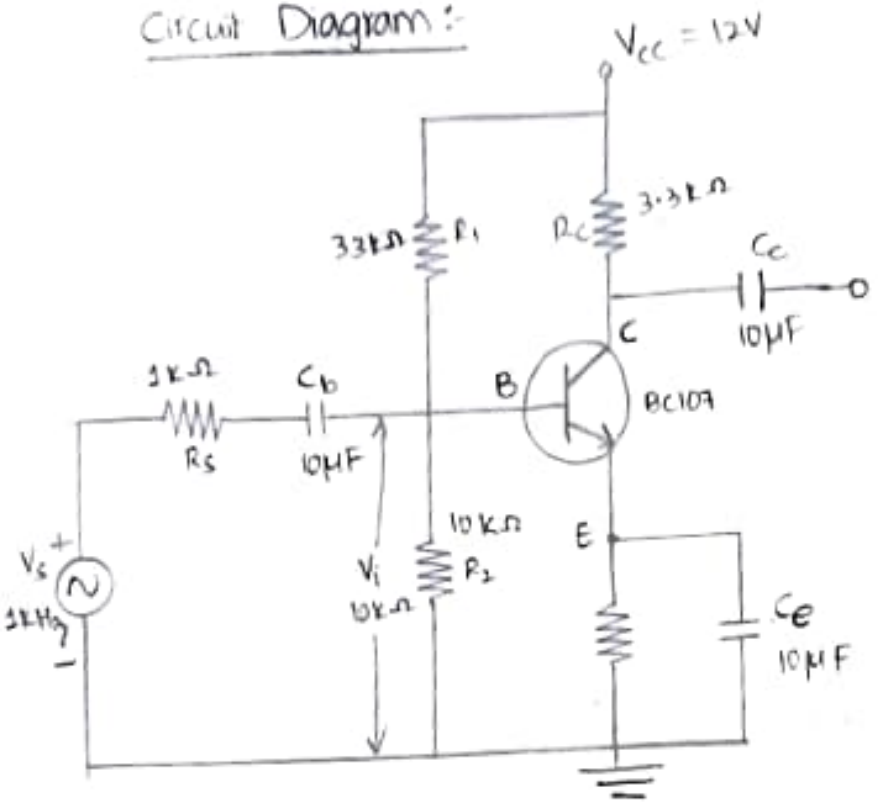
4. Plot the graph : gain (dB) versus frequency on the semilog graph sheet

5. Calculate the 3-dB bandwidth from the frequency response.

Result :-

The frequency response of common Emitter amplifier is plotted and its bandwidth is calculated.

Circuit Diagram:

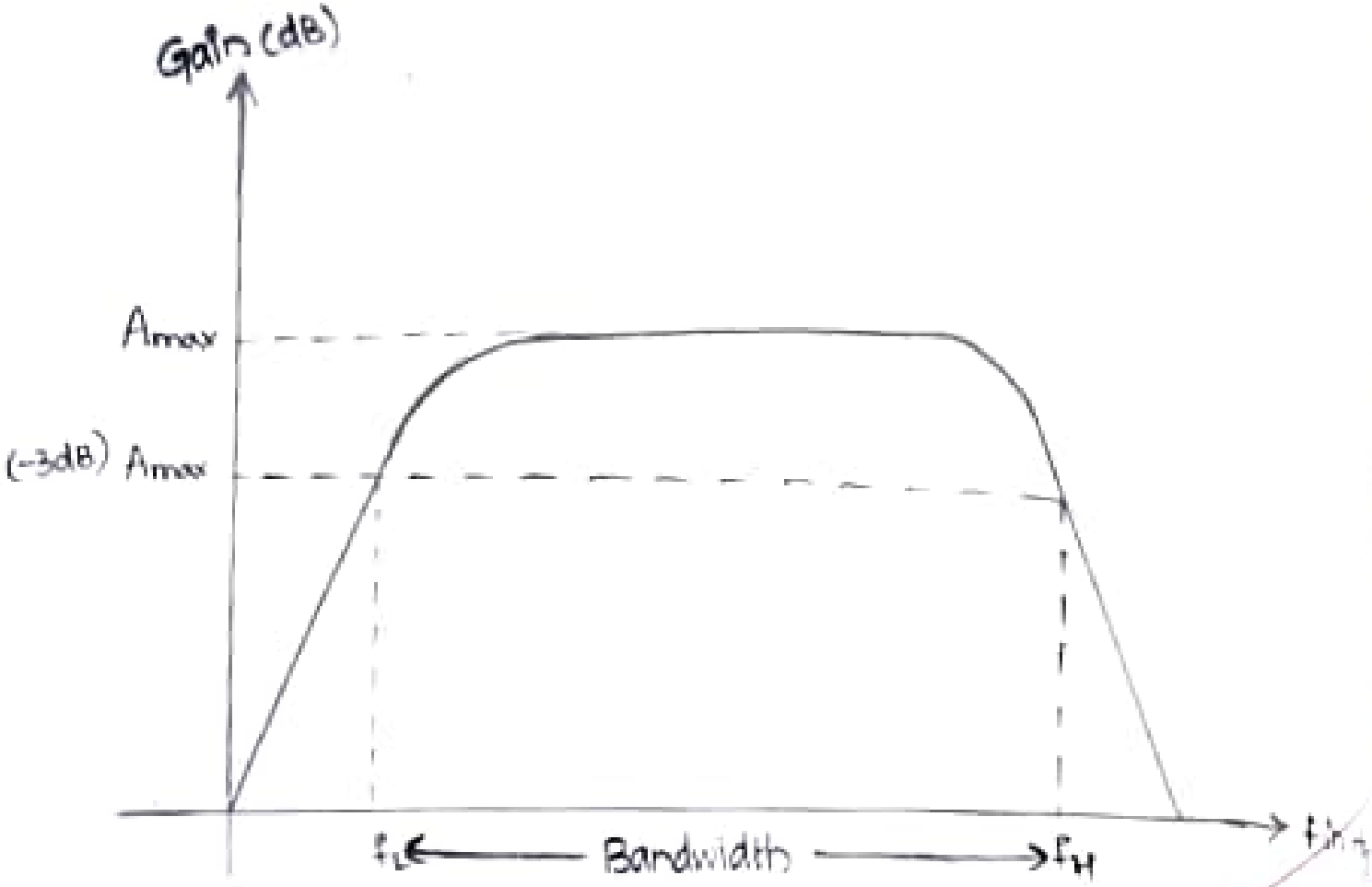


I/p Signal:
Amplitude:
50mV x 4 = 200mV

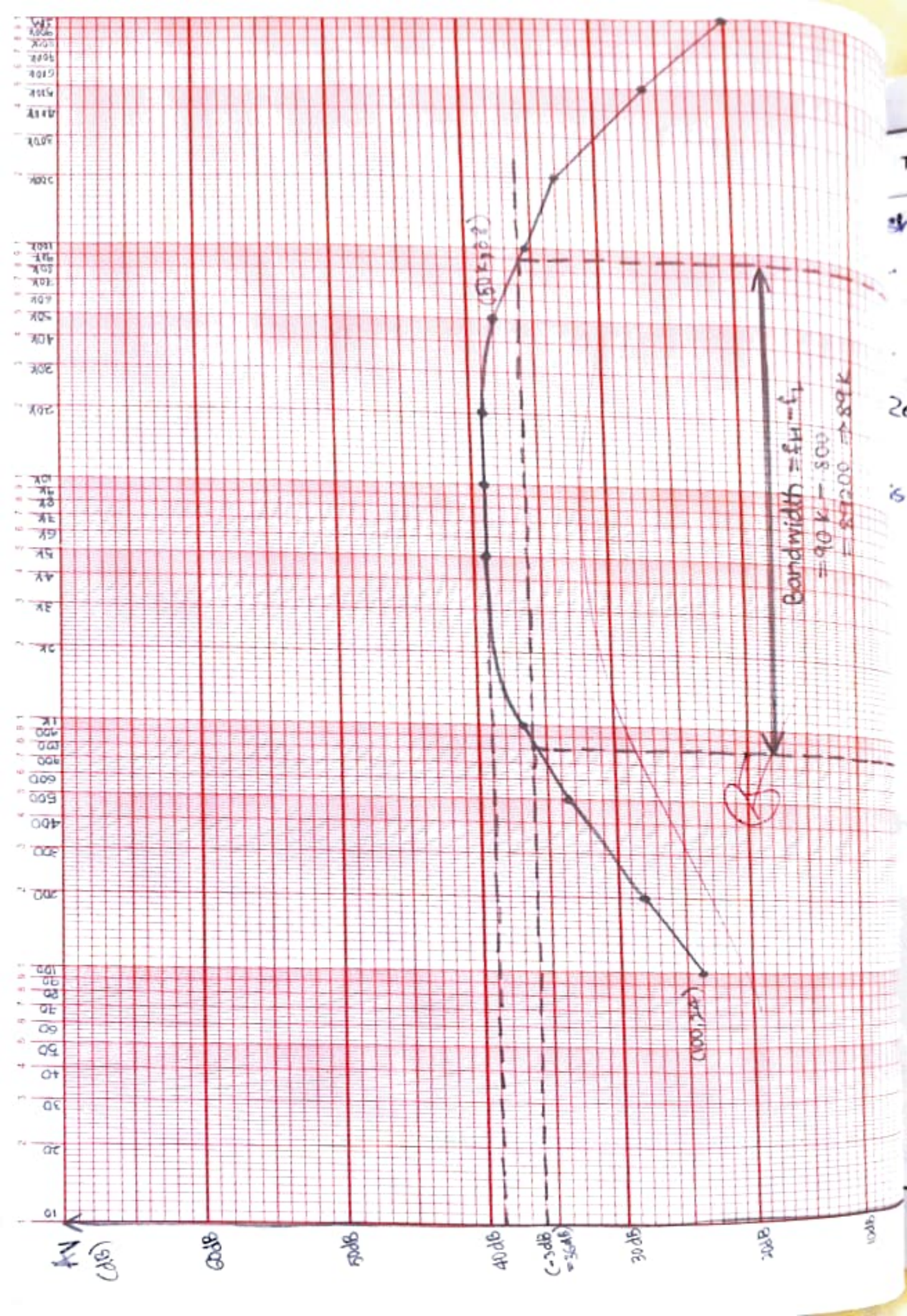
Observations: Input Voltage = 200mV.

S.No.	Frequency (Hz)	Output Voltage V_o (V)	Voltage Gain $A_V = \frac{V_o}{V_i}$ (V_i=200mV)	A_V in dB = 20 log(A_V)
1.	100	1.6 x 2 = 3.2	$\frac{3.2}{200\times10^{-3}}$ = 16	24.082
2.	200	2.6 x 2 = 5.2	26	28.299
3.	500	2x5 = 10	50	33.979
4.	1K	2.8 x 5 = 14.0	70	36.901
5.	5K	3.6 x 5 = 18	90	39.084
6.	10K	3.6 x 5 = 18	90	39.084
7.	20K	3.6 x 5 = 18	90	39.084
8.	50K	3.2 x 5 = 16	80	38.061
9	100K	2.4 x 5 = 12	60	35.563
10.	300K	1.8 x 5 = 9	45	33.064
11.	500K	0.5 x 5 = 4	20	26.020
12.	1M	0.4 x 5 = 2	10	20

Modd Graph



The difference between higher cut-off and lower frequency is referred to as bandwidth ($f_H - f_L$).


