Experiment - 1

Aim - Study of various measurement equipment listed below.

a) To find the amplitude and frequency using CRO
b) Study of multimeter.
c) Bread Board
d) Signal Generator
e) DC voltage Source

Components and Equipment's Required -
Cathode Rays, Oscilloscope (CRO), Signal Generator, resistance, capacitors, multimeter, bread board, CRO probes, testing probes and DC voltage source

Theory -
The block diagram shown in Fig. 1, explain how an oscilloscope works. Like a television screen, the screen of an oscilloscope consists of a Cathode Ray Tube (CRT) which is also called the heart of CRO. Although the size and shape are different, the operating principle is the same. Inside the tube is a vacuum. The electron beam emitted by the heated cathode at the rear end of the tube is accelerated and focused by one or more anodes, and strikes the front of the tube, producing a bright spot on the phosphorescent screen.
The electron beam is bent, or deflected, by voltages applied to two sets of plates fixed in the tube. The horizontal deflection plates or

X plates produce side to side movement. As you can see, they are linked to a system block called the time base. This produces a saw tooth waveform. During the rising phase of the saw tooth, the spot is driven at a uniform rate from left to right across the front of the screen. During the falling phase, the electron beam returns rapidly from right to left, but the spot is 'blanked out' so that nothing appears on the screen. In this way, the time base generates the X-axis of the V/t graph. The slope of the rising phase varies with the frequency of the saw tooth and can be adjusted, using the TIME/DIV control, to change the scale of the X-axis. Dividing the oscilloscope screen into squares allows the horizontal scale to be expressed in seconds, milliseconds or microseconds per division (s/DIV, ms/DIV, μs/DIV). The signal to be displayed is connected to the input. The AC/DC switch is usually kept in the DC position (switch closed) so that there is a direct connection to the Y-amplifier. In the AC position (switch open) a capacitor is placed in the signal path. The capacitor blocks DC signal but allows AC signals to pass. ~~The Y-amplifier is linked in turn to a pair of Y plates so that it provides the Y-axis of~~ the Y amplifier is linked in turn to a pair of Y-plates so that it provides the Y-axis of the V, graph.

The overall gain of the Y amplifier can be adjusted, using the VOLTS/DIV control, so that the resulting display is neither too small nor too ~~big~~ large, but fits the screen and can be seen clearly. The vertical scale is usually given in V/DIV or m/DIV. The trigger circuit is used to delay the time base waveform so that the same section of the input signal is

displayed on the screen each time the spot moves across. The effect of this is to give a stable picture on the oscilloscope screen, making it easier to measure and interpret the signal.
changing the scales of the X-axis and Y-axis allows many different signals to be displayed. Sometimes, it is also useful to be able to change the position of the axes. This is possible using the X-POS and Y-POS controls. For example, with no signal applied, the normal trace is a straight line across the centre of the screen. Adjusting Y-POS allows the zero level on the Y-axis to be changed, moving the whole trace up or down on the screen to give an effective display of signals like pulse waveforms which do not alternate between positive and negative

Formula used

$$V(p-p) = X^{*}Y$$

$$Vm = V(p-p)/2.$$

$$T = X^{*}Y$$

$$F = 1/T$$

Theory
Cathode Ray Oscilloscope (CRO)
It consist of a cathode ray tube (CRT) which is also called the size and shape are different, the operating principle is the same. Inside the tube is vaccum. The electron beam emitted by the heated cathode at the rear end of the tube is accelerated

and focused by one or more anode and strikes the front of the ~~plate~~ tube, producing the bright spot on the phosphorescent screen.

Multimeter

A multimeter is an instrument that allows us to make multiple electrical measurements using the same tool. We can use it as a voltmeter to measure voltage, as an ammeter to measure current, as an ohm meter to measure resistance. There are two types of multimeter.

(i) Digital multimeter

They are superior to analouge multimeter because of there better accuracy in measurements, sensitivity to very small changes in input voltage and clear and easy to read displays.

(ii) Analog multimeter

Since Digital multimeter need a Power supply. such as batteries also because they digitalise the analog signals, multimeter can add noise. In addition, digital multimeters are ~~are~~ not the best when it comes to testing semi conductor electronic parts.

Bread Board

A thin plastic board use to hold electronic components that are wired together used to develop prototype of electronic circuits wired together used to develop prototypes of electronic circuits, bread board can be used for failure jobs They can be used to create one of a land system but rarely become commercial products.

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Signal Generator.

Signal generator also called as a function generator useful in generating different types of wave form size wave, rectangular wave.

DC source or power supply

The power supply has an electrically floating output. This permits easy series or parallel connection with other power supply units to decrease supply voltage or current respectively. Basically, the power supply is constituted by rectifier, filters and basically the power supply is constitude by supply.

Observation Table

S.No	No. of vertical division (x)	Voltage / Division (Y)	$V_{(p-p)} = X*Y$ in (volt)	$V_m = V_{p-p}/2$ in (volt)
1	3	2	6	3
2	4	2	8	4
3	6	2	12	6
4	2	2	4	2.

S.No.	No. of horizontal Division (x)	Voltage / Division (Y)	$T = X * Y$ millisec.	$F = 1/T$ (KHz)
1	4	0.5	2	0.5
2	1	0.5	0.5	2
3	2	0.5	1	1
4	5	0.5	2.5	0.4

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S.No.	Resistance	Theoretical Value	Practical Value
1	R_1	$10 \times 10^3 \pm 5\%$	9.98×10^3
2	R_2	$10 \times 10^1 \pm 5\%$	9.99×10^1
3	R_3	$10 \pm 5\%$	9.97
4	R_4	$10 \times 10^2 \pm 5\%$	9.9×10^2

Verified

Verified

Conclusion

These measurement equipments are highly useful and have their specific uses which are used commonly in electronics. The study of multimeter breadboard, function generator and power supply is completed.

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Experiment -2

Aim -
Verification of ohm's law, kirchoff's current law and voltage law.

Apparatus Required :-
Ohm's law, Kirchoff's law (Voltage and Current) are essential in the analysis of linear circuit. Kirchoff's law deal with the voltage and current in the circuit. Ohm's law relates voltage, current and resistances to one another. These three laws apply to resistive circuits.

1. Ohm's Law :-
Ohm's Law is used to relate voltage to current and resistance. It states that voltage is directly proportional to current and resistance. This is stand mathematically

$$V = IR$$

V = Voltage in the current
I = current
R = Resistance

2. Kirchoff's Law :-
Kirchoff's Law Voltage (KVL) states that the sum of all voltage in a closed Loop must be zero.

$$V_1 + V_2 - V_3 = 0$$

The equation holds true only if the passive sign convention is satisfied. In the case of KVL the passive sign convention states that when a positive node is connected while following a loop the voltage across the element is positive.

3. Kirchoff's Current Law's:-

Kirchoff's Current Law (KCL) deals with the current floating into and out of a given node must equal to zero. KCL the passive sign convention deals with the direction of currents with respect the node. Current entering the node must have opposite signs as those exiting the node. The passive sign convention with respect to KVL can also be applied to KCL.

4. Circuit Current Analysis:-

The current voltages and polarities were labelled as given schematic, the current direction and voltage polarities have been assigned such that the passive sign convention has been satisfied wherever possible.

Observation

KVL and KCL circuits are analyzed and the values of different parameter are mentioned.

Voltage (V)	Resistance R (KΩ)	$I = V/R$
5V	1KΩ	$I = \frac{5V}{1K\Omega} = 5mA$

Voltage of resistor when measured with multimeter = 5V

V_{R_1}	V_{R_2}	$I_1 = \frac{V}{R_{eq}}$	$I_2 = \frac{V_{R_1}}{R_1}$	$I_3 = \frac{V_{R_3}}{R_3}$	$I_2 + I_3$
5.1	5.1	10.2 ?	5.1	5.1 ?	10.2 ?

$\therefore I_1 \approx I_2 + I_3$

V_s	V_{R_1}	V_{R_2} (V)	$V_s = V_{R_1} + V_{R_2}$ (V)	Unit ?
5V	+2.56	2.54	5.1	

$V_s \approx V_{R_1} + V_{R_2}$

Calculation

1) $I = \frac{V}{R} = \frac{5V}{1K\Omega} = 5mA$

2) $R_1 = R_2 = 1K\Omega$

$R_{eq} = \frac{1 \times 1}{1+1} = \frac{1}{2} = 0.5\ K\Omega$

$I_1 = \frac{V}{R_{eq}} = \frac{5}{0.5} = 10\ mA$

$I_2 = \frac{V_{R_1}}{R_1} = \frac{5.1}{1K\Omega} = 5.1\ mA.$

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$$I_3 = \frac{V_{R2}}{R_2} = \frac{5.1}{1k\Omega} = 5.1\,mA$$

$I_2 + I_3 = 10.2\,mA \approx I_1$ $\qquad$ $I_3 = 5.1\,mA$

$$I_1 = I_2 + I_3$$

3) R_1 $1k\Omega$, $R_2 = 1k\Omega$

$$R_{eq} = \frac{1\times 1}{1+1} = \frac{1}{2} = 0.5\,k\Omega$$

$V_s = 5\,V$

$V_1 = 2.56\,V$; $\quad V_2 = 2.54\,V$

Clearly, $V_s = V_1 + V_2$.

Result

06 The calculated and measured values match ohm's law, Kirchoff's current law and Kirchoff's voltage law have been verified successfully.

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Experiment - 3

Aim: To study and verification of Thevenin's Theorem.

Apparatus Required: Bread-board, Multi-meter, Resistance, Voltage/ Current source, Connecting wires, etc.

Theory:

(a) Thevenin's Theorem: It states that "Any linear circuit containing several voltages and resistance can be replaced by just one single voltage in series with a single resistance connected across the load". In other words, it is possible to simplify any electrical circuit, no matter how complex, to an equivalent two-terminal circuit with just a single constant voltage source in series with a resistance (or impedance) connected to a load as shown below.

Simple steps to analyse electronic circuit given in Fig. through Thevenin's Theorem.

1. Open the load resistor
2. Calculate / measure the open circuit voltage. This is the Thevenin's voltage (V_{th})
3. Open current source and short the voltage sources.
4. Calculate / measure the open circuit resistance. This is the Thevenin's resistance (R_{th})
5. Now, Redraw the circuit with measured open circuit voltage (V_{th}) in step (2) as voltage source and measured the open

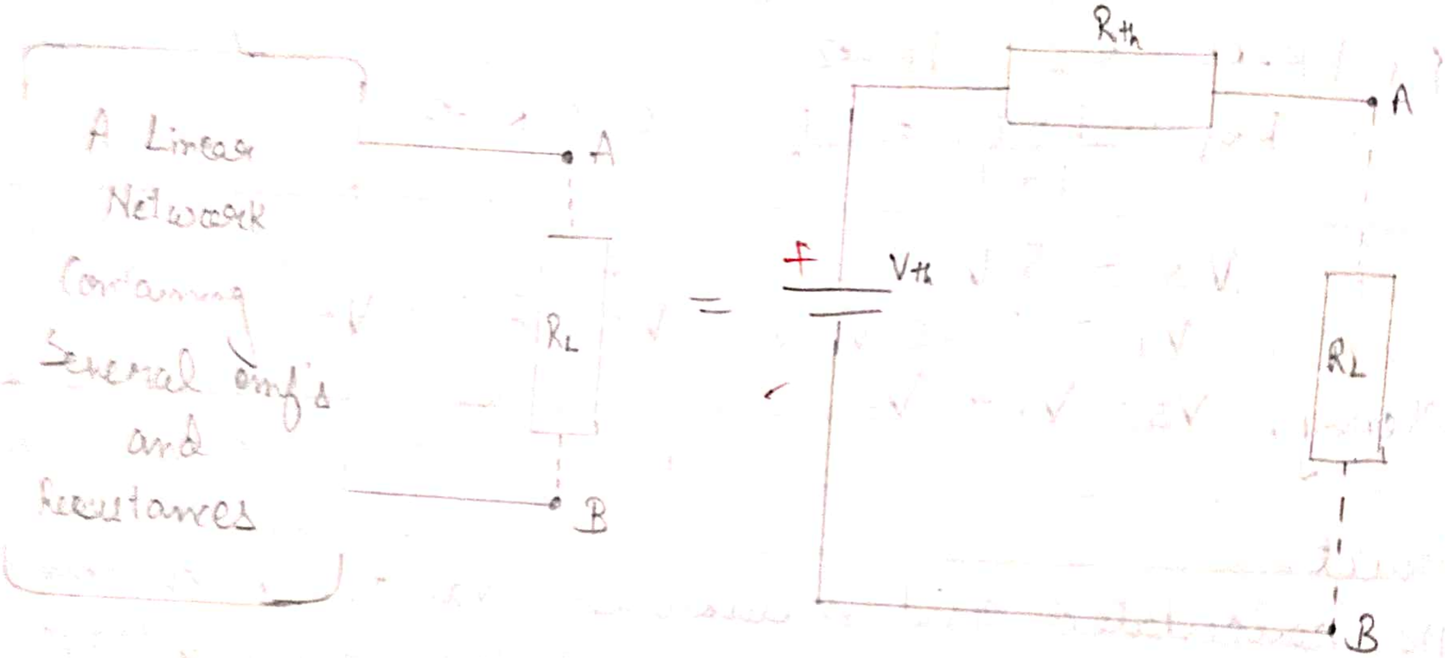

Fig. 3.1 Thevenin's Equivalent Circuit

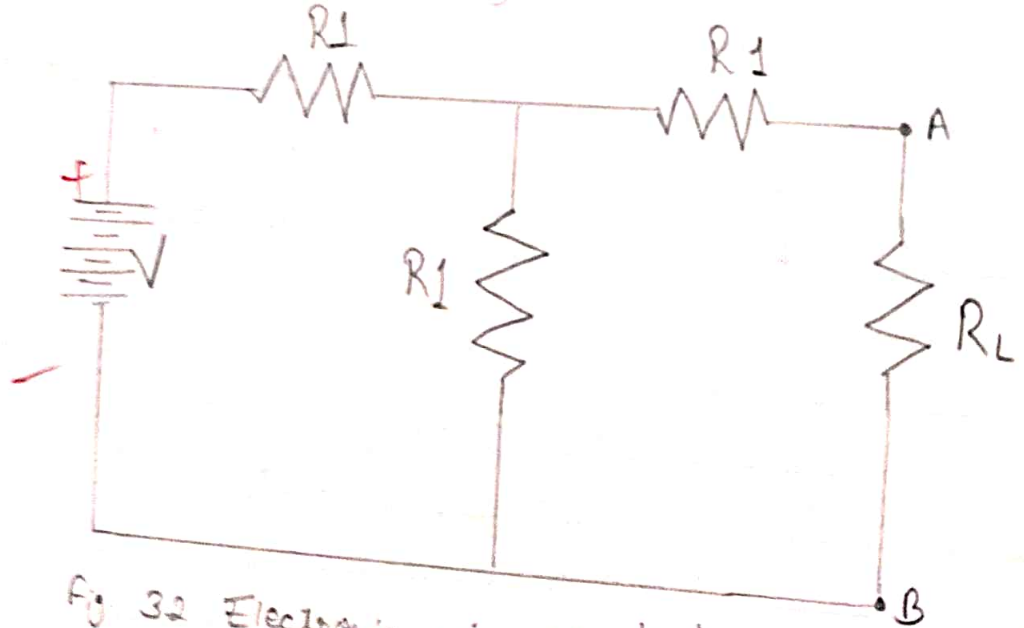

Fig 3.2 Electronic circuit to be analyzed through Thevenin's Theorem

circuit resistance (R_{th}) in step (4) as a series resistance and connect the ~~local~~ load resistor which had been removed in step (1). This the the equivalent Thevenin circuit of that linear electric network or complex circuit which had to be simplified and analyzed by Thevenin's Theorem.

Formula Used :-

$$V_{oc} = IR3$$

$$I = V / (R1 + R3)$$

$$V_{oc} \text{ or } V_{th} = V * R3 (R1 + R3)$$

$$R_{th} = R2 + \frac{R1 * R3}{R1 + R2}.$$

Observation Table.

S.No	Theoritical values			Experimental values		
	R_{TH} (KΩ)	V_{TH} (V)	I_L (mA)	R_{TH} (KΩ)	V_{TH} (V)	V_L (mA)
1	2.102	1.784	0.26	2.101	1.846	0.12.