Bandwidth = $f_H - f_L$
= 90 K − 50
= 89200 ≈ 89K
(50 Hz, 60dB)
(100 KHz, 20dB)
60dB
50dB
40dB
(-3dB = 36dB)
30dB
20dB
10dB
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1K
2K
3K
4K
5K
6K
7K
8K
9K
10K
20K
30K
40K
50K
60K
70K
80K
90K
100K
150K
200K
250K
300K
350K
400K
450K
500K
550K
600K
650K
700K
750K
800K
850K
900K
950K
1000K

Title :

Date : 29/12/21

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Frequency Response of Common Source FET Amplifier

Aim :- To plot the frequency response of common source FET amplifier and calculate its Bandwidth.

Apparatus Required :-

Sl.no	Description	Range / Number / Value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	FET	BFW10/11	1
3.	Resistors	1KΩ, 2.2MΩ, 4.7KΩ, 470Ω	Each 1
4.	Capacitors	47 μF	2
5.	Capacitors	0.001 μF	1
6.	Signal Generator	(0-1 MHz)	1
7.	Dual Trace CRO	20M Hz	1
8.	Bread board and Connecting wires.		

Theory :-

OF the possible three configurations of JFET amplifiers, common source (CS) configuration is mostly used. The advantage of using CS configuration is that it has very high input Impedance.

At the mid-frequency range, there is n effect of input and output coupling capacitors. Therefore the voltage gain and phase angle are constant in this frequency range. The amplifier shown in the circuit diagram has only two RC networks that influence its low-frequency response. One network is

formed by the output coupling capacitors and the output impedance at the drain. Just as in the case of BJT amplifier, he reactance of the input coupling capacitor, reactance increases he frequency decreases. The phase angle also changes with change in frequency.

As the frequency is increased beyond mid frequency ange the internal transistor capacitance effect is predominant. or JFET's the internal capacitance is formed between gate nd source. This is also called input capacitance. The other iternal capacitance, which effects the performance is acts as a eedback circuit, which couples both input and output.

Procedure :-

- Connect the circuit as shown in the circuit diagram.
- Set source voltage V_s = 50mV (say) at 1 KHz frequency using the function generator. Observe the phase difference between input and output by giving these two signals to the dual channels of CRO.

Keeping the input voltage constant, vary the frequency from 50 Hz to 1 MHz in regular steps and note down the corresponding output voltage. Calculate gain in dB as shown in the tabular column.

- Plot the graph: gain (dB) versus frequency on a semilog graph sheet.

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5. Calculate the 3-dB bandwidth from the frequency response.

Result :- The frequency response of common source FET amplifier is plotted and its bandwidth is calculated.

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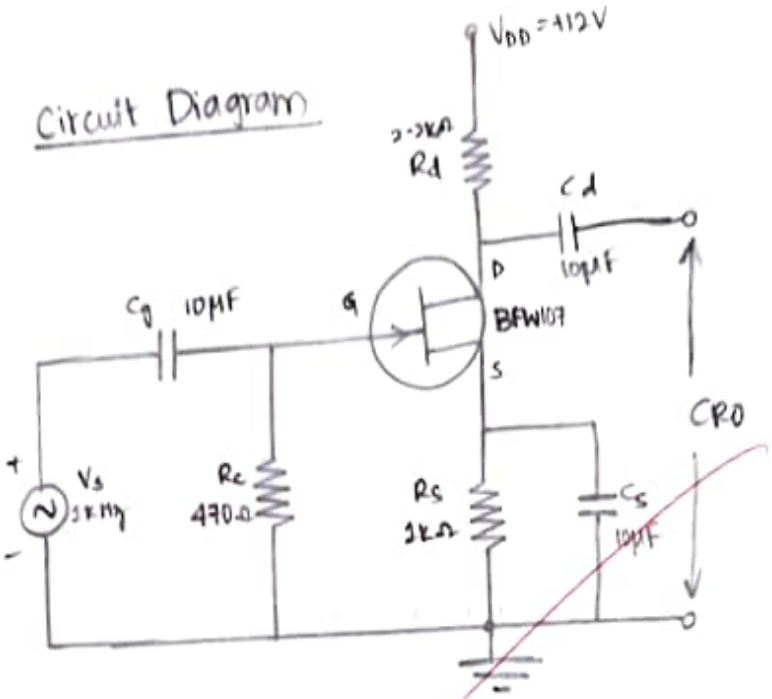
Circuit Diagram

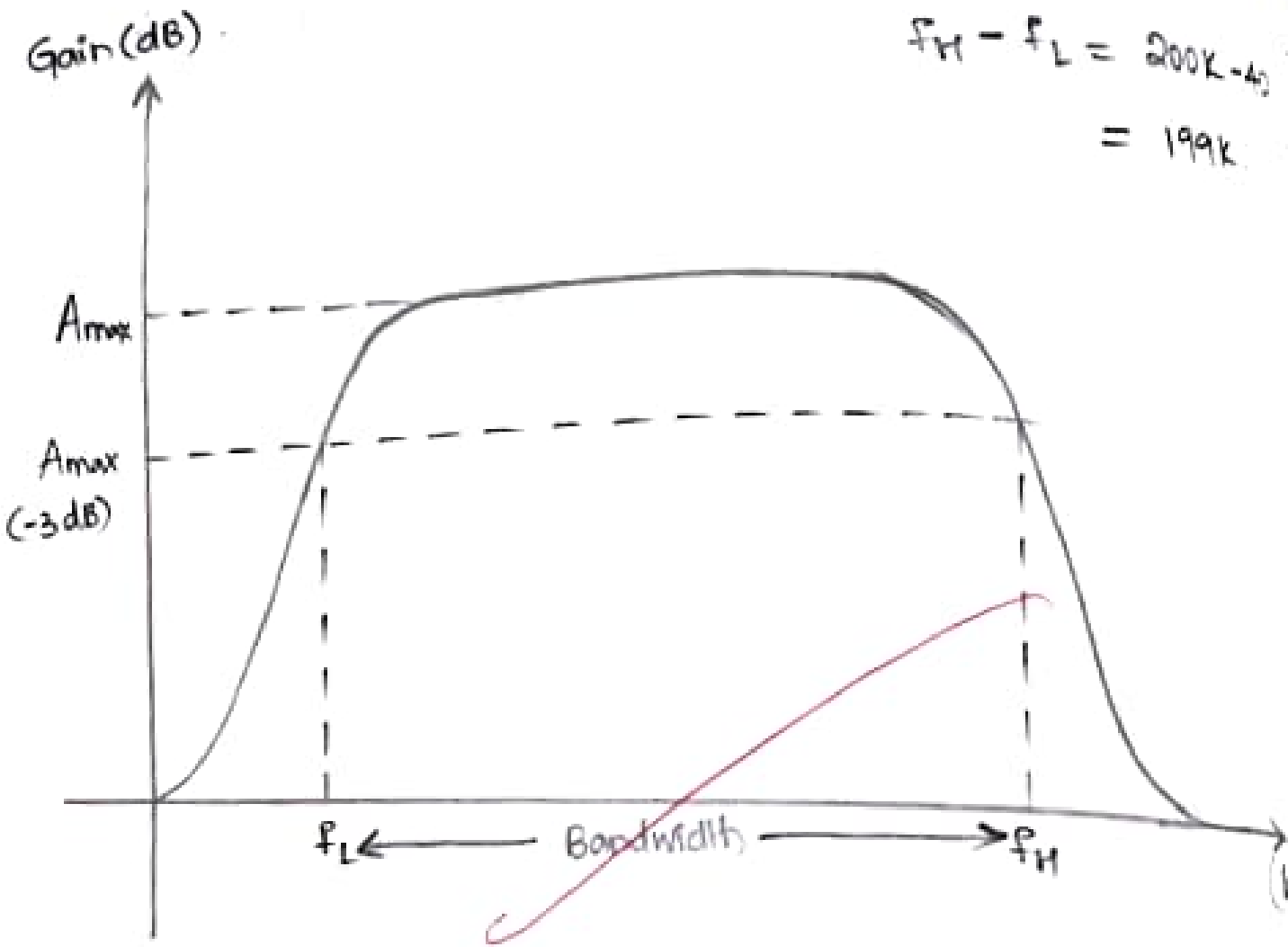


I/p Signal.
Amplitude :
50 mV × 4 = 200

Observation : Input Voltage V_i = 50 mV

Sl No.	Frequency (Hz)	Output Voltage V_o (V)	Voltage Gain $A_V = V_o/V_i$	A_V in dB $= 20 \log(A_V)$
1.	20	1.8 X 0.1 = 0.18	0.9	-0.91
2.	30	2.6 X 0.1 = 0.26	1.3	2.27
3.	50	3.4 X 0.1 = 0.34	1.7	4.60
4.	100	4 X 0.1 = 0.4	2	6.02
5.	200	4.2 X 0.1 = 0.42	2.1	6.44
6.	500	4.6 X 0.1 = 0.46	2.3	7.23
7	1K	4.6 X 0.1 = 0.46	2.3	7.23
8.	2K	4.6 X 0.1 = 0.46	2.3	7.23
9.	5K	4.6 X 0.1 = 0.46	2.3	7.23
10.	10K	4.4 X 0.1 = 0.44	2.2	6.84
11.	20K	4.2 X 0.1 = 0.42	2.1	6.44
12.	50K	4 X 0.1 = 0.4	2	6.02
13.	100K	3.8 X 0.1 = 0.38	1.9	5.57
14.	200K	3.6 X 0.1 = 0.36	1.8	5.10
15	500K	2.6 X 0.1 = 0.26	1.3	2.27
16.	1M	1.4 X 0.1 = 0.14	0.7	-3.09