S.No.	Theoritical (KΩ)	Experimental (KΩ)
R_1	1.769 KΩ	1.8
R_2	1.471k	1.5
R_3	0.982	1
R_4	4.82	4.7

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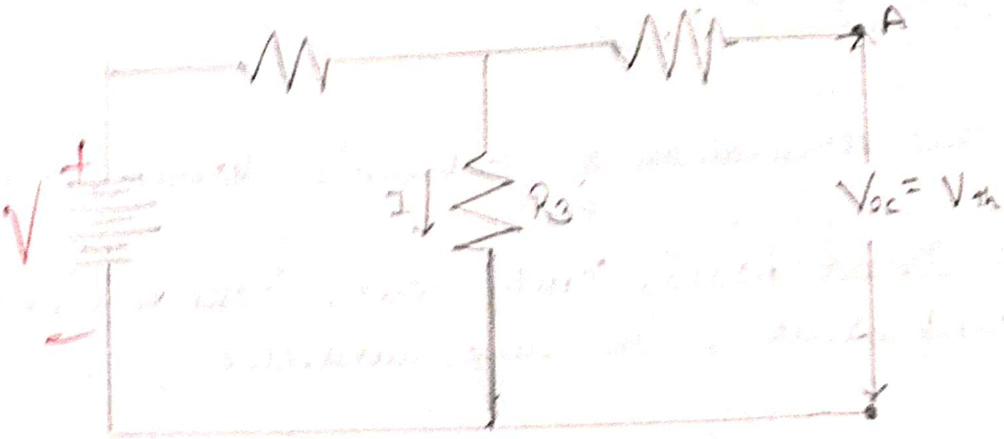
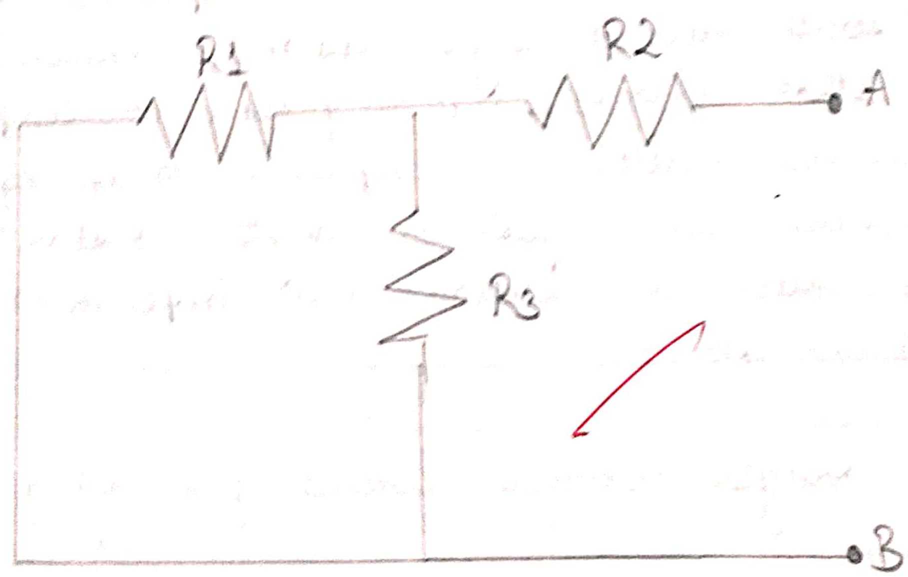


A
V
+
-
I
R3
Voc = Vth



R1
R2
A
R3
B

Calculation

1) $R_{TH} = \dfrac{R_1 . R_3}{R_1 + R_3} + R_2$

$= \dfrac{1.769 \times 0.982}{1.769 + 0.982} + 1.471$

$= 2.102\ k\Omega$

2) $V_{TH} = \dfrac{V_s}{R_1 + R_3} \times R_3$

$= \left(\dfrac{5}{1.769 + 0.982} \right) 0.982$

$= 1.784\ V$

3) $I_L = \dfrac{V_{TH}}{R_{TH} + R_L}$

$= \dfrac{1.784}{2.102 + 4.82}$

$= 0.26\ mA$

Result

Since Theoretical and practical values of Thevenin's theorem ~~are~~ almost the same. It is verified.

Experiment - 4

Aim
study and perform superposition theorem.

Apparatus Required
DC power supply (+5V, +8V), resistances, multimeter, breadboard, connecting wires.

Theory
Superposition theorem states that if more than one source acts simultaneously in an electric circuit, then the current through any one of the branches of the circuit is the summation of currents which would flow through the branch for each source, keeping all the other sources dead.

Formula used.

1) $i_1' = \dfrac{V_1}{R_1 + \dfrac{R_2 - R_3}{R_1 + R_3}}$ 2) $i_2' = \dfrac{i_1' \cdot R_3}{R_2 + R_3}$ 3) $i_3' = \dfrac{i_1' R_2}{R_2 + R_3}$

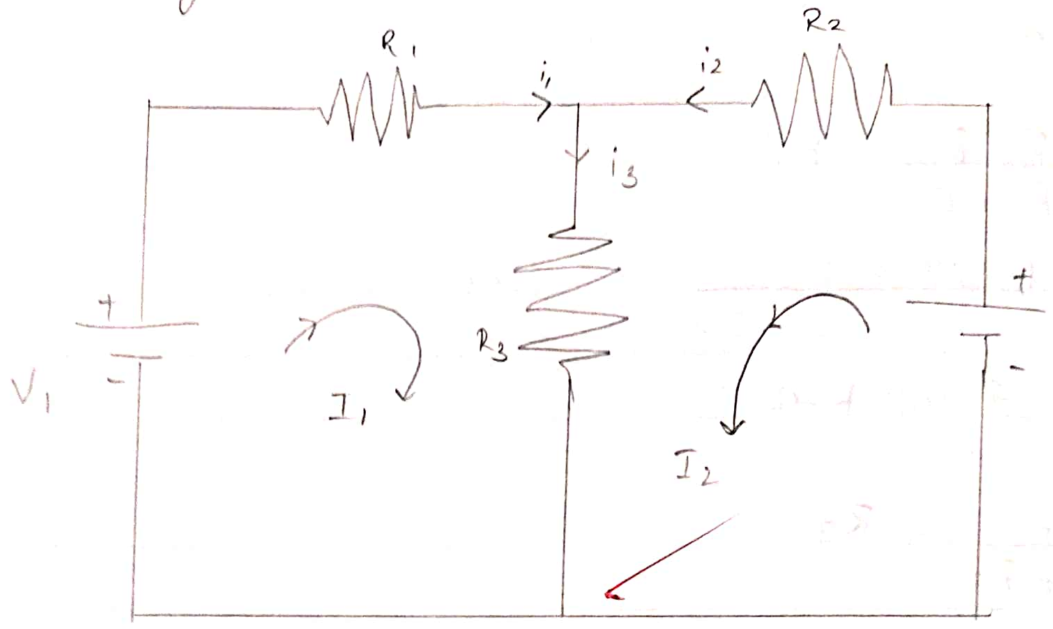
4) $i_2'' = \dfrac{V_2}{R_2 + \dfrac{R_1 \cdot R_3}{R_1 + R_3}}$ 5) $i_1'' = \dfrac{i_2'' \cdot R_3}{R_1 + R_3}$ 6) $i_3'' = \dfrac{i_2'' - R_1}{R_1 + R_3}$

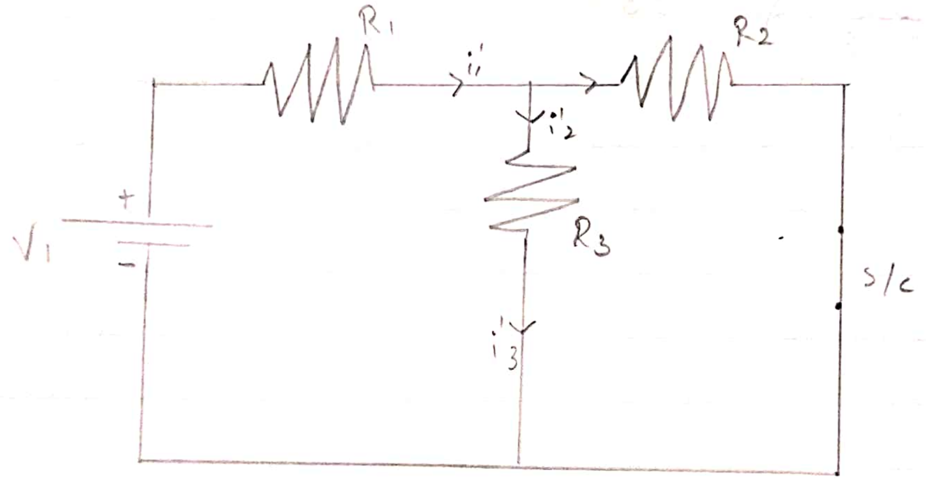
7) $i_3 = i_1'' + i_2''$

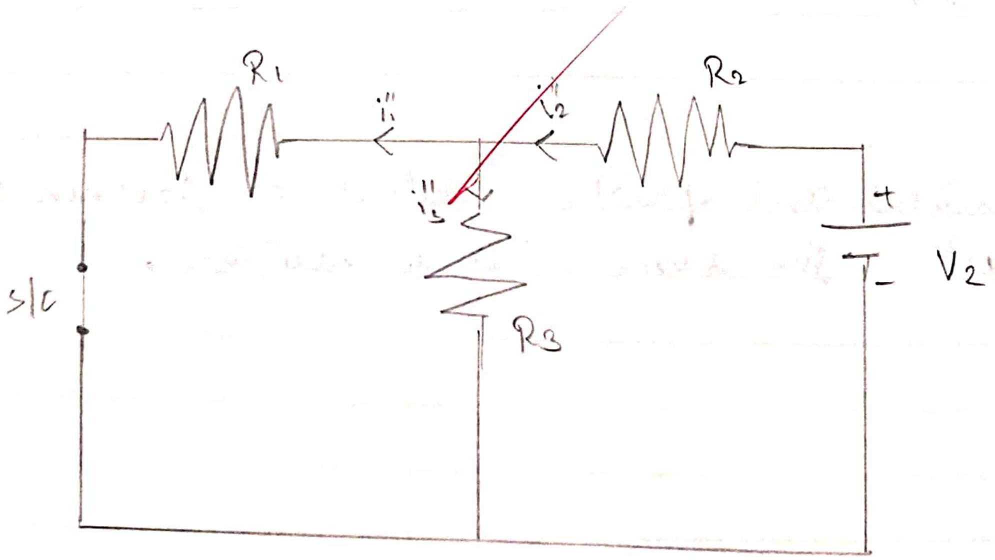
8) $i_1 = i_1' - i_1''$

9) $i_2 = i_2'' - i_2'$

Circuit Diagram







Calculation

1) $i_1' = \dfrac{V_1}{R_1 + \dfrac{R_2 \cdot R_3}{R_1 + R_3}} = \dfrac{5}{0.979 + \dfrac{(3.23 \times 9.84)}{3.23 + 9.84}} = \dfrac{5}{0.979 + 2.431}$

$= 1.4659 \text{ mA}$

2) $i_2' = \dfrac{i_1' \cdot R_3}{R_2 + R_3} = \dfrac{1.4659 \times 9.84}{3.23 + 9.84} = \dfrac{14.424}{13.07}$

$= 1.1035 \text{ mA}$

3) $i_3' = \dfrac{i_1' \cdot R_2}{R_2 + R_3} = \dfrac{1.4659 \times 3.23}{9.84 + 3.23} = \dfrac{4.7350}{13.07}$

$= 0.3622 \text{ mA}$

4) $i_2'' = \dfrac{V_2}{R_2 + \dfrac{R_1 R_3}{R_1 + R_3}} = \dfrac{5}{3.23 + \left(\dfrac{0.979 \times 9.84}{0.979 + 9.84}\right)} = \dfrac{5}{3.23 + 0.890}$

$= 1.2134 \text{ mA}$

5) $i_1'' = \dfrac{i_2'' \cdot R_3}{R_1 + R_3} = \dfrac{1.2134 \times 9.84}{0.979 + 9.84} = \dfrac{11.9405}{10.819}$

$= 1.1036 \text{ mA}$

6) $i_3'' = \dfrac{i_2'' \cdot R_1}{R_1 + R_3} = \dfrac{1.2134 \times 9.79}{0.979 + 9.84} = \cancel{\dfrac{11.9405}{10.819}} \quad \dfrac{1.189}{10.819}$

$= 1.1097 \text{ mA}$

Observation

~~Devi~~ Observed Current (mA) and Voltage (V)					
i_1'	i_2'	i_3'	i_1''	i_2''	i_3''
1.469	1.108	0.362	1.107	1.219	0.110
V_1'	V_2'	V_3'	V_1''	V_2''	V_3''
1.439	3.58	3.57	1.084	3.94	1.083

Theoretical Value (mA)			Observed Value (mA)		
i_1	i_2	i_3	i_1	i_2	i_3
0.3623	0.1099	2.317	0.361	0.109	2.115

7) $i_3 = i_1'' + i_3''$

$= 1.1036 + 1.2134$

$= 2.317 \text{ mA}$

8) $i_1 = i_1' - i_1''$

$= 1.4659 - 1.1036$

$= 0.3623 \text{ mA}$

9) $i_2 = i_2'' - i_2'$

$= 1.2134 - 1.1035$

$= 0.1099 \text{ mA}$

Result

Superposition theorem has been verified successfully

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Experiment - 5

Aim
Verification of maxima for power transfer theorem.

Apparatus
Resistance, Pot, Multimeter, Voltage source (10 V).

Theory
The maximum power transfer theorem states that to obtain maximum external power from a source with a finite internal Resistance, the resistance of the load must equal to the resistance of the source as viewed from its output terminal.

Formula Used:
i) $I_L = \frac{V_L}{R_L}$ (ohm's Law).

(ii) $P = V_L I_L$.

(iii) $P_m = \frac{V^2}{4R^{th}}$

Observation
Value of P_m showed in table 1 and shown in graph.

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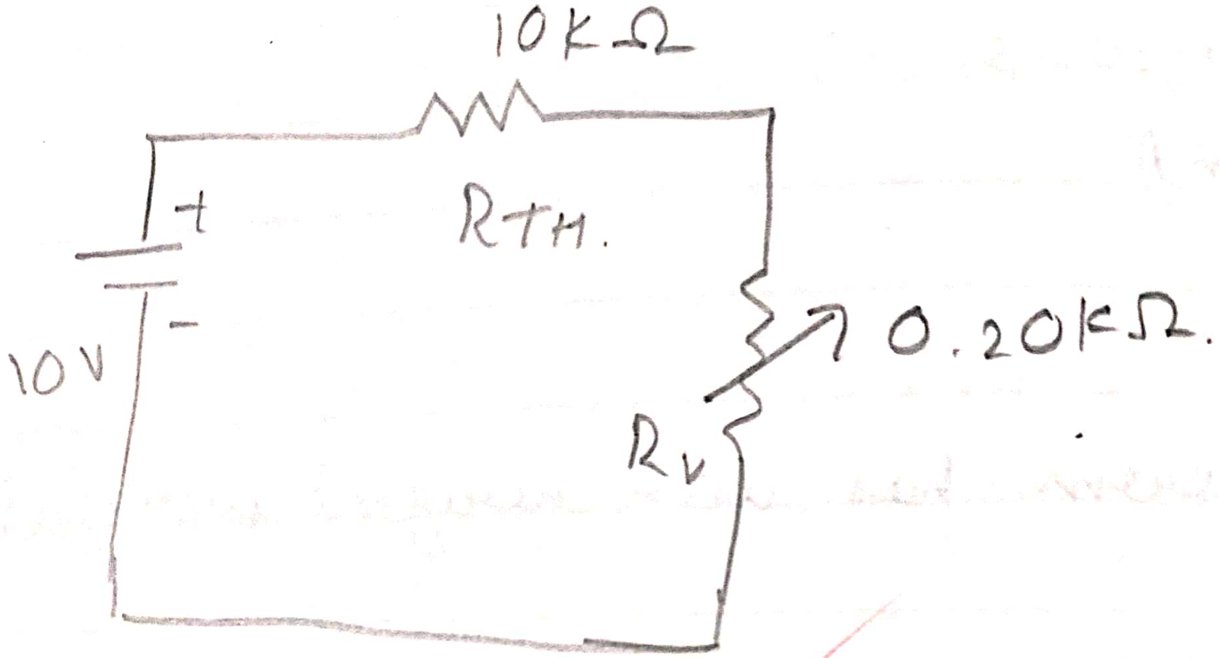
10KΩ
RTH.
+
-
10V
0.20KΩ.
Rv

Observation Table.

S.No.	R_{th} (R Ω)	R_L (R Ω)	V_L (V)	$R_L = V_L I_L$ (mW)	$P_{max} = \frac{V^2}{4_{th}}$ (mW)
1		2	1.65	1.36	
2		3	2.48	2.05	
3		4	2.90	2.10	
4		6	3.7	2.39	
5		8	4.51	2.54	
6	10	10	5.09	2.59	2.5
7		12	5.53	2.53	
8		14	5.89	2.47	
9		16	6.26	2.44	
10		18	6.51	2.35	
11		20	6.72	2.25	

Calculation:-

1. $I_L = \frac{V_L}{R_L} = \frac{1.65}{2} = 0.82\ mA$

$P_L = V_L \times I_L = 1.65 \times 0.82 = 1.36\ mW$.

2. $I_L = \frac{2.48}{3} = 0.826\ mA$

$P_L = 0.826 \times 2.48 = 2.05\ mW$

3. $I_L = \frac{2.90}{4} = 0.725\ mA$

$P_L = 0.725 \times 2.90 = 2.10\ mW$

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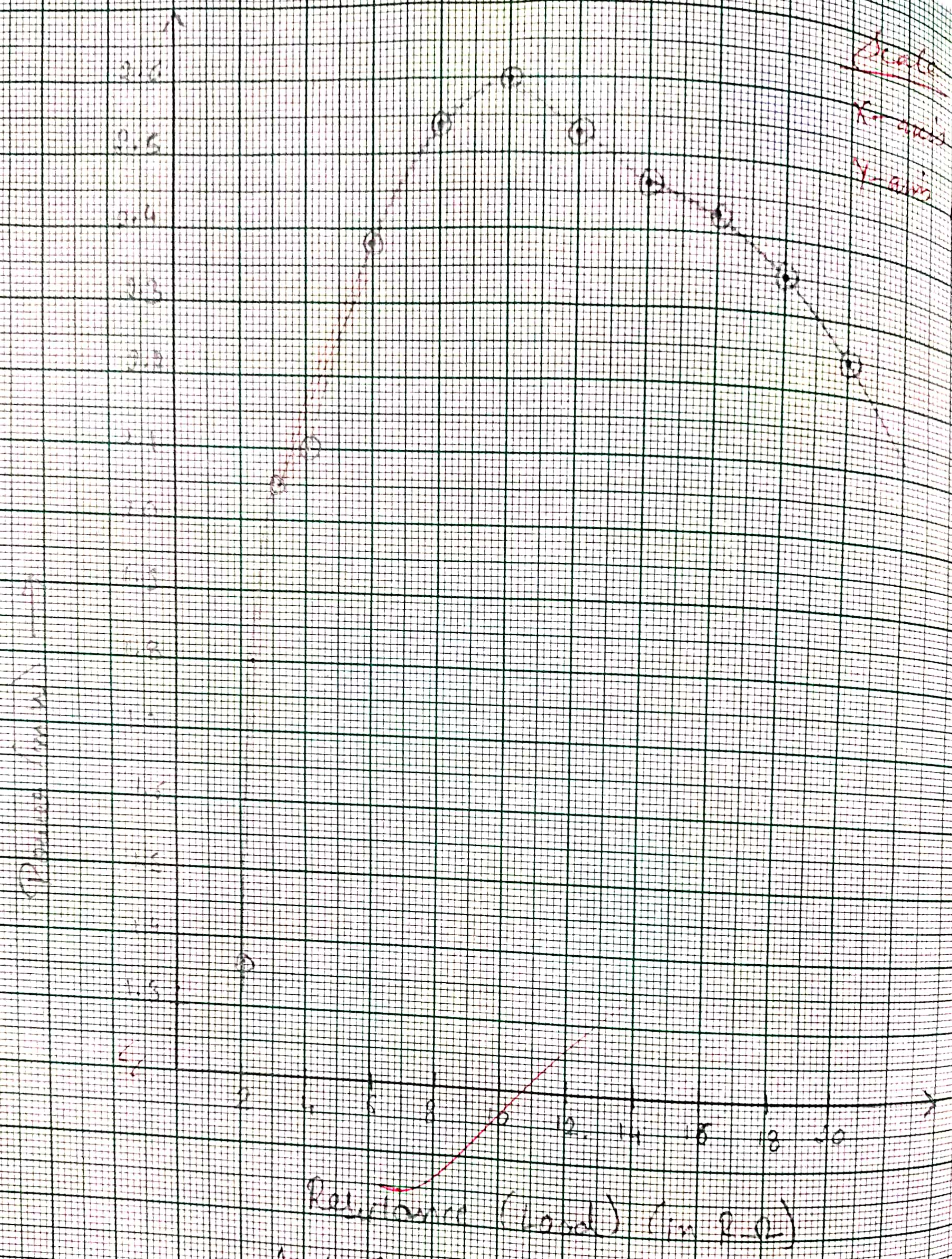
Scale
X-axis 1 div...
Y-axis 1 div...



1 scale div

x-axis = 2 K Ω
y-axis = 0.1 mW

4. $I_L = \frac{3.7}{6} = 0.616\ mA$

~~$P_L = 0.563 \times 4.51 =$~~

$P_L = 0.616 \times 3.7 = 2.39\ mW$

5. $I_L = \frac{4.51}{8} = 0.563\ mA$

$P_L = 0.563 \times 4.51 = 2.54\ mW$

6. $I_L = \frac{5.09}{10} = 0.50\ mA$

$P_L = 0.506 \times 5.09 = 2.59\ mW$

7. $I_L = \frac{5.53}{12} = 0.460\ mA$

$P_L = 0.460 \times 5.53 = 2.53\ mW$

8. $I_L = \frac{5.89}{14} = 0.420\ mA$

$P_L = 0.420 \times 5.89 = 2.47\ mA$

. $I_L = \frac{6.26}{16} = 0.391\ mA$

$P_L = 0.391 \times 6.26 = 2.44\ mA$

. $I_L = \frac{6.51}{18} = 0.361\ mA.$

$P_L = 0.361 \times 6.51 = 2.35\ mW.$

Teacher's Signature

Expt. No.

11. $I_L = \frac{6.72}{20} = 0.336\ mA.$

$P_L = 0.336 \times 6.72 = 2.25\ mW.$

For theoretical max. Power transfer

$$P_{max} = \frac{V^2}{4R_{in}} = \frac{(10)^2}{4 \times 10} = 2.5\ mW$$

Result
Therefore verification of maximum power transfer theorem is proved.

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Experiment - 6

Aim:
Study of Low Pass and High Pass characteristics of RC Filter circuit.

a) Study of transfer function and phase shift of a low pass RC filter network.

b) Study the Transfer function and phase shift of a high pass RC filter network.

Apparatus Required
Bread-Board, Digital Multimeter, Digital Oscilloscope, Resistors, Capacitors, Connecting wires, Testing probes, CRO probes, Function Generator, etc.

Theory

1) Low Pass Filter
It is used to filter noise from a circuit. 'Noise' is a high frequency signal. When passed through a low pass filter most the noise is removed and a clear sound is produced.

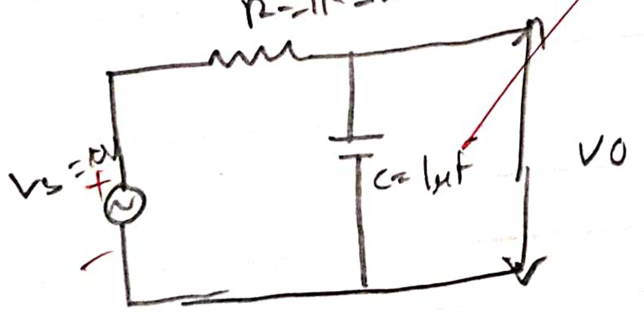
2) High Pass Filter.
The filter are used in speakers for amplification. High Pass Filter is used to remove unwanted sound near to the lower end of the available range.

Observation

Table 1: For low pass.

S.No.	F(Hz)	V(in) (V)	Vout (V)	$A_v = \frac{V_{out}}{V_{in}}$
1	20	10	10.00	1
2	40	10	9.60	0.96
3	60	10	9.20	0.92
4	80	10	8.80	0.88
5	100	10	8.40	0.83
6	120	10	7.66	0.76
7	140	10	7.20	0.72
8	160	10	6.80	0.68
9	180	10	6.40	0.64
10	200	10	6.00	0.60
11	220	10	5.60	0.56
12	240	10	5.20	0.52
13	260	10	5.00	0.50
14	280	10	4.80	0.48
15	300	10	4.80	0.48

1) low pass



Expt. No. ____________

Formula Used:-

i) $V_{in} = \left(R + \frac{1}{J\omega C}\right)$

ii) $V_o = \frac{J}{J\omega C}$

(iii) $A_v = \frac{V_o}{V_{in}} = \frac{1}{1 + J\omega RC}$

Observation

Value of low pass and high pass is shown in Table 1st and Table 2nd Reportedly.

Calculation

i) for Lower Pass:-

1) $A_v = \frac{10}{10} = 1$

2) $A_v = \frac{9.60}{10} = 0.96$

3) $A_v = \frac{9.20}{10} = 0.92$

4) $A_v = \frac{8.80}{10} = 0.88$

5) $A_v = \frac{8.10}{10} = 0.81$

6) $A_v = \frac{7.60}{10} = 0.76$

7) $A_v = \frac{7.20}{10} = 0.72$

8) $A_v = \frac{6.80}{10} = 0.68$

(ii) For High Pass

1) $A_v = \frac{2.10}{10} = 0.21$

2) $A_v = \frac{3.10}{10} = 0.31$

3) $A_v = \frac{4.10}{10} = 0.41$

4) $A_v = \frac{4.80}{10} = 0.48$

5) $A_v = \frac{5.60}{10} = 0.56$

6) $A_v = \frac{6.40}{10} = 0.64$

7) $A_v = \frac{6.80}{10} = 0.68$

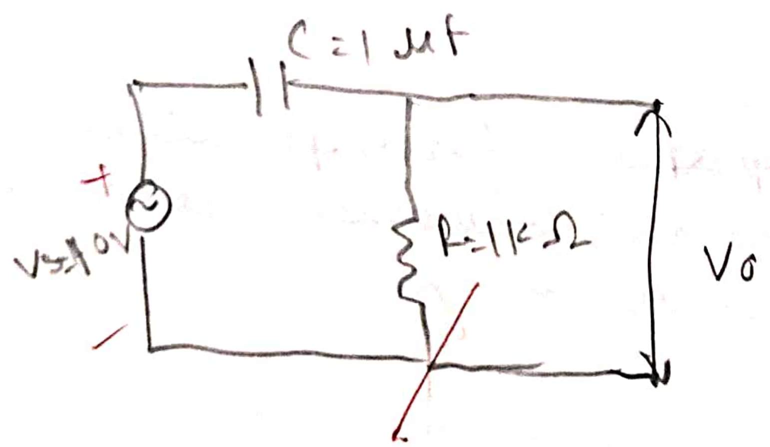
8) $A_v = \frac{7.20}{10} = 0.72$

Teacher's Signature ____________

Table 2nd : For high pass

S. No.	F (Hz)	Vin (V)	Vout (V)	Av = Vout/Vin
1	20	10	2.10	0.21
2	40	10	3.10	0.31
3	60	10	4.12	0.41
4	80	10	4.80	0.48
5	100	10	5.60	0.56
6	120	10	6.40	0.64
7	140	10	6.80	0.68
8	160	10	7.20	0.72
9	180	10	7.60	0.76
10	200	10	8.00	0.80
11	220	10	8.20	0.82
12	240	10	8.40	0.84
13	260	10	8.60	0.86
14	280	10	8.80	0.88
15	300	10	8.80	0.88

2) High Pass Filter



9) $A_v = \frac{6.90}{10} = 0.69$

10) $A_v = \frac{6.00}{10} = 0.60$

11) $A_v = \frac{5.60}{10} = 0.56$

12) $A_v = \frac{5.20}{10} = 0.52$

13) $A_v = \frac{5.00}{10} = 0.50$

14) $A_v = \frac{4.80}{10} = 0.48$

15) $A_v = \frac{4.80}{10} = 0.48$

9) $A_v = \frac{7.60}{10} = 0.76$

10) $A_v = \frac{8.00}{10} = 0.80$

11) $A_v = \frac{8.20}{10} = 0.82$

12) $A_v = \frac{8.40}{10} = 0.84$

13) $A_v = \frac{8.60}{10} = 0.86$

14) $A_v = \frac{8.80}{10} = 0.88$

15) $A_v = \frac{8.80}{10} = 0.88$

iii) Cut - off frequency

$\omega = 2\pi f$

$f = 0.$

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 1.0 \times \omega^2 \times 1.0 \times 10^{-6}}$$

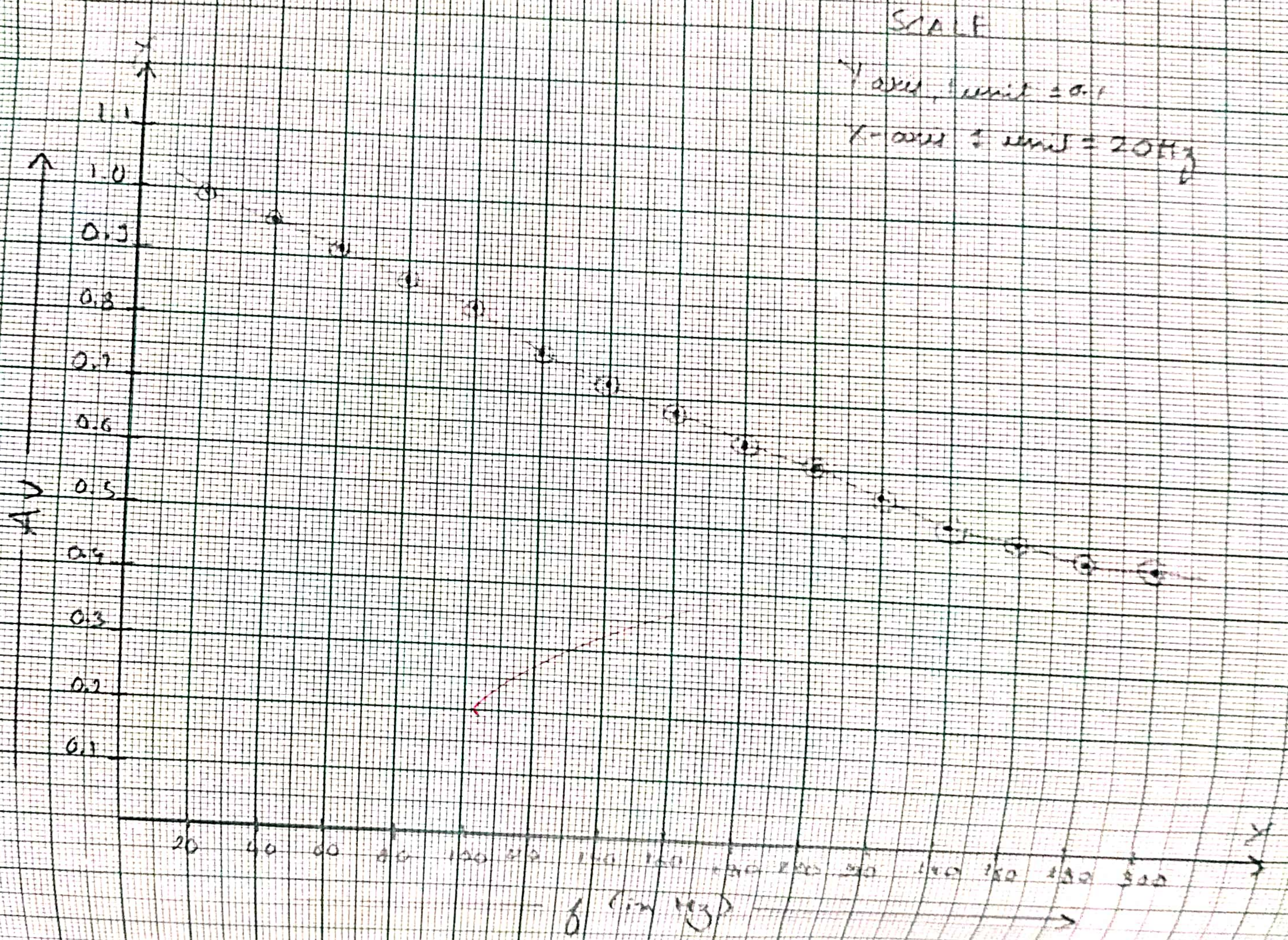
$f_c = 159.15\ Hz$

$F_2 = 160\ Hz$

where,

$\omega \rightarrow 0$

$H(j\omega)$ is max


SCALE
Y axis, 1 unit = 0.1
X-axis 1 unit = 20Hz
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
20
40
60
80
100
300
f (in Hz)
Y
X

for

$\omega = \omega_0$

$H(j\omega_c) = \frac{1}{\sqrt{2}}$.