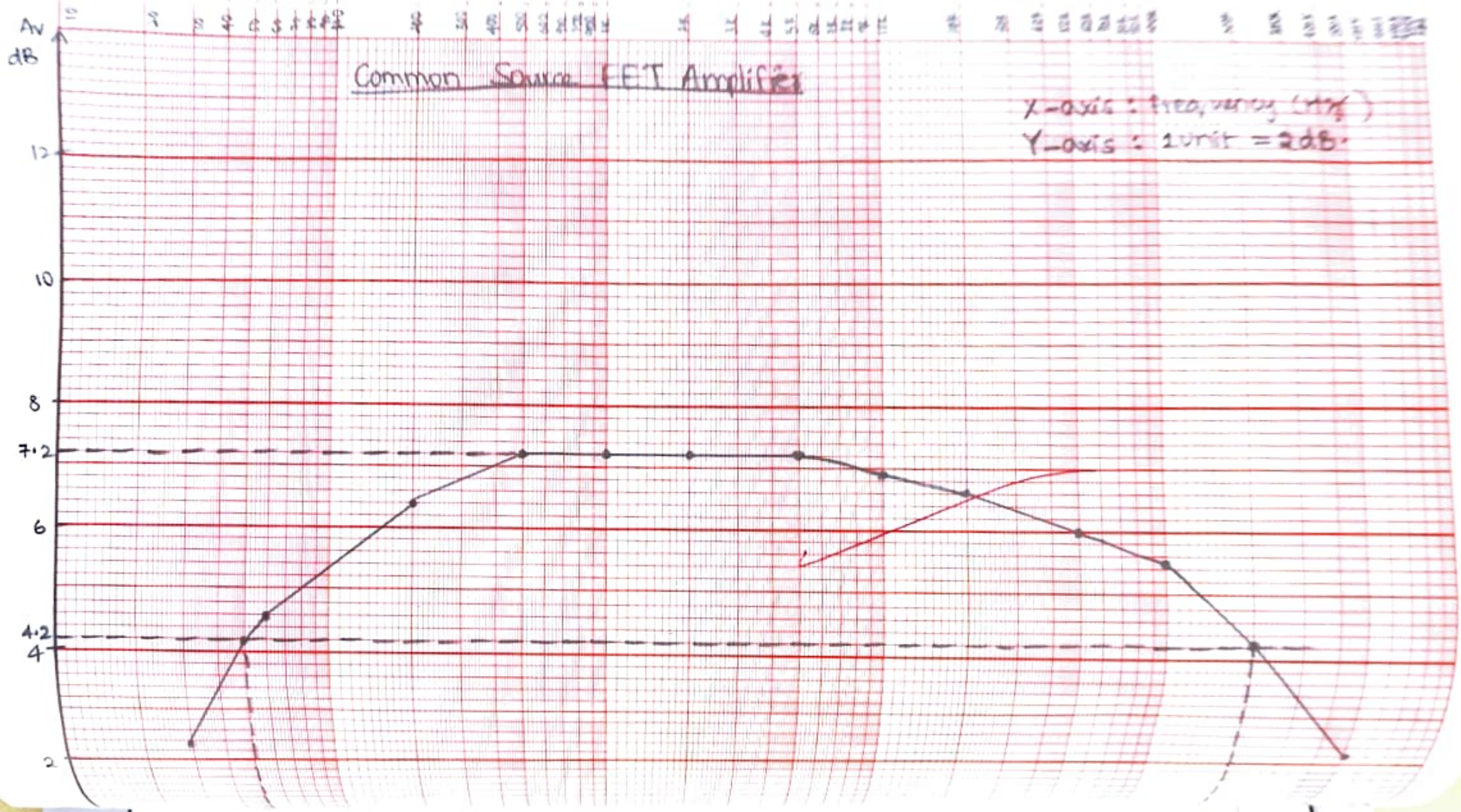
Model Graph:



$f_H - f_L = 200K - 1$

$= 199k$

The difference between higher cut-off and lower cut-off frequency is refered to as bandwidth $(f_H - f_L)$


Common Source FET Amplifier
X-axis : frequency (Hz)
Y-axis : 1 unit = 2dB.
Av
dB
12
10
8
7.2
6
4.2
4
2

Characteristics of FET

Aim:- To plot the drain and transfer characteristics of a FET (Field Effect Transistor). Also calculate its drain resistance (r_d), transconductance (g_m), and amplification factor (μ)

Apparatus Required :-

Sl.No	Description	Range / Value	Quantity
1.	Regulated Power Supply	(0-30)V	1
2.	JFET	BFW10	1
3.	DC Ammeter	(0-200)mA	1
4.	DC voltmeter	(0-20)V	2
5.	Resistor	100Ω , 560Ω	1 of each
6.	Breadboard and Connecting wires		

Theory :-

The FET is a unipolar transistor and voltage controlled device. It has three terminals gate, source and drain.

A FET can be either a JFET or MOSFET. Again a JFET can either have N-channel or P-channel. The gate is given a negative bias with respect to the source. The drain is given a positive potential with respect to source.

The drain current I_D is controlled by electric field

that extends into the channel due to reverse biased voltage applied to the gate. The drain current depends on the drain voltage V_{DS} and gate source voltage V_{GS}. Any of these variables may be fixed and the relation between the other two are determined when $V_{DS} = V_p$, I_D becomes maximum. when V_{DS} ↑ beyond V_p, the length of pinch off region increases.

Procedure :-

A) Drain Characteristics:

1. All the connections are made as per the circuit diagram.
2. To plot the drain characteristics, keep V_{GS} as constant at 0V.
3. Vary the V_{DD} and observe the values of V_{DS} & I_D.
4. Repeat the above steps 2,3 for different values of V_{GS} at -1V and -2V.
5. All the readings are tabulated.
6. Draw the graph V_{DS} (Vs) I_D against V_{GS} as parameter on graph.
7. From the above graph calculate r_d and notedown the corresponding diode current against the voltage in the tabular form.

B) Transfer Characteristics:

1. To plot the transfer characteristics, keep V_{DS} as constant at 2V.
2. Vary V_{GG} and observe the values of V_{GS} & I_D.

3. Repeat steps 2 and 3 for different values of V_{DS} at 4V & 6V.
4. The readings are tabulated.
5. Draw graph between V_{GS} (Vs) I_D with V_{DS} as parameter.
6. From the graph find g_m.
7. Now, $\mu = g_m \times r_d$.