$P \to 0$

so,

f_v is max

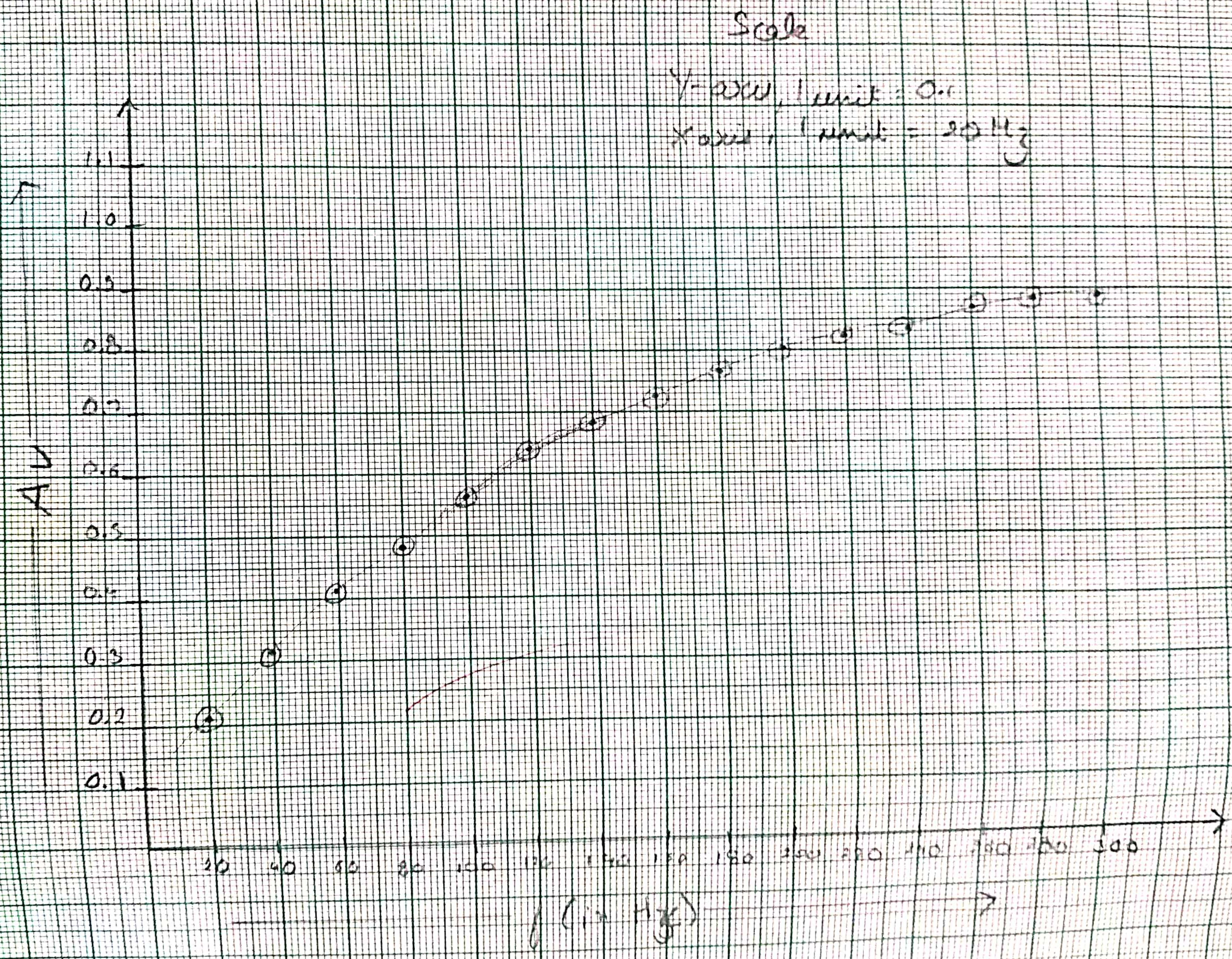
for $F = F_j$, $A_v = \frac{1}{\sqrt{2}} = 0.702 = 0.71$ approx.

Result

Here the high pass filter & low pass filter has been successfully verified.

10

02/03/22



Scale
Y-axis, 1 unit = 0.1
X axis, 1 unit = 20 Hz
AV
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
f (in Hz)

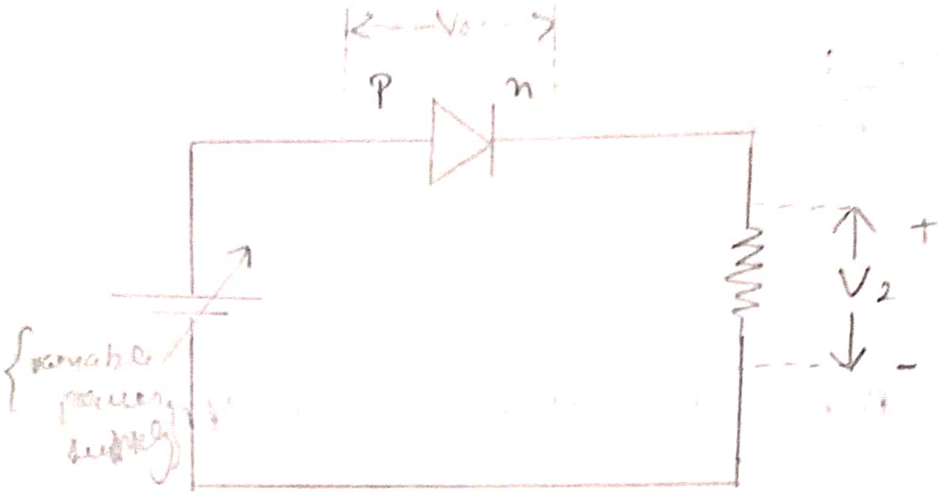
Experiment - 7

Aim: To study and measurement of voltage current (V-I) characteristic of a p-n junction diode (Ge or Si)

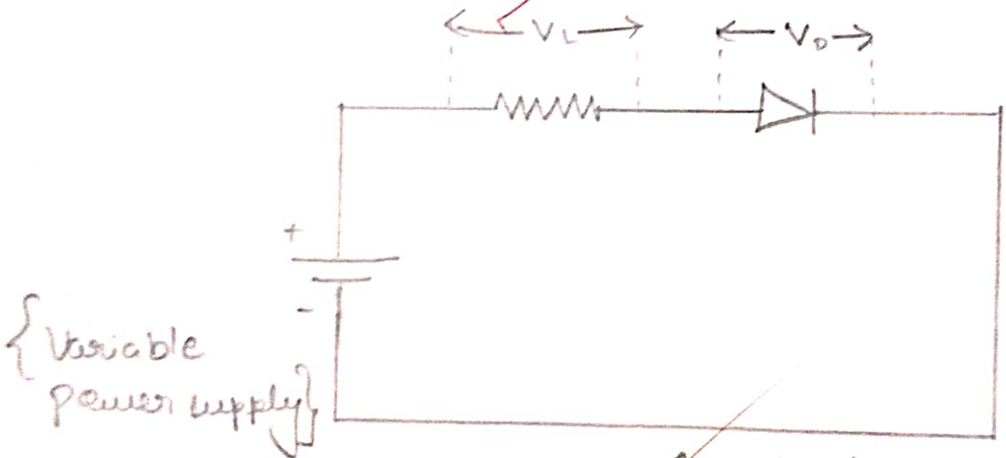
Apparatus Required: Variable DC power supply (0-30V), Breadboard, Multimeters (two Nos), pn junction diode, resistors of different values, connecting wires and crocodile clips, Resistors of different values: 100 Ω, 1 kΩ, 10K Ω, 100K Ω and 1 M Ω

Theory - A pn junction diode is active electronics component made of semiconductor material such as silicon (Si). The basic feature of the diode is that it conducts significantly when forward biased, beyond a certain critical voltage called "diode -cut in voltage" Forward biasing refers to the p-side connected to positive and n-side connected to negative terminal of battery. For p-n junction diodes made in silicon, the value of cut-in voltage is about 0.7 V. For diodes made in Germanium (Ge) semiconductor material, the corresponding value is of the order of 0.3 V. In the reverse bias conditions (n side connected to positive terminal and p side to negative terminal of battery) negligible current flows through the diode till the voltage reaches the breakdown value.

Circuit Diagram.



Forward bias



Reverse bias

S.No.	V (in V)	Vd (in V)	V_L (in V)	$I_L = \frac{V_L}{R_L}$ (mA) $\{R_L = 1k\Omega\}$
	0	0	0	0 0
1	0.2	0.199	0.003.	0.003
2	0.4	0.390	0.009.	0.009
3	0.6	0.488	0.111	0.111
4	0.8	0.528	0.27	0.27
5	1.0	0.553	0.445	0.445
6	1.2	0.576	0.627	0.627
7	1.4	0.587	0.816	0.816
8	1.6	0.592	1.004	1.004
9	1.8	0.6	1.199	1.199
10	2.0	0.608	1.390	1.390
11	2.6	0.620	1.778	1.778
12	2.8	0.630	2.168	2.168
13	3.0	0.634	2.360	2.360
14	3.5	0.644	2.952.	2.952.
15	4.0	0.649.	3.345	3.345.
16	5.0	0.661	4.340	4.340

Calculation
for forward bias current

$$I_L = \frac{V_L}{R_L} \text{ (mA)}$$

where $R_L = 1k\Omega$

hence $I_L = \frac{V_1}{1000\Omega}$

$I_L = V_L$ (mA)

for each case

Topic :   Date :

Scale for
Y axis 1 unit : 0.2 Ampere
X-axis - 1 unit 0. 5 (Volt)
I_L (Amp)
Vd (Volt)
Axis
Axis

Result

The data on IV measurement is plotted on a graph sheet & compared the diode behaviour in forward bias condition.

VVD 16/10/23

No.

Experiment - 8

Aim: (a) To study V-I characteristics of zener diode
(b) To study zener diode as a voltage regulator.

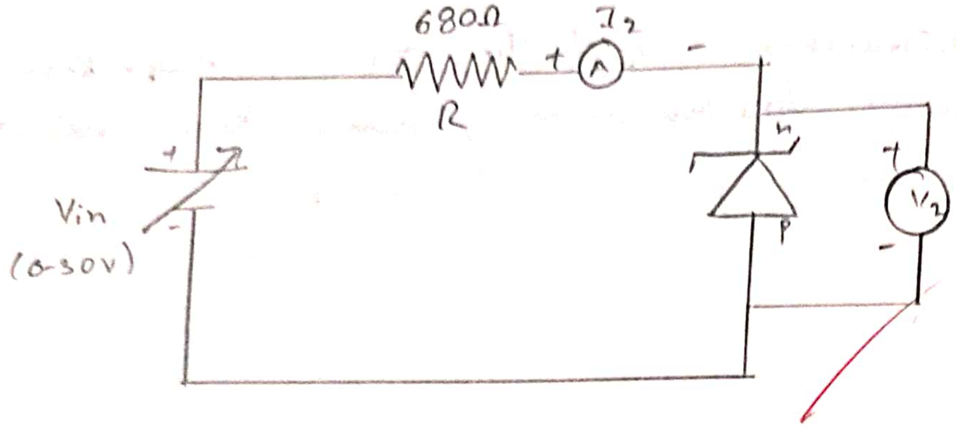
Apparatus Used :- dc power supply (0-30 V), zener diode, resistor multimeter, bread board, connecting wire

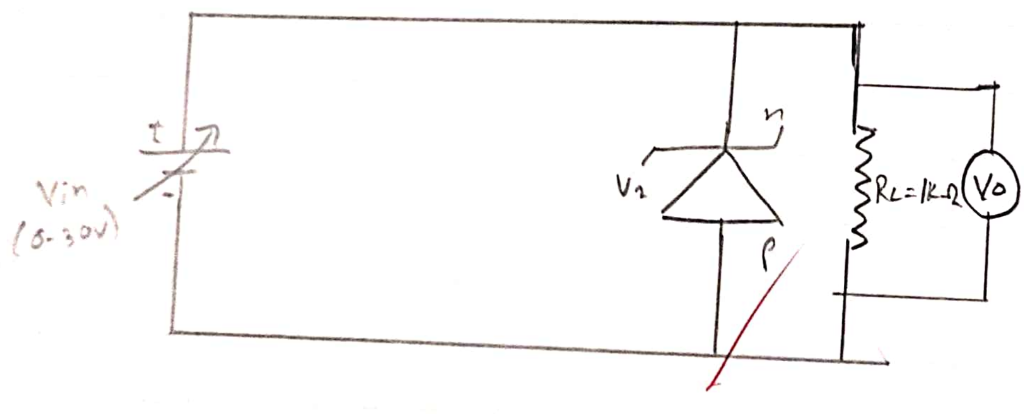
Theory :- A p-n junction diode normally does not conduct with reverse biased. But if the reverse biased is increased at a particular voltage it starts conducting heavily. This voltage is called breakdown voltage. High current through the diode can permanently damaged. To avoid high current, with connected resistor in series with it. Once the diode starts conducting it maintains almost constant across its terminal whatever may be current through it. It has very low dynamic resistance. A zener diode is p-n junction diode especially made to work in breakdown region. It is used as a voltage regulator.

Dynamic Resistance

$$r_d = \frac{\Delta V_z}{\Delta I_z} = \frac{AB}{CD}$$

Teacher's Signature

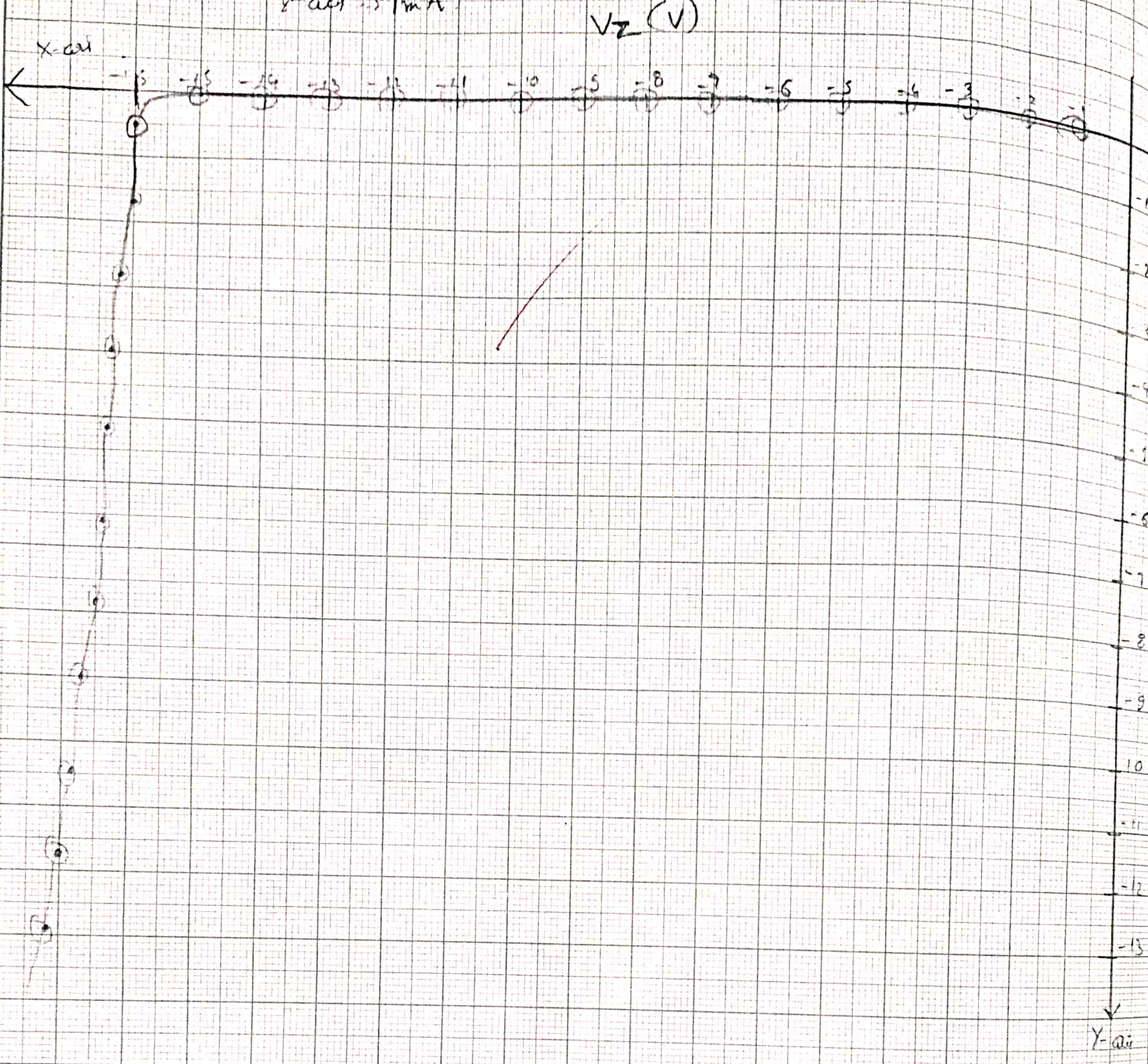

680Ω
R
I_z
+
A
-
n
p
V_z
Vin
(0-30V)


Vin
(0-30V)
n
V_z
p
R_L=1kΩ
Vo

Observation Table 1

SNo	V_{in} (V)	V_Z (V)	$I_L = V_Z/R$ (mA)
1	0	0	0
2	1	1.092	0
3	2	2.150	0
4	3	3.12	0
5	4	4.16	0
6	5	5.15	0
7	6	6.13	0
8	7	7.18	0
9	8	8.15	0
10	9	9.13	0
11	10	10.13	0
12	11	11.18	0
13	12	12.15	0.001
14	13	13.16	0.001
15	14	14.12	0.001
16	15	14.94	0.410
17	16	15.03	1.601
18	17	15.10	2.8
19	18	15.24	4.0
20	19	15.34	5.3
21	20	15.42	6.6
22	21	15.50	7.8
23	22	15.66	9.0
24	23	15.82	10.4
25	24	15.93	11.7
26	25	16.13	12.9

Scale
(unit on :)
X - axis : 1V
Y - axis : 1mA



Observation Table 2.

S. No.	V_{in} (V)	V_o (V)
01	1	0.682
02.	2	1.284
03.	3	1.878
04.	4	2.478
05.	5	3.06
06.	6	3.61
07.	7	4.04
08.	8	4.32
09.	9	4.49
10.	10	4.61
11.	11	4.67
12.	12	4.72.
13.	13	4.76
14.	14	4.80
15.	15	4.84
16.	16	4.87
17.	17	4.90
18.	18	4.92.
19.	19	4.94
20.	20	4.95.

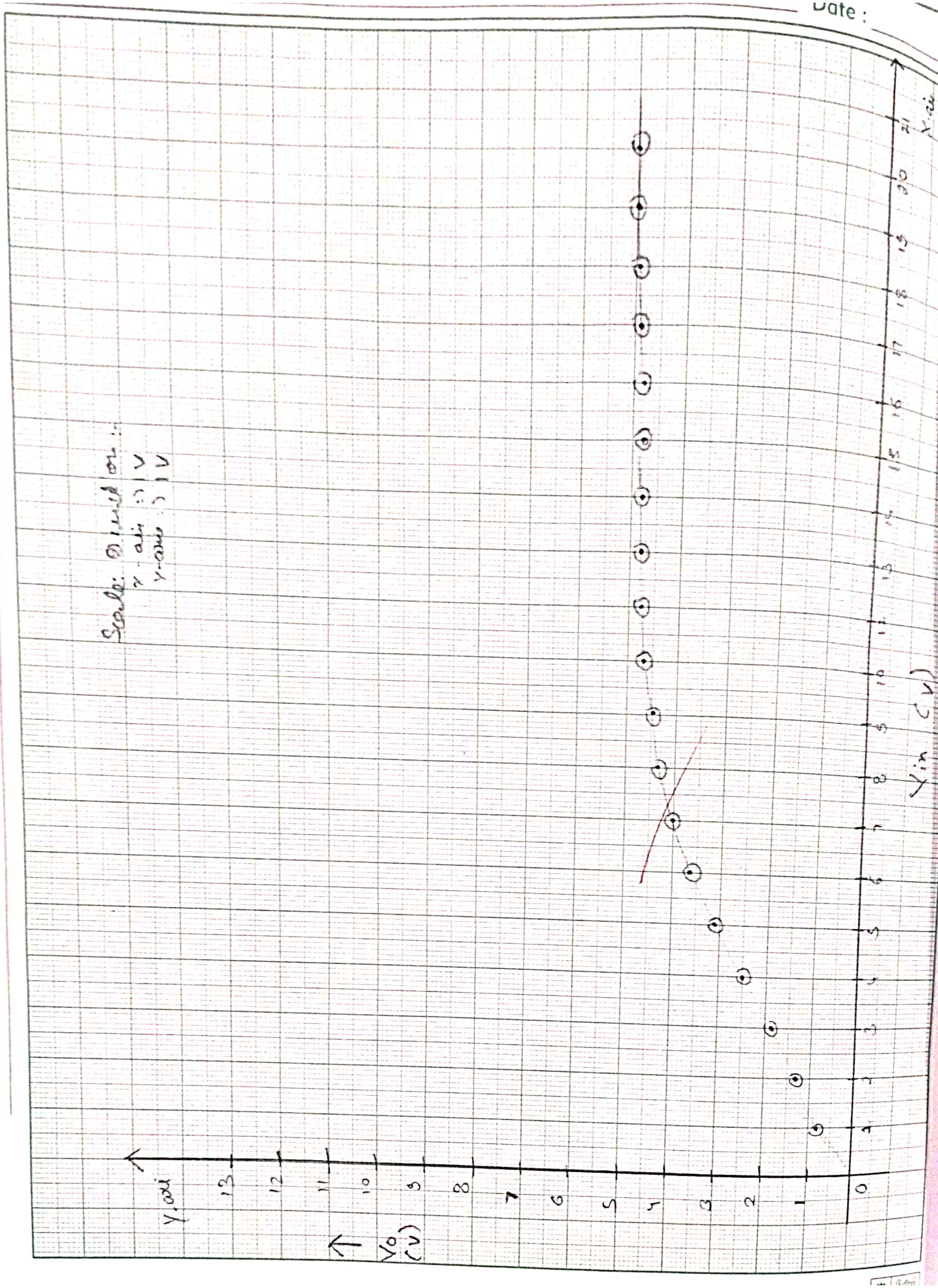
Result

a) The study of V-I characteristics have been successfully performed

b) The study of zener diode as a voltage regulator has been successfully performed.

10
21/5/22

Date :



Expt. No. ______

Experiment - 9

Aim: To design and study of half wave rectifier (without and with capacitance) on bread board and observe the input and output waveform. Also calculate the ac output voltage V_{rms}, dc output voltage (V_{dc}), DC current (I_{dc}) and ripple factor.

Apparatus Used: function generator, DSO, diode, resistance, multimeter, bread board, connecting

Theory: Half wave rectifier is primarily used to convert a given ac signal into a DC signal. Power transmitted from power stations is an AC signal (220 V/50 Hz) whereas most of the home applicances or other electrical equipment we use in our day-to-day life require DC power. The method by which we convert a given AC signal into a DC signal is called 'rectification'. In this experiment, one of such basic circuits used for rectification is built. The output current.

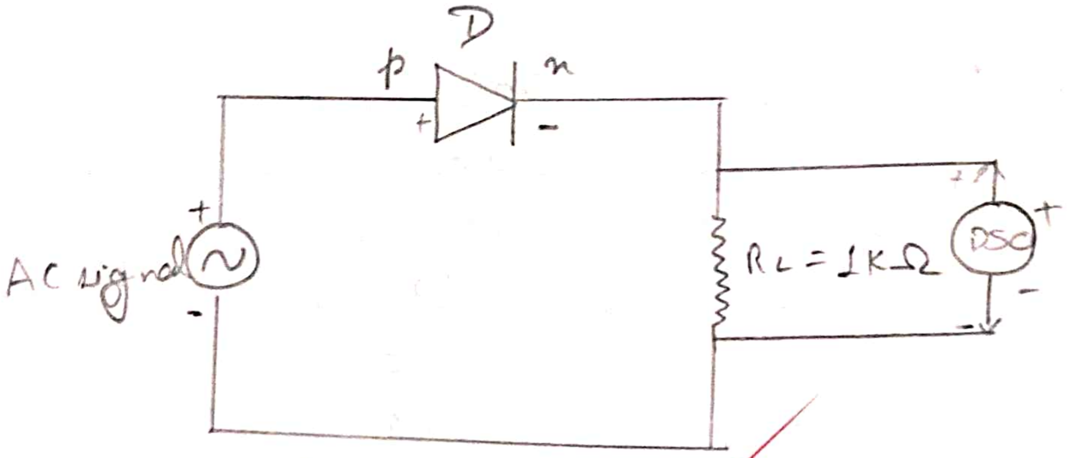
Formula Used

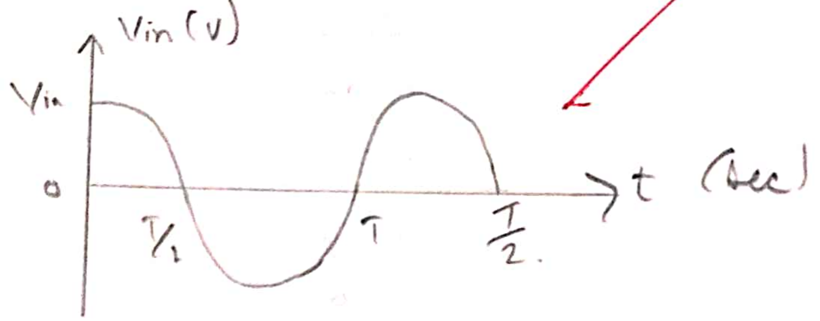
1. AC input voltage $(V_{RMS}) = \frac{V_m}{2}$

2. DC output voltage $(V_{dc}) = \frac{V_m}{\pi}$

3. DC current $(I_{dc}) = \frac{I_m}{\pi}$

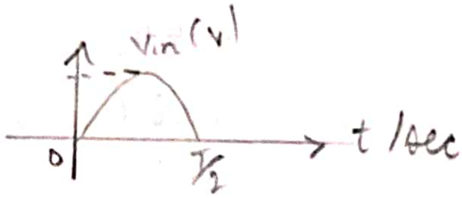
Teacher's Signature ______

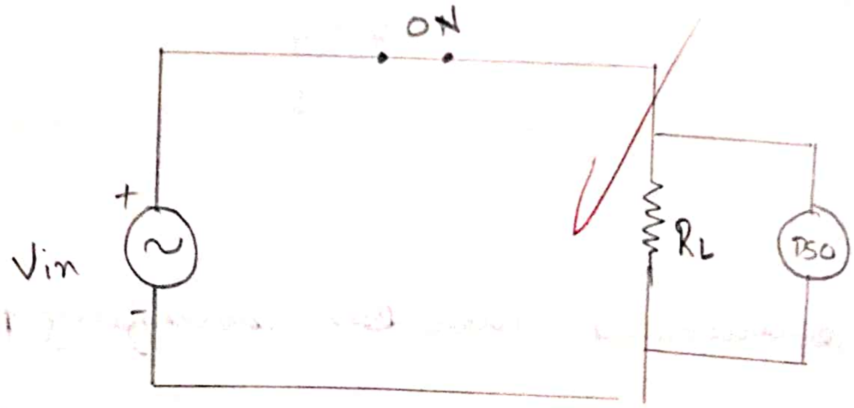




During +ve half cycle

$0 \longrightarrow \frac{T}{2}$





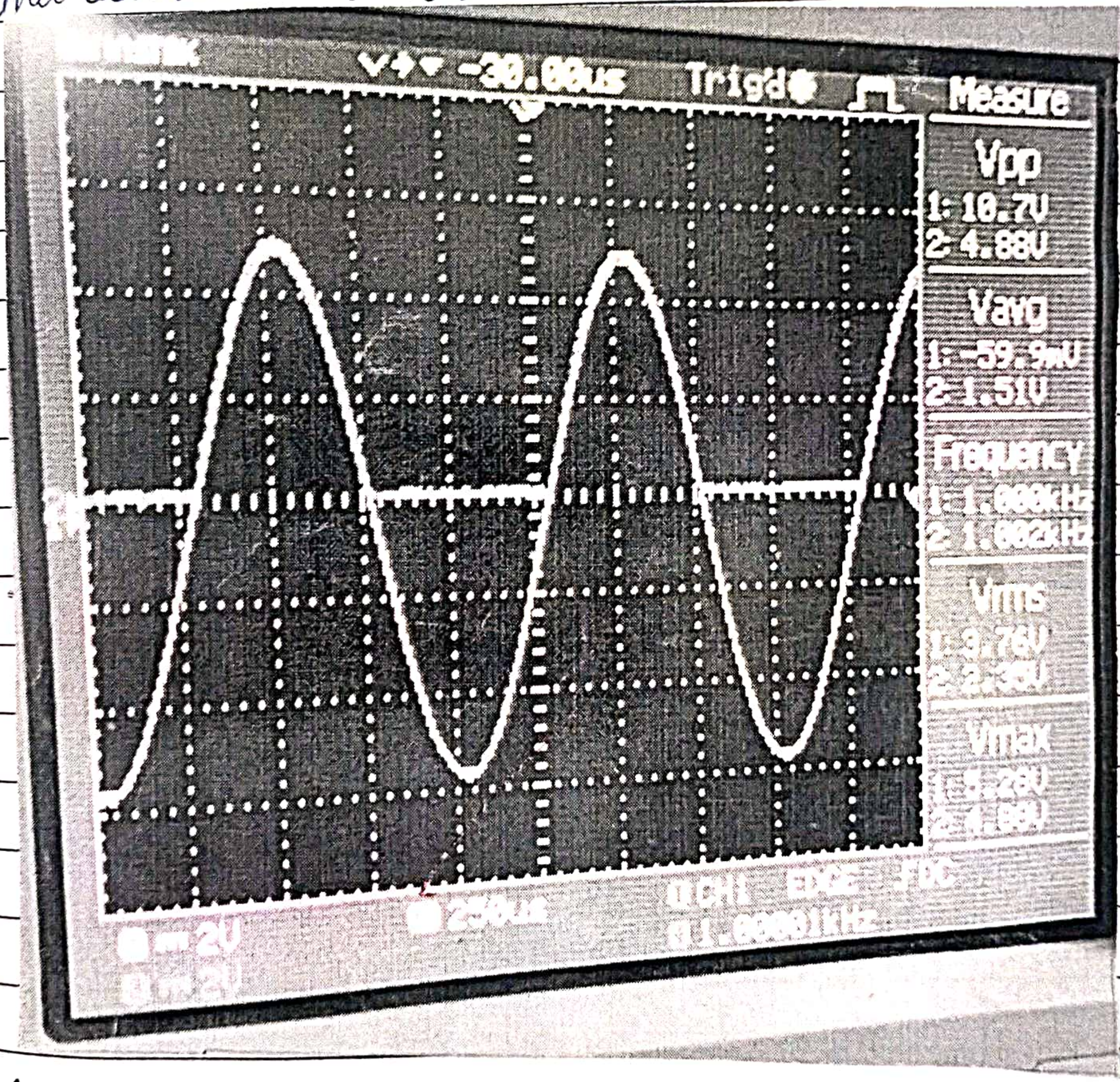
4) Ripple factor $\gamma = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$

$I_{rms} = \frac{I_m}{2}$

$\gamma = \sqrt{\left(\frac{I_m/2}{I_m/\pi}\right)^2 - 1}$

Observation

Output waveform without capacitor.