Calculation of r_d :-

Construct a triangle on one of the drain characteristics for a particular V_{GS} in the active region and find ΔV_{DS} & ΔI_D.

$$r_d = \frac{\Delta V_{DS}}{\Delta I_D}\Big|_{V_{GS} = \text{constant}}$$

Calculation of g_m :-

Construct the triangle on one of the transfer characteristics for a particular V_{DS}, find ΔV_{GS} and ΔI_D.

$$g_m = \frac{\Delta I_D}{\Delta V_{GS}}\Big|_{V_{DS} = \text{constant}}$$

Calculation of μ :-

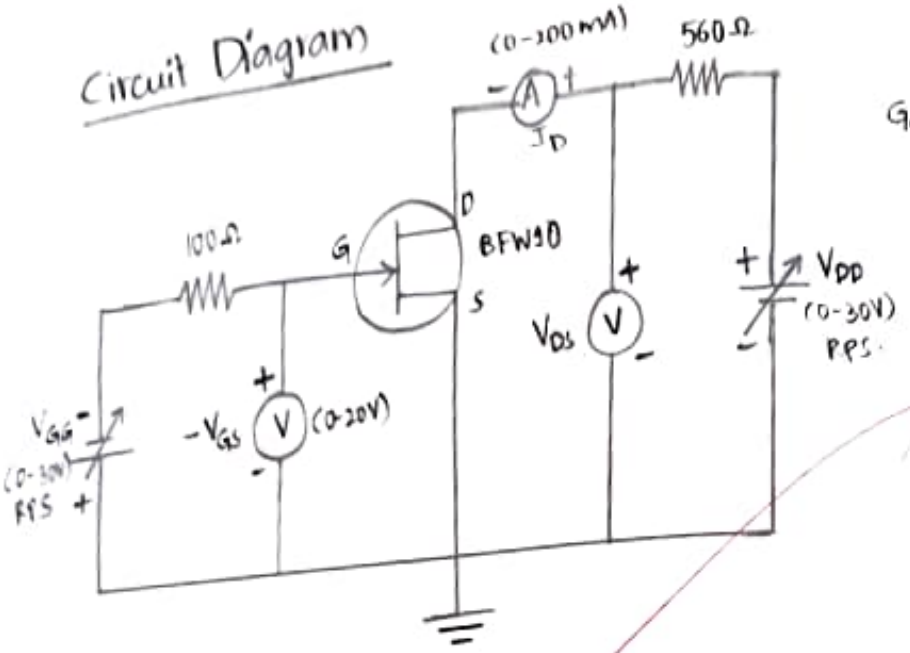
$$\mu = g_m \times r_d$$

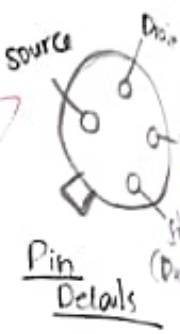
Result :- The drain and transfer characteristics of a Field Effect transistor (FET) are plotted on graph & drain resistance (r_d), transconductance (g_m), and amplification factor (μ) are calculated.

$r_d = 755\Omega$; $g_m = 2.27 \times 10^{-3}$ ℧ ; $\mu = 1.71$.

7/1/2022

Circuit Diagram





Pin Details

Observations :- A) Drain Characteristics

S.NO	RPS	V_{GS} = 0V		V_{GS} = 2V	
	V_{DD}(V)	V_{DS}(V)	I_D(mA)	V_{DS}(V)	I_D(mA)
1.	0.5	0.15	0.6	0.35	0.3
2.	0.7	0.2	0.9	0.49	0.3
3.	1.0	0.29	1.2	0.75	0.4
4.	1.5	0.45	1.8	1.18	0.4
5.	1.8	0.54	2.2	1.44	0.4
6.	2.0	0.61	2.4	1.66	0.4
7.	2.2	0.7	2.7	1.9	0.4
8.	2.5	0.78	2.9	2.16	0.4
9.	2.7	0.88	3.2	2.28	0.4
10.	3.0	1.00	3.4	2.63	0.4
11.	3.5	1.22	4.0	3.08	0.4
12.	3.7	1.33	4.1	3.22	0.4
13.	4.0	1.47	4.3	3.59	0.5
14.	4.5	1.97	4.47	3.99	0.5
15.	5.0	2.12	4.49	4.48	0.5
16.	5.5	2.49	5.1	4.97	0.5
17.	6.0	2.89	5.2	5.48	0.5

B) Transfer Characteristics :

S.NO	RPS V_{GG}(V)	V_{DS} = 2V	
		V_{GS} (V)	I_D (mA)
1.	0.5	-0.53	3.4
2.	0.7	-0.77	3.1
3.	1.0	-1.03	2.5
4.	1.2	-1.25	2.0
5.	1.4	-1.49	1.5
6.	1.6	-1.63	1.1
7	1.8	-1.84	0.7
8.	2.0	-2.09	0.3
9.	2.2	-2.30	0.2
10.	2.3	-2.34	0.1
11	2.4	-2.53	0

$$r_d = \frac{\Delta V_{DS}}{\Delta I_D} = \frac{(2.12 - 0.61)}{(4.5 - 2.5)\,10^{-3}} = 755\ \Omega$$