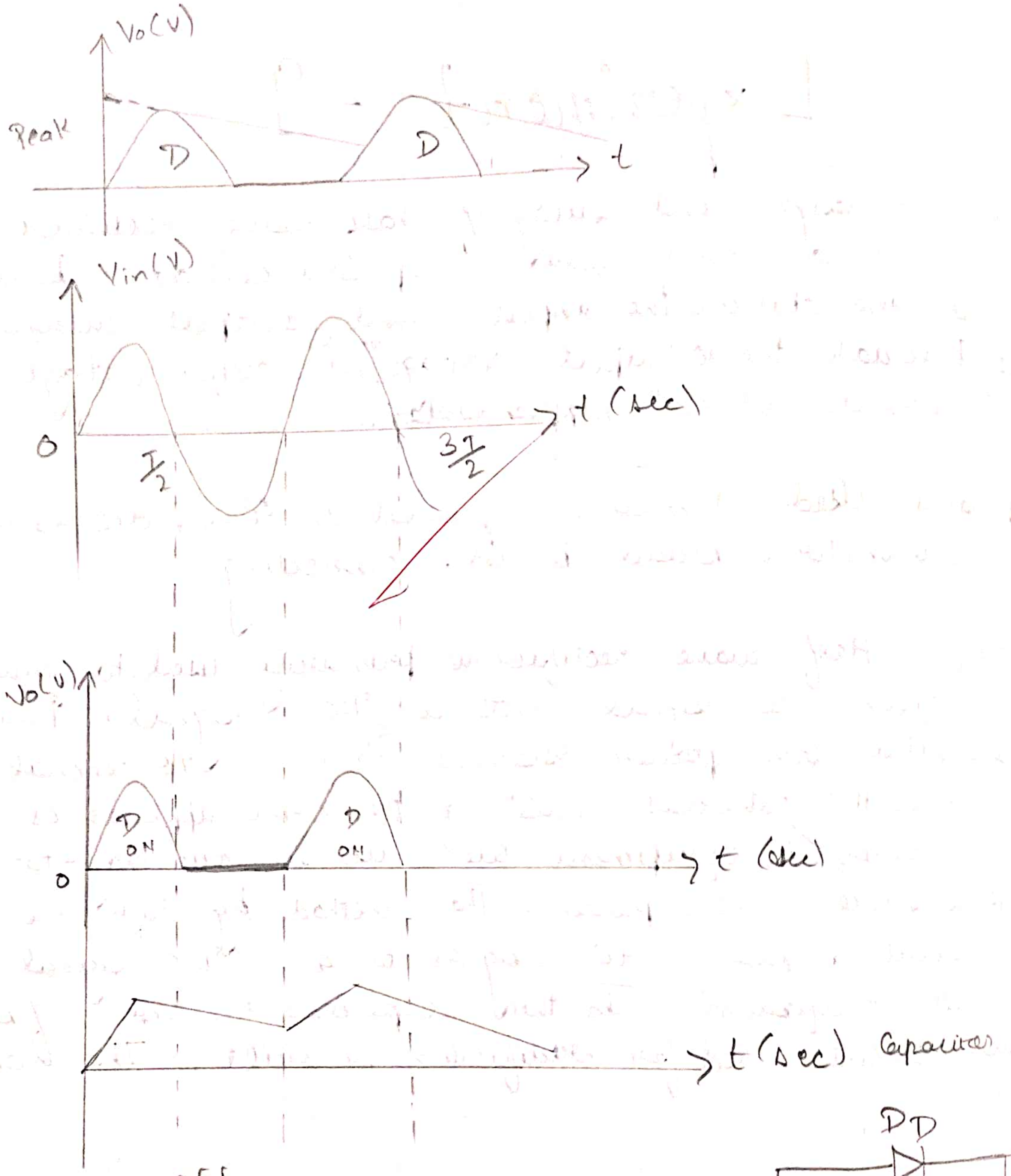


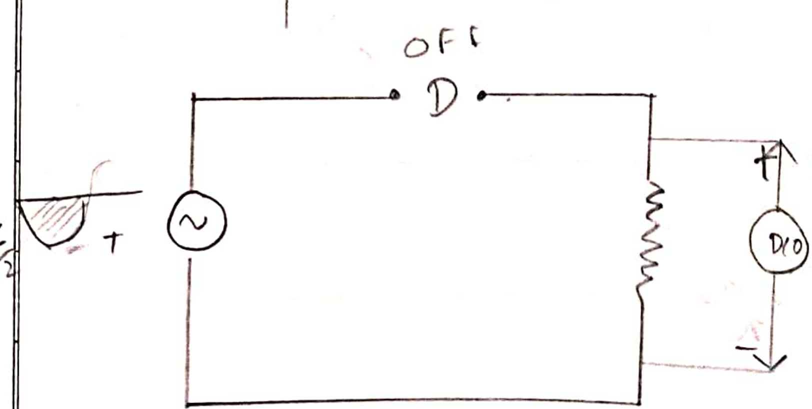
Calculation

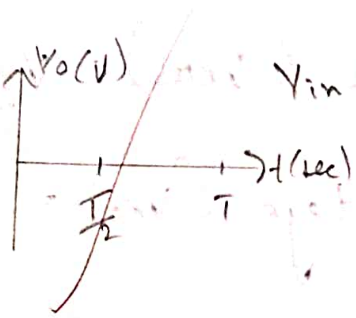
Without capacitor

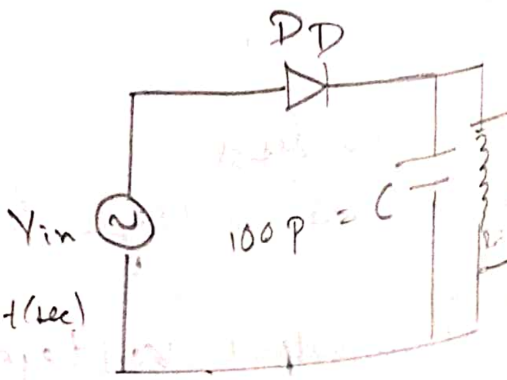
V_{pp} = ~~8.40 V~~ 10.7 $\qquad R = 1k\Omega = 1 \times 10^3 \Omega$

$V_m = \frac{V_{pp}}{2} = \cancel{8.40}\ \frac{10.7}{2} = 5.35\ V$


Vo(V)
Peak
D
D
t
Vin(V)
t (sec)
0
T/2
3T/2
Vo(V)
D ON
D ON
t (sec)
0
t (sec)
Capacitor


OFF
D
+
-
D/O
T


Vo(V)
t (sec)
T/2
T


DD
Vin
100P = C

1) AC input voltage $(V_{RMS}) = \frac{V_m}{2} = \frac{5.35}{2} = 2.67$ volts.

2) DC output voltage $(V_{dc}) = \frac{V_m}{\pi} = \frac{5.35}{3.14} = 1.703$

3) $I_m = \frac{V_m}{R} = \frac{5.35}{1\times10^3} = 5.35\times10^{-3}$ A

Dc current $(I_{dc}) = \frac{V_m}{\pi} = 1.70\times10^{-3}$ A

4.94
244
234

4) Ripple factor $r = \sqrt{\left(\frac{I_m/2}{I_m/\pi}\right)^2 - 1}$

$$= \sqrt{\left(\frac{\left(\frac{5.35\times10^{-3}}{2}\right)}{\frac{\cancel{1.70\times10^{-3}}}{3.14\times10^{-3}}}\right)^2 - 1}$$

$$\cancel{= \sqrt{\left(\frac{0.002}{0.541}\right)^2 - 1}} = \sqrt{\left(\frac{2.67}{0.54}\right)^2 - 1}$$

$$\cancel{= \sqrt{(0.003)^2 - 1}} \qquad = 4.83$$

$$= \cancel{0.957}$$

With capacitor

$V_{pp} = \cancel{9.152}$ 7.52 V $\qquad R = 1k\Omega = 1\times10^3\,\Omega$

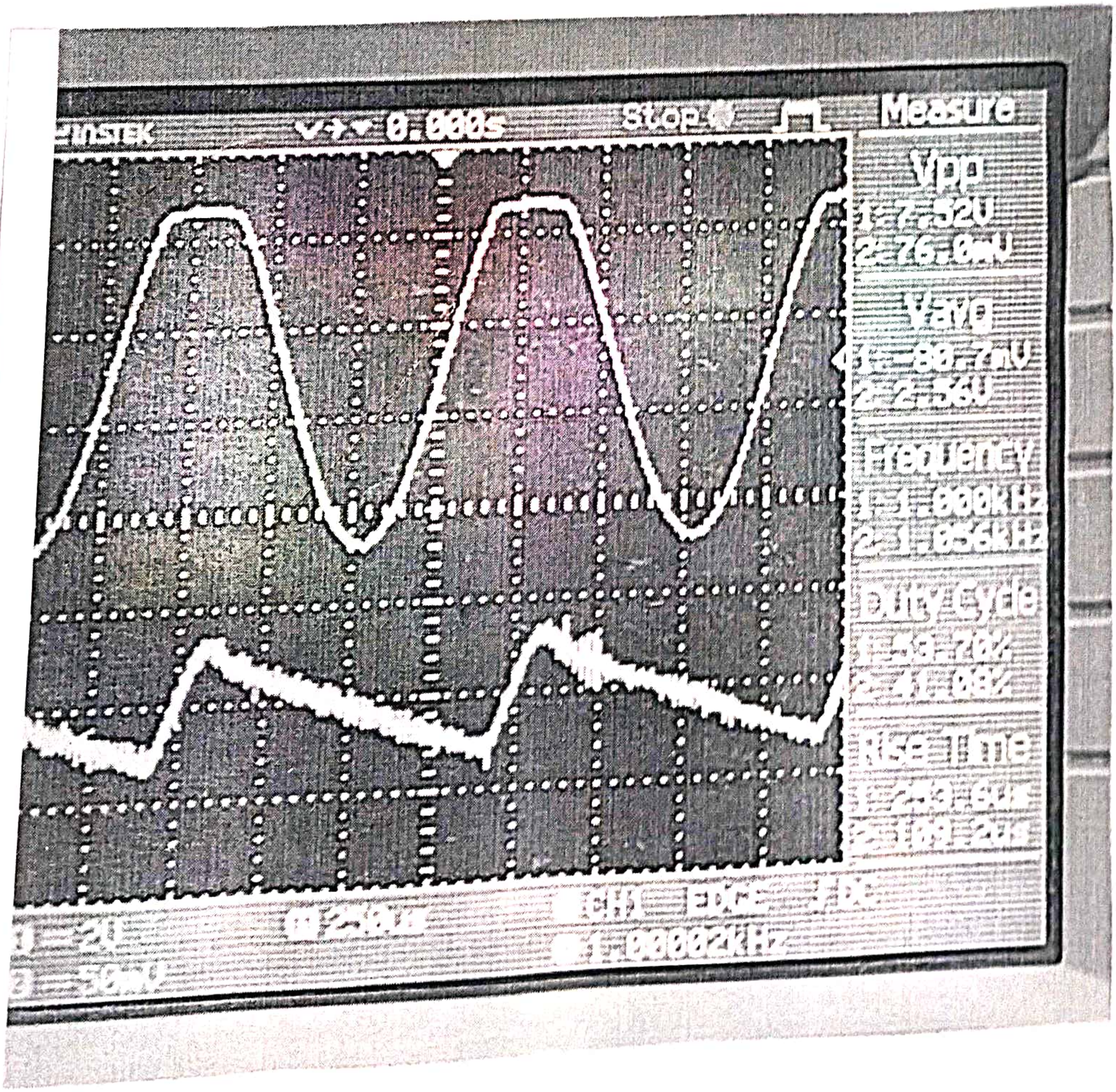
$V_m = \frac{V_{pp}}{2} = \frac{7.52}{2} = 3.76$ V

1) AC input voltage $(V_{RMS}) = \frac{V_m}{2} = \frac{3.76}{2} = 1.88$ V

2) DC output voltage $(V_{dc}) = \frac{V_m}{\pi} = \frac{3.76}{\pi} = 1.197$ V

3) $I_m = \frac{V_m}{R} = \frac{3.76}{1\times10^3} = 3.76\times10^{-3}$ A

Teacher's Signature ____________



INSTEK
0.000s
Stop
Measure
Vpp
1: 7.52V
2: 76.0mV
Vavg
1: -80.7mV
2: 2.56V
Frequency
1: 1.000kHz
2: 1.056kHz
Duty Cycle
1: 53.70%
2: 41.08%
Rise Time
1: 253.6us
2: 109.2us
250us
CH1 EDGE DC
1.00002kHz
2V
50mV

DC current $(I_{dc}) = \frac{I_m}{\pi} = \frac{3.76 \times 10^{-3}}{3.14} = 1.197 \times 10^{-3}$ A

Ripple factor $\cancel{r} = r = \sqrt{\frac{(I_m/2)}{(I_m/\pi)^2} - 1}$

$= \sqrt{\left(\frac{1.88 \times 10^{-3}}{1.197 \times 10^{-3}}\right)^2 - 1}$

$= 1.211$

Result
The experiment was successfully conducted.
r (without capacitor) = 4.83
r (with capacitor) = 1.211

08

23/05/22

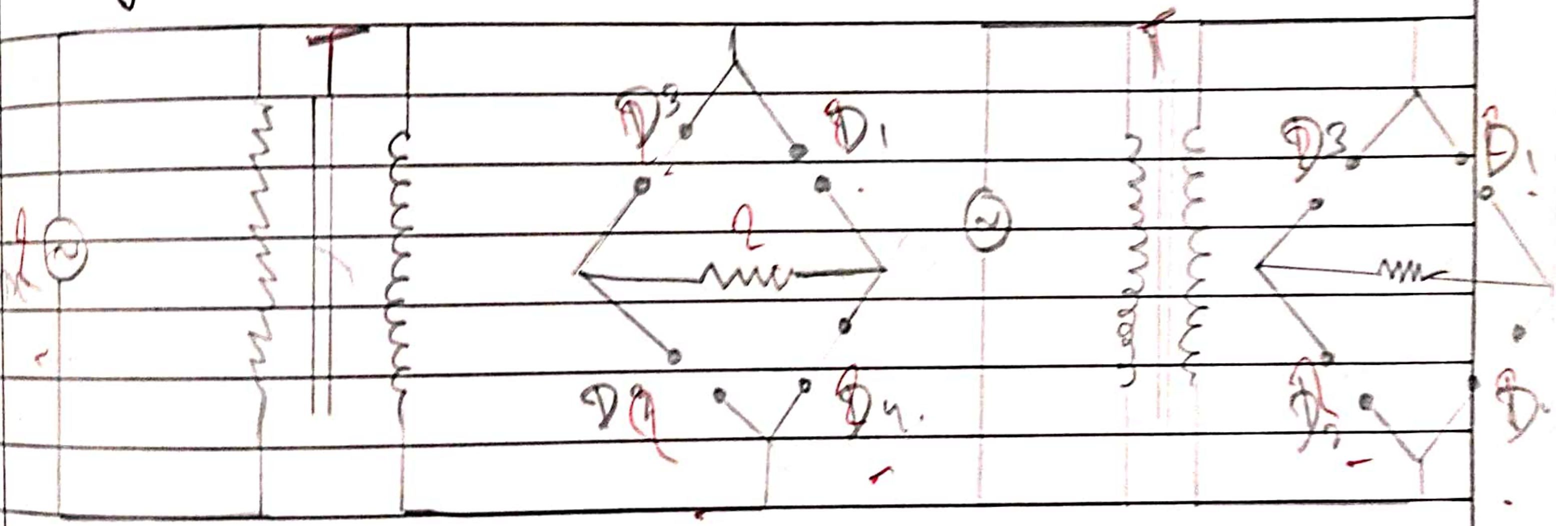
Experiment - 10

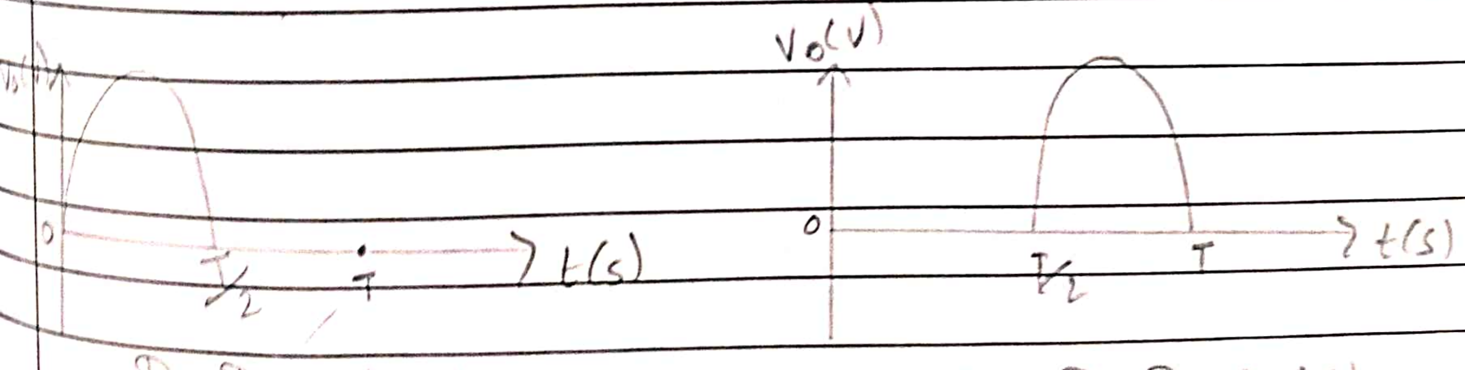
Aim - To design a bridge rectifier circuit (without and with capacitor) and also plot the output waveform. Calculate peak values, rms value and ripple factor.

Apparatus Used: Diode, capacitor form, resistance, step down transformer, DSO, bread board, connecting wire

During +ve half cycle $0 \to \frac{T}{2}$

Theory without capacitor

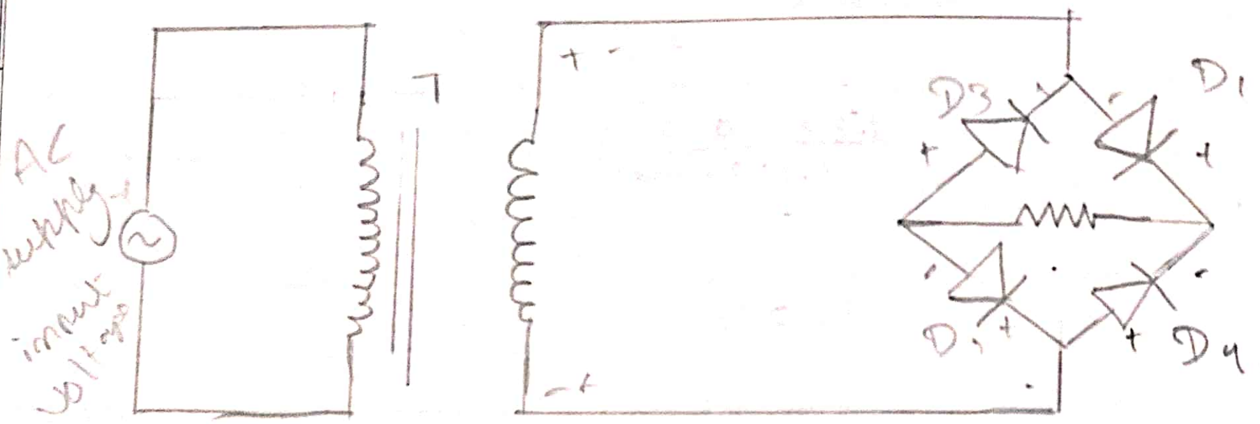


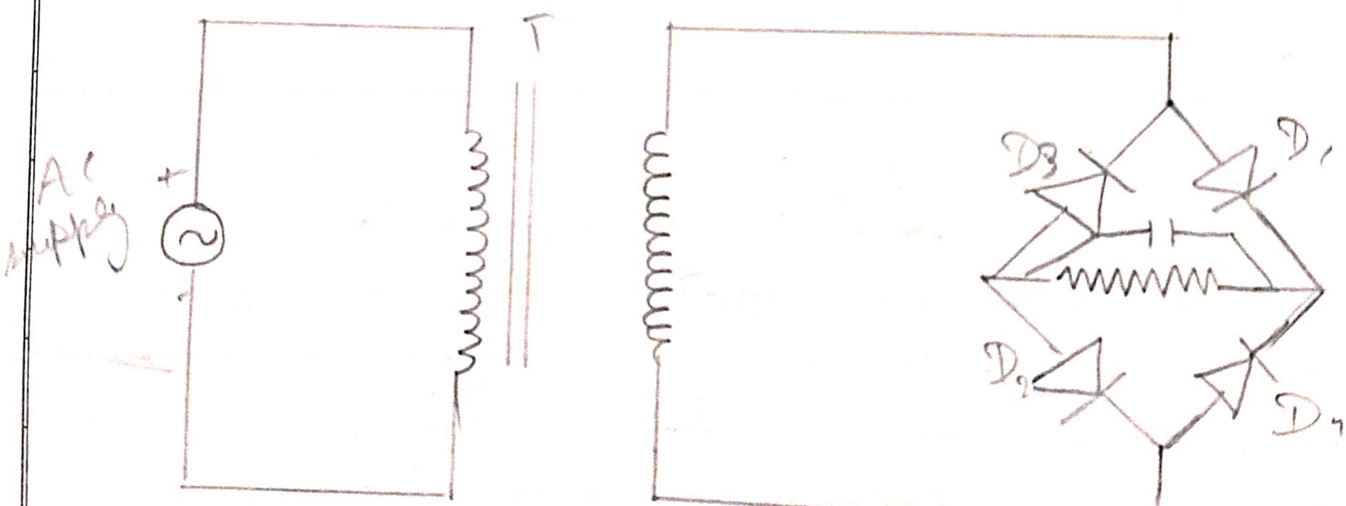


D1 & D2 → ON

D3, D2, D4 → ON

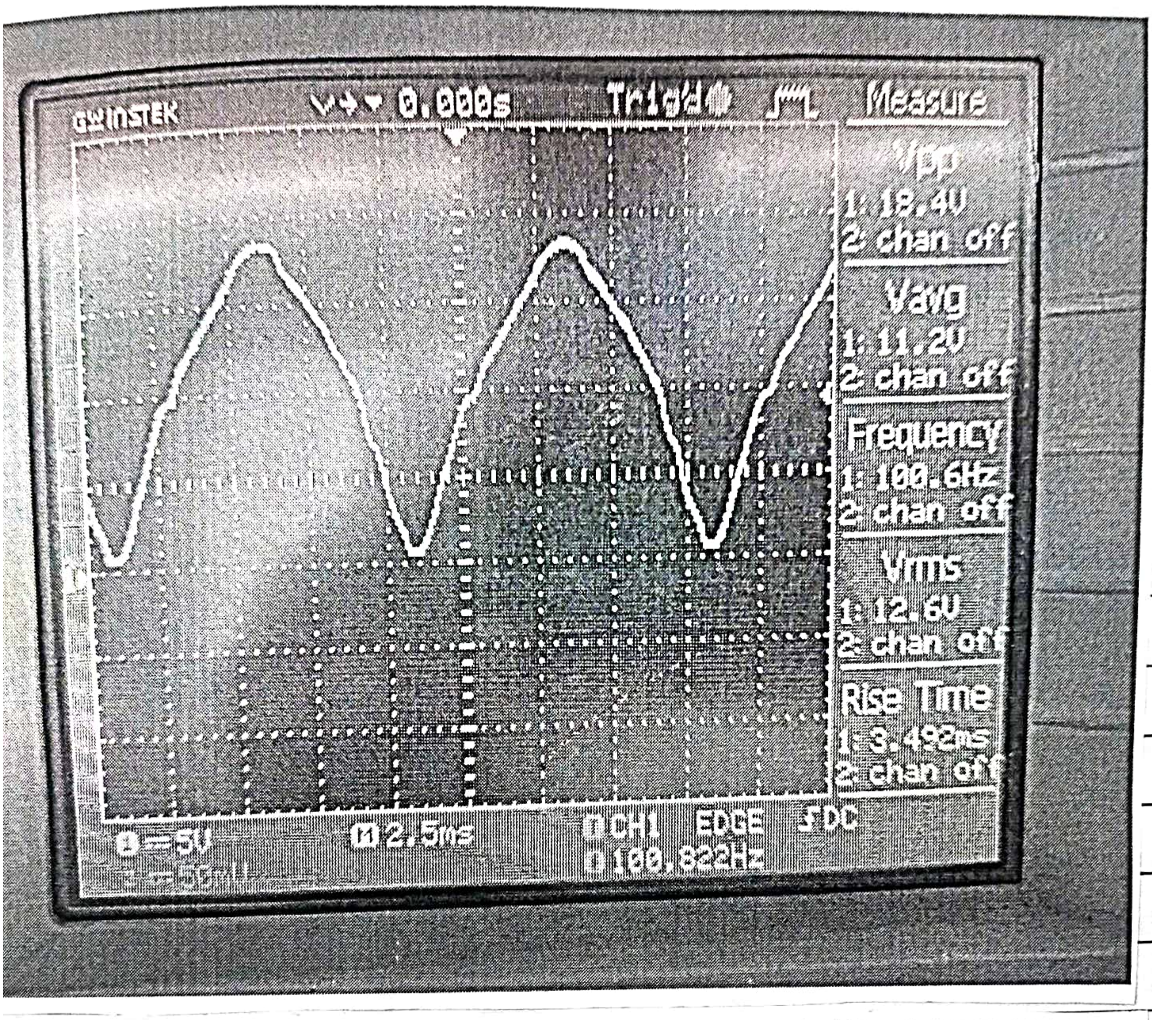
Teacher's Signature

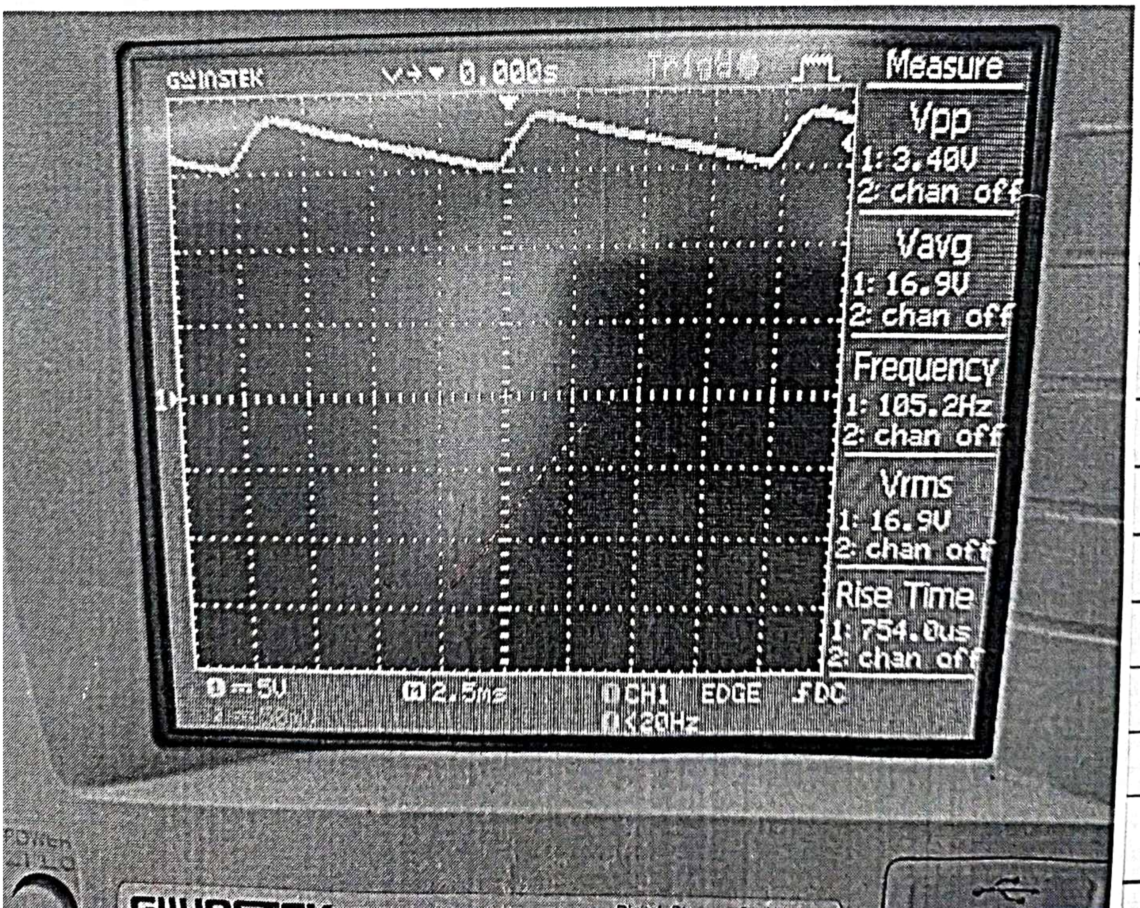




without capacitor.

Expected Waveform.
Input waveform:





Expt. N

Observation :-

Without capacitor.

Vpp (V)	Vavg (V)	Vrms (V)	freq (Hz)	Ripple factor (γ)
18.4	11.2	12.6	100.6	0.~~125~~515

Ripple factor $= \sqrt{\left(\frac{V_{rms}}{V_{avg}}\right)^2 - 1} = \sqrt{\left(\frac{12.6}{11.2}\right)^2 - 1} = \cancel{1.125}\ 0.515$

With capacitor.

Vpp (V)	Vavg (V)	Vrms (V)	freq (Hz)	Ripple factor (γ)
3.40	16.9	16.9	105.2	1.

Ripple factor $= \sqrt{\left(\frac{V_{rms}}{V_{avg}}\right)^2 - 1} = \sqrt{\left(\frac{16.9}{16.9}\right)^2 - 1} = 0$

Result

The experiment was succesfully conducted R.F of without rectifier and with rectifier is 0

8

30/5/22

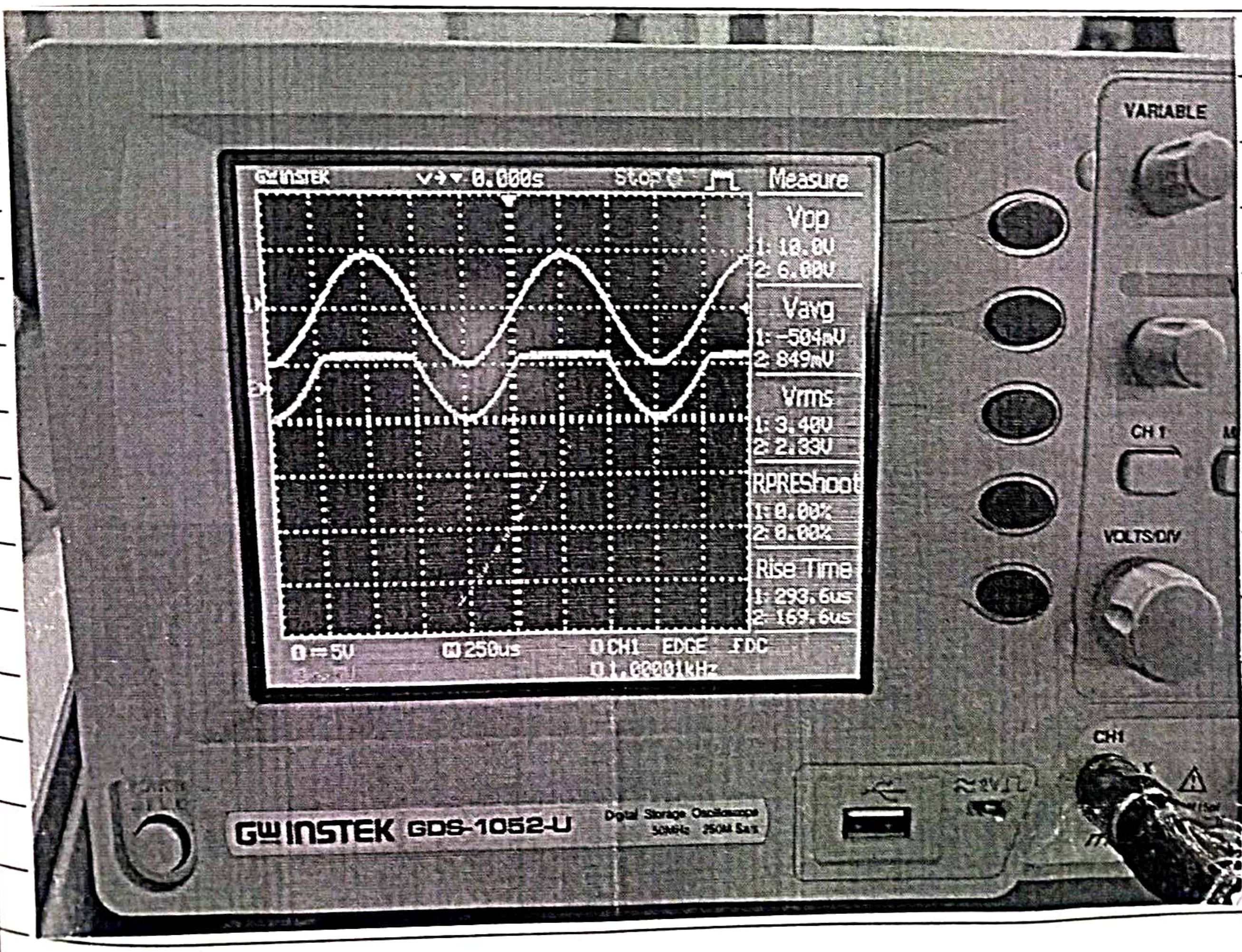
Teacher's Signature ______

Experiment - 11

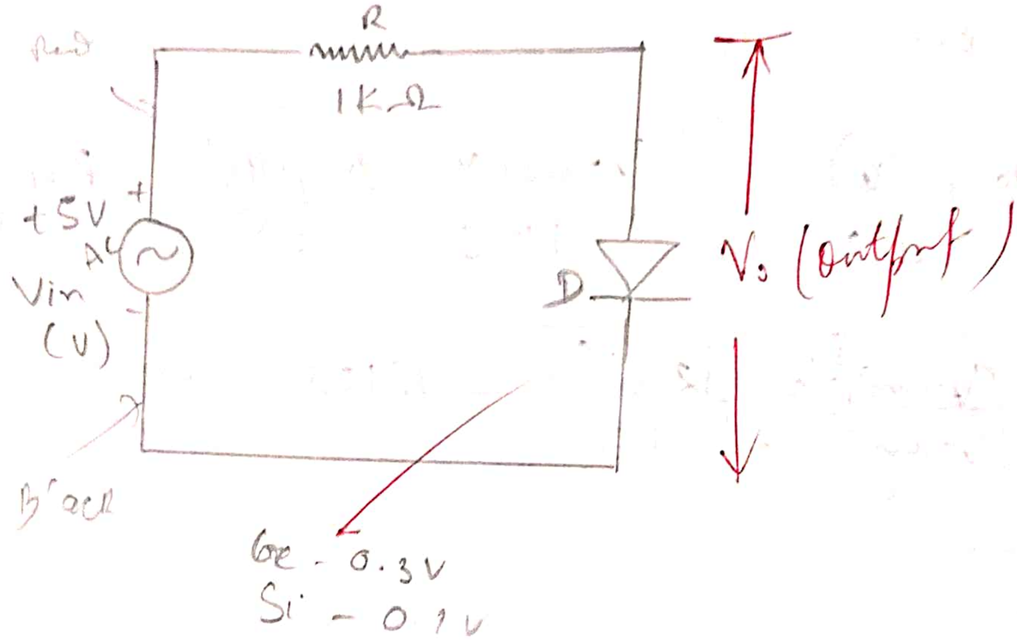
Aim - Design and study clipper circuit.

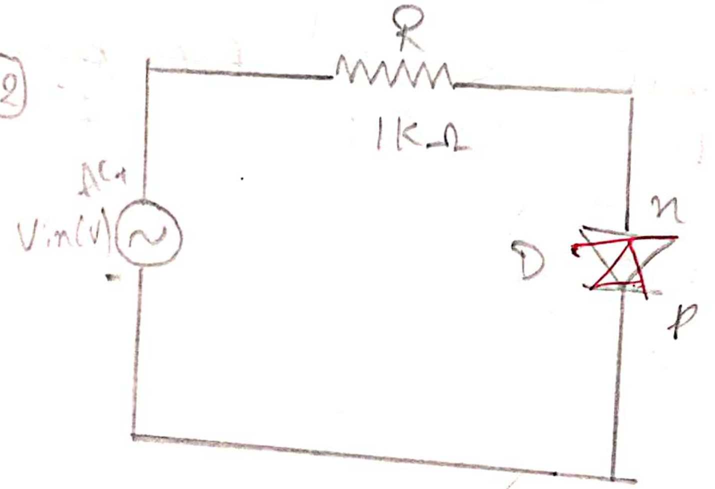
Apparatus Used :- Function generator, DSO, dc power supply, resistance, bread board, probe and connecting wire.