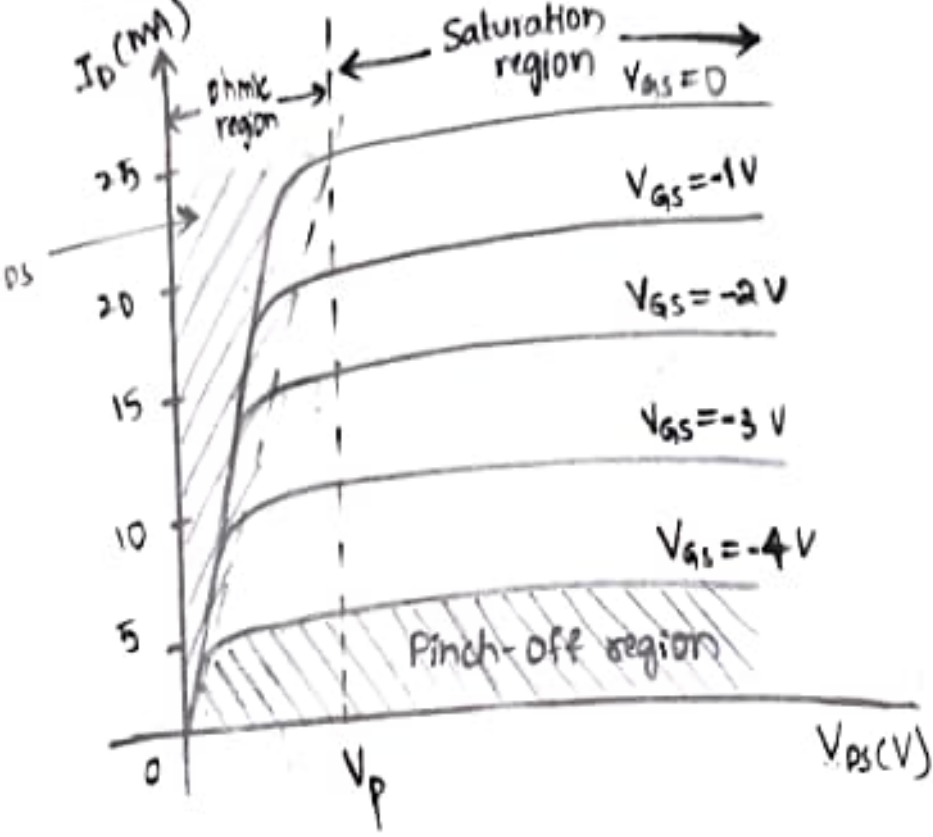
$$g_m = \frac{\Delta I_d}{\Delta V_{GS}} = \frac{(2.5 - 2)\,10^{-3}}{-1.03 + 1.25} = 2.27 \times 10^{-3}\ \mho$$

$$\mu = r_d \cdot g_m = 755 \times 2.27 \times 10^{-3}$$

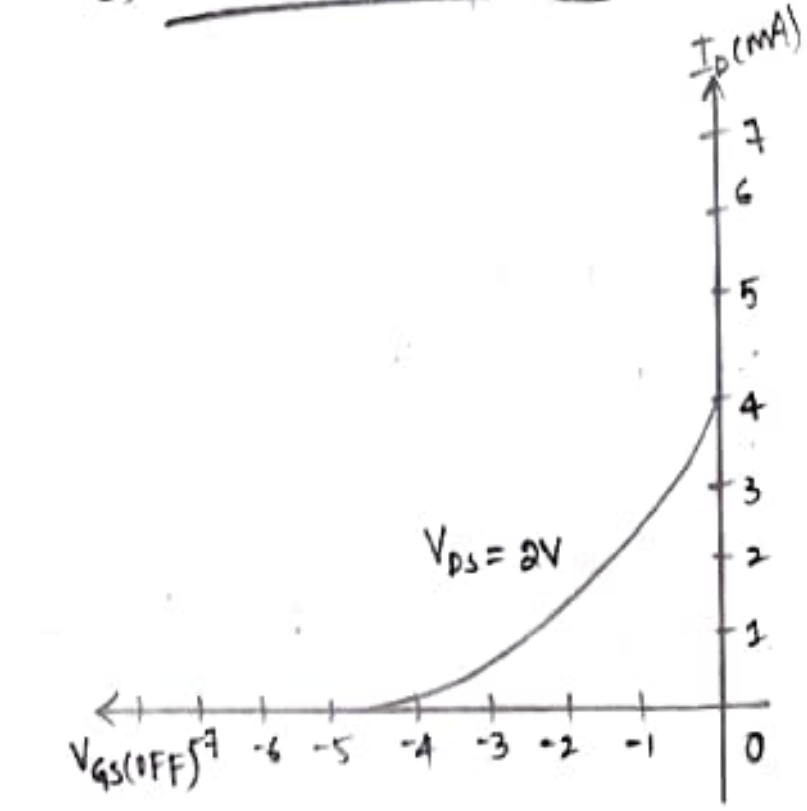
$$\mu = 1.71$$

Model Graph:

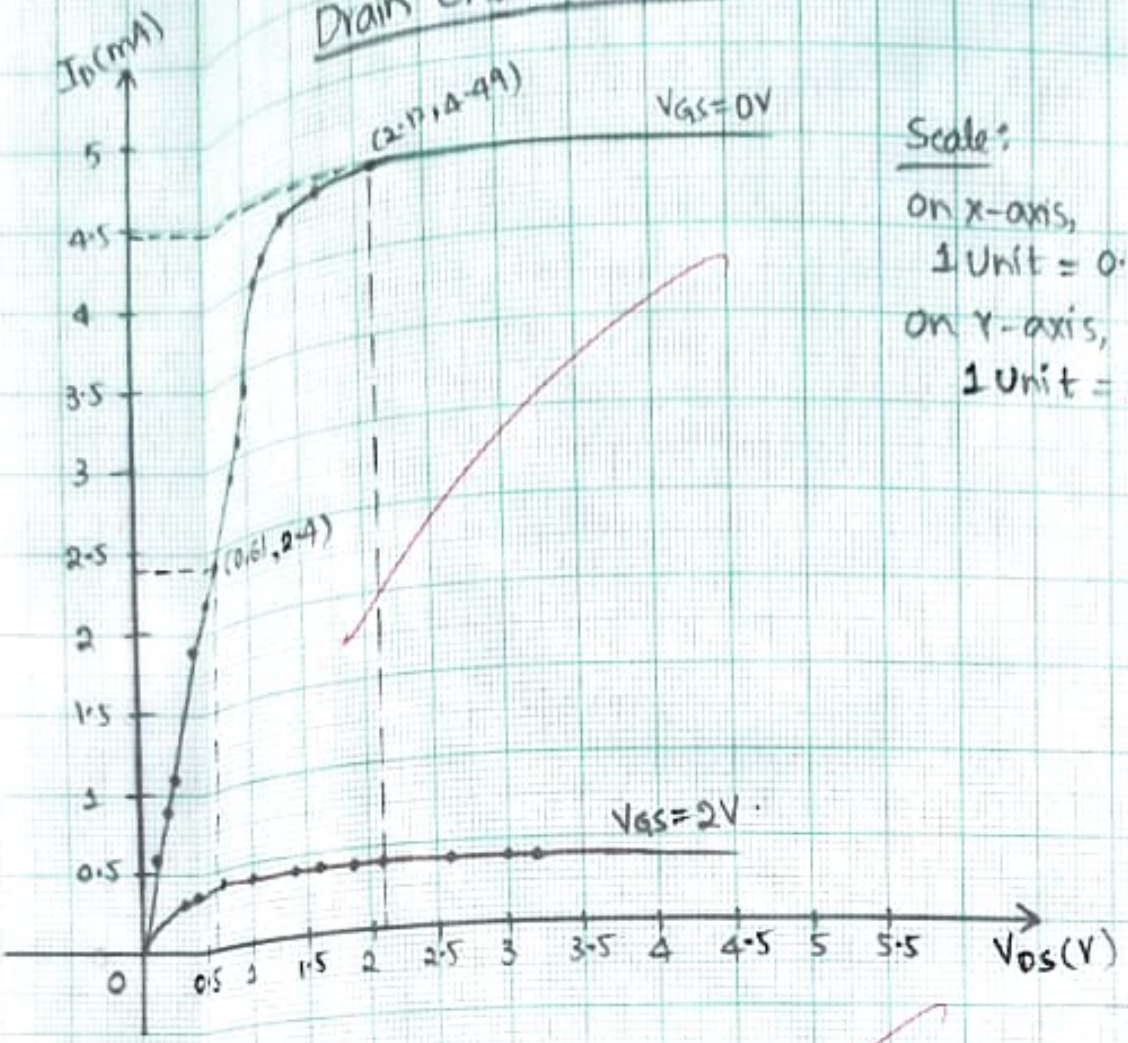
A) Input Characteristics:



B) Transfer Characteristics:



Drain Characteristics

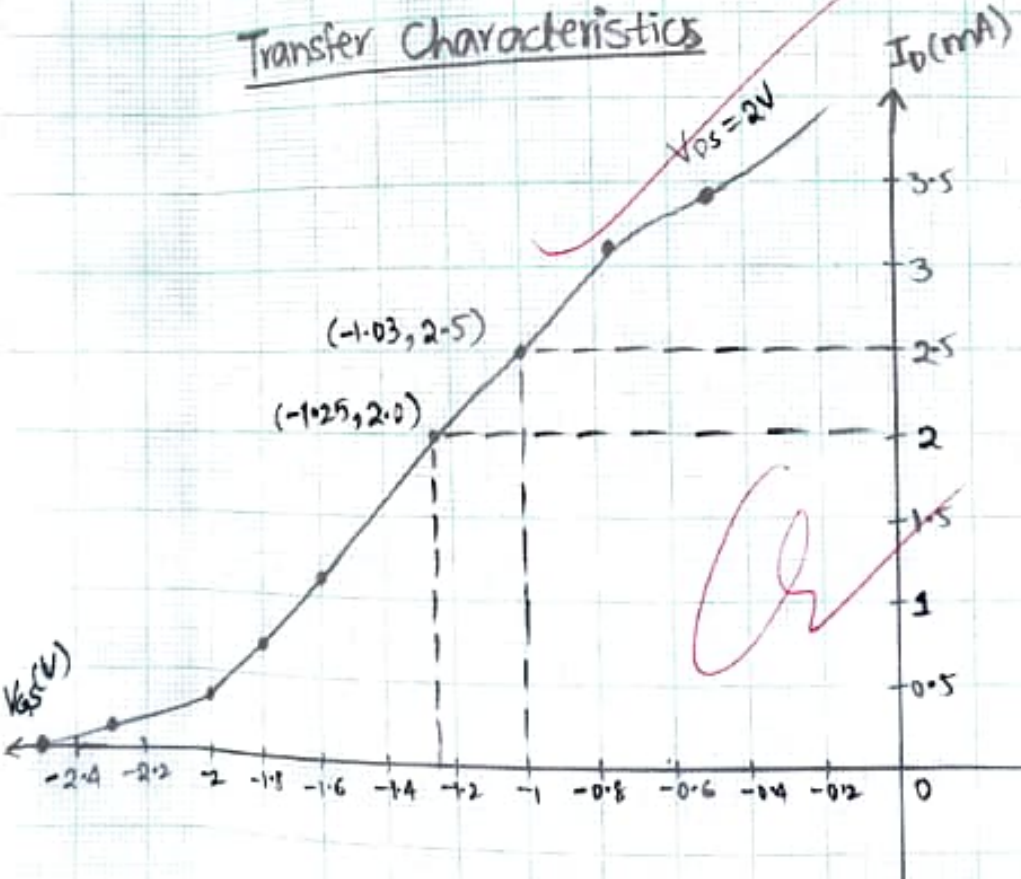


Scale:

On x-axis,
1 Unit = 0.5 V

On Y-axis,
1 Unit = 0.5 mA

Transfer Characteristics



Scale:-

On x-axis,
1 Unit = 0.2V

On Y-axis,
1 Unit = 0.5m