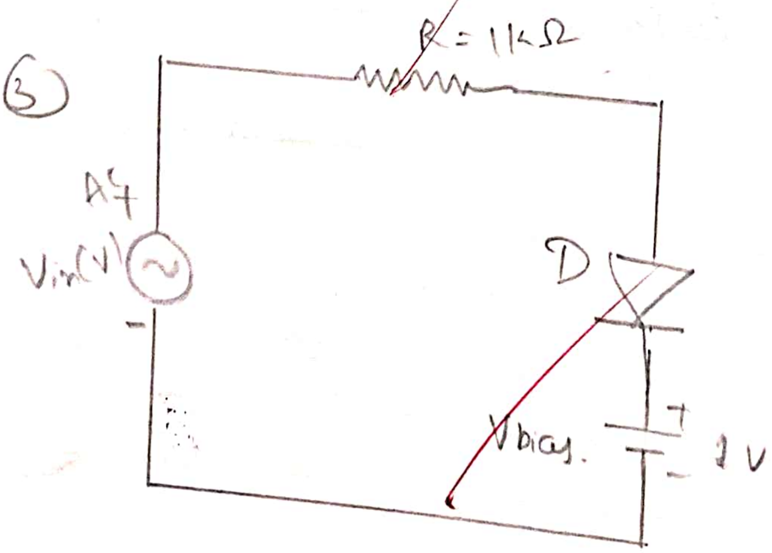
Theory - Circuit with which waveforms can be shaped by removing a portion of the signal is known as clipper circuit. They are used as limiters / slicers to clip the waveform above / below a certain level.

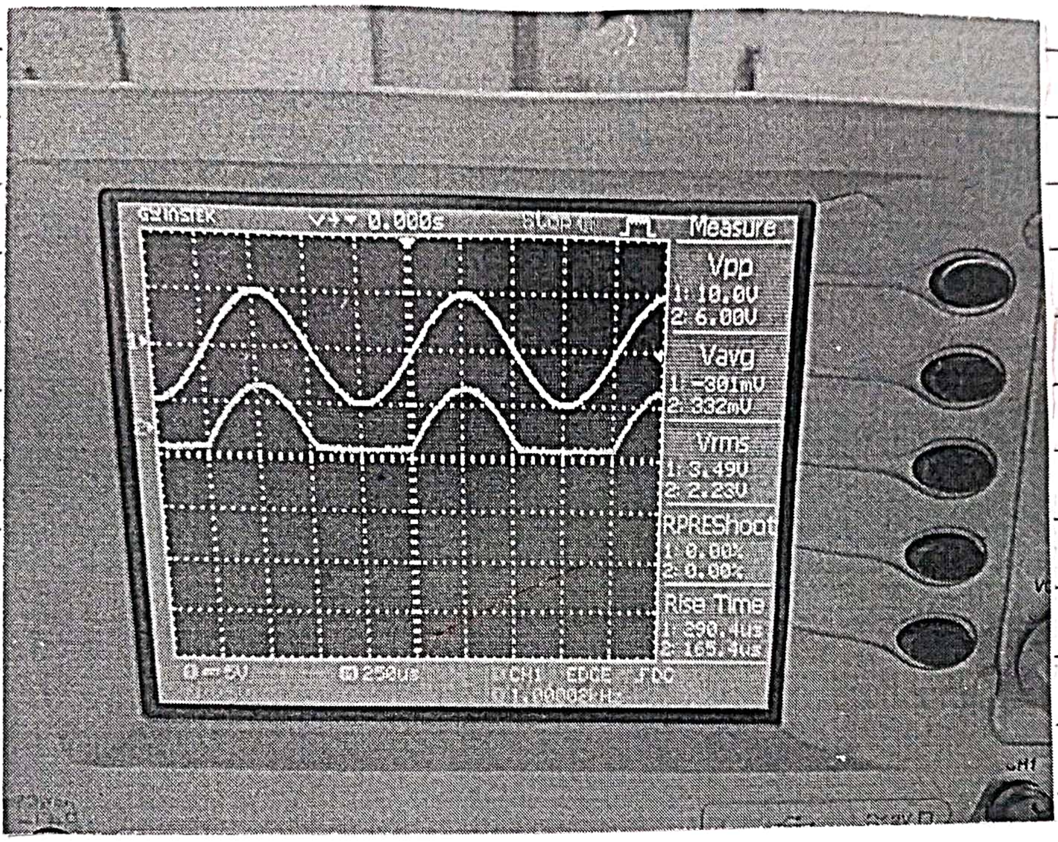


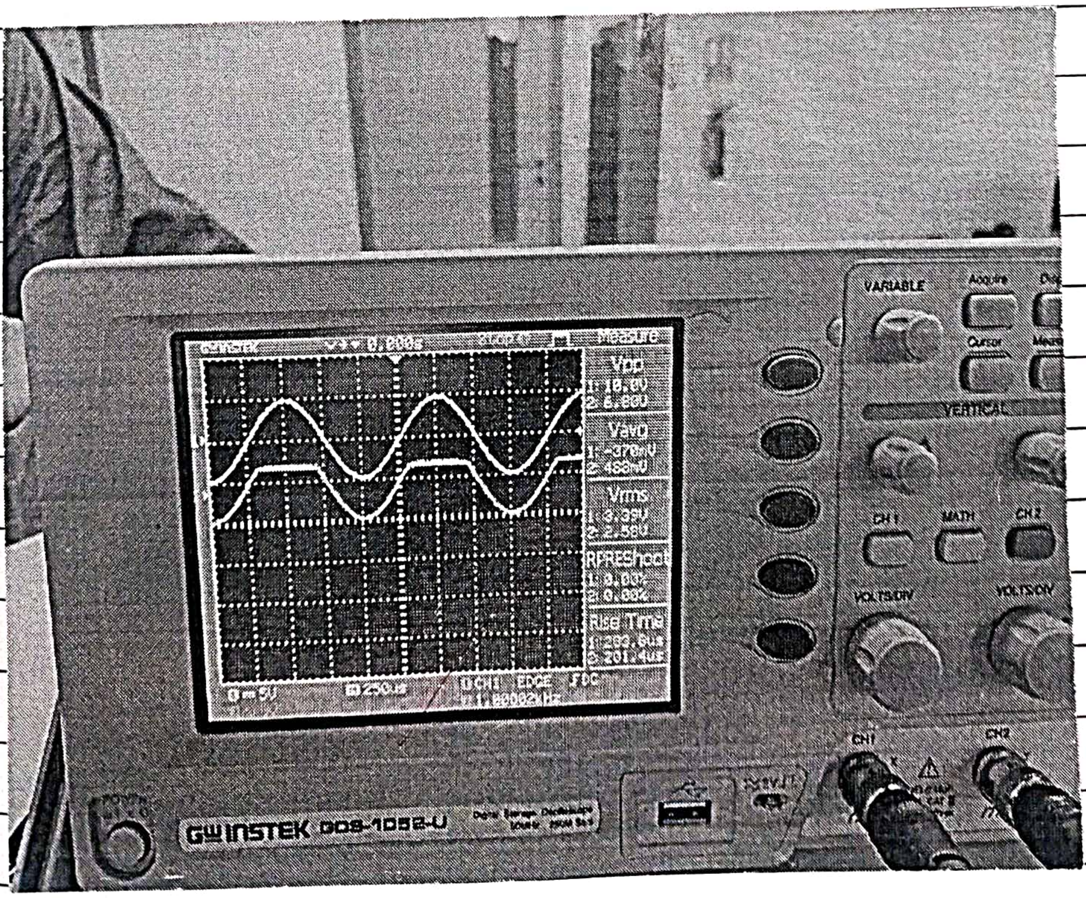
Circuit Diagram.

①


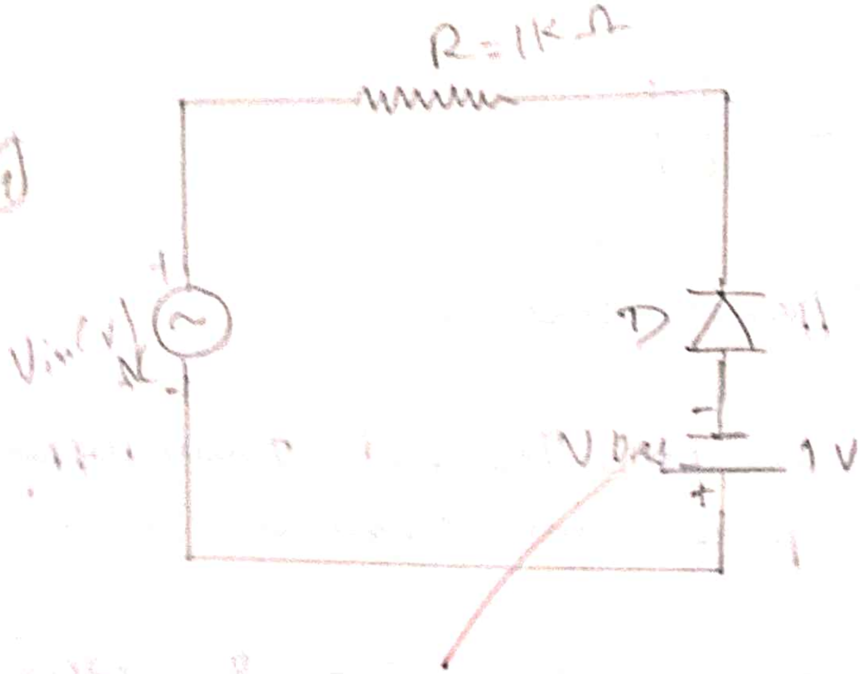
②


③


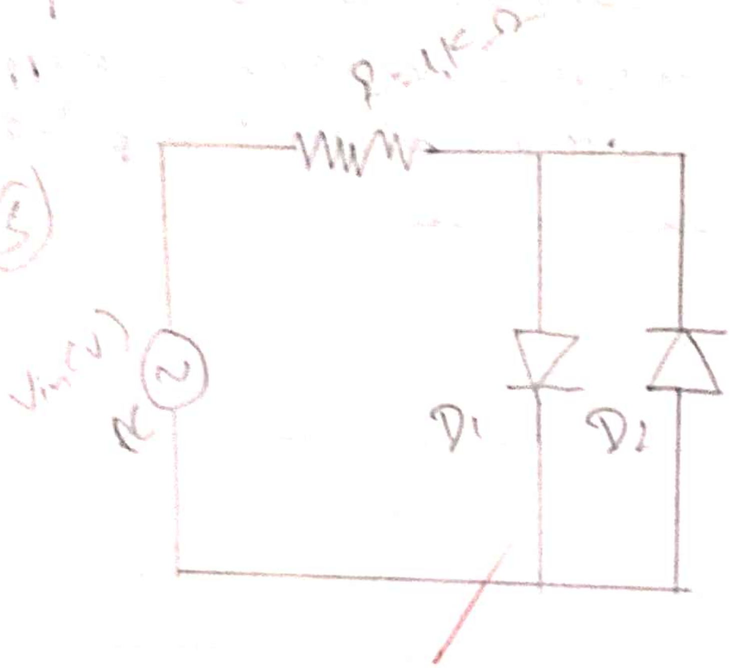

GW INSTEK
0.000s
Measure
Vpp
1: 10.0V
2: 6.00V
Vavg
1: -301mV
2: 332mV
Vrms
1: 3.49V
2: 2.23V
RPREShoot
1: 0.00%
2: 0.00%
Rise Time
1: 290.4us
2: 165.4us
5V
250us
CH1 EDGE DC

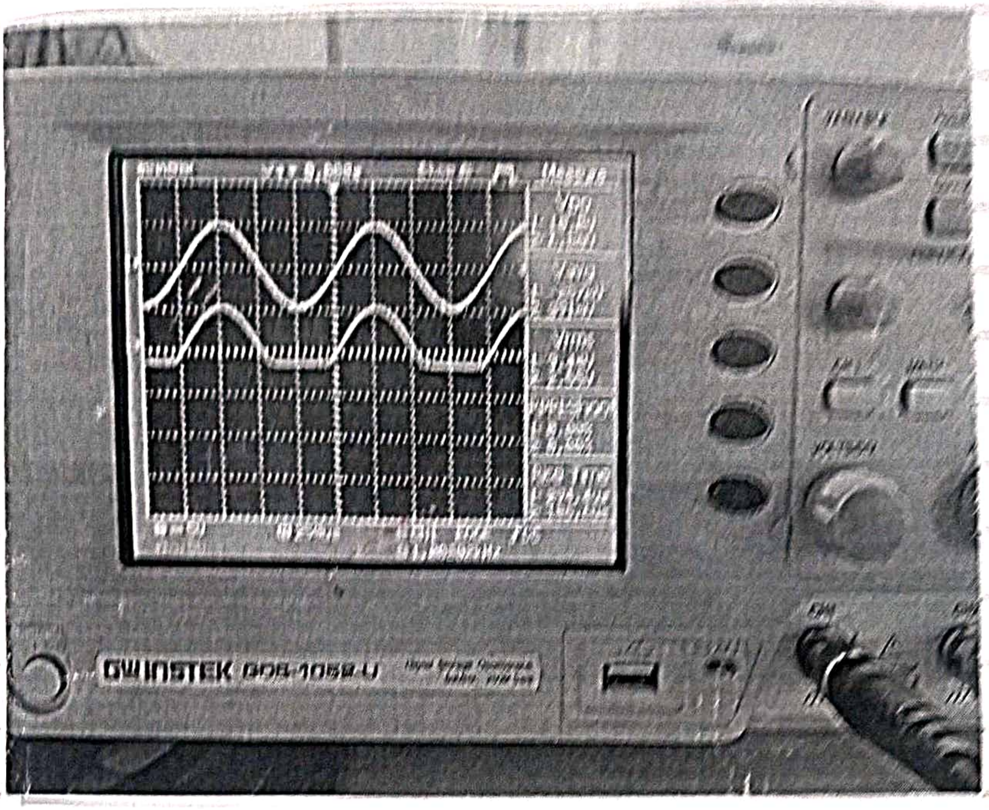

Measure
Vpp
1: 10.0V
Vavg
Vrms
RPREShoot
Rise Time
5V
250us
CH1 EDGE DC
VARIABLE
Acquire
Cursor
VERTICAL
CH 1
MATH
CH 2
VOLTS/DIV
VOLTS/DIV
CH1
CH2
POWER
GW INSTEK GDS-1052-U

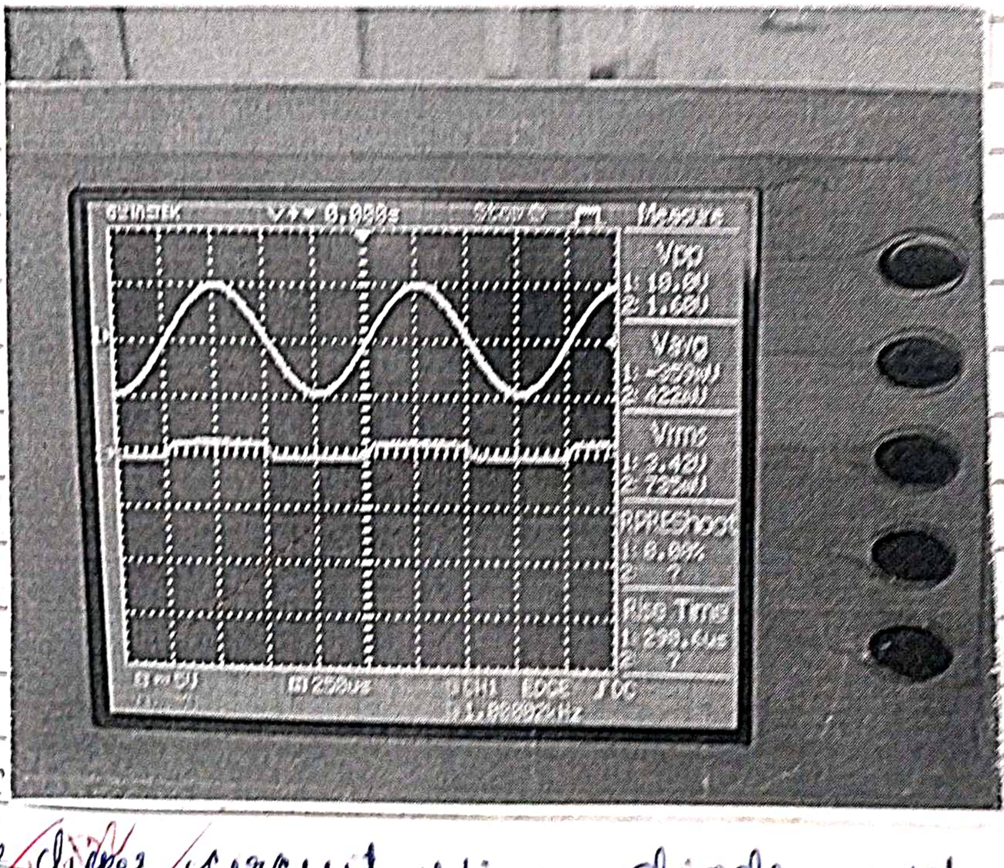
(4)



(5)







Result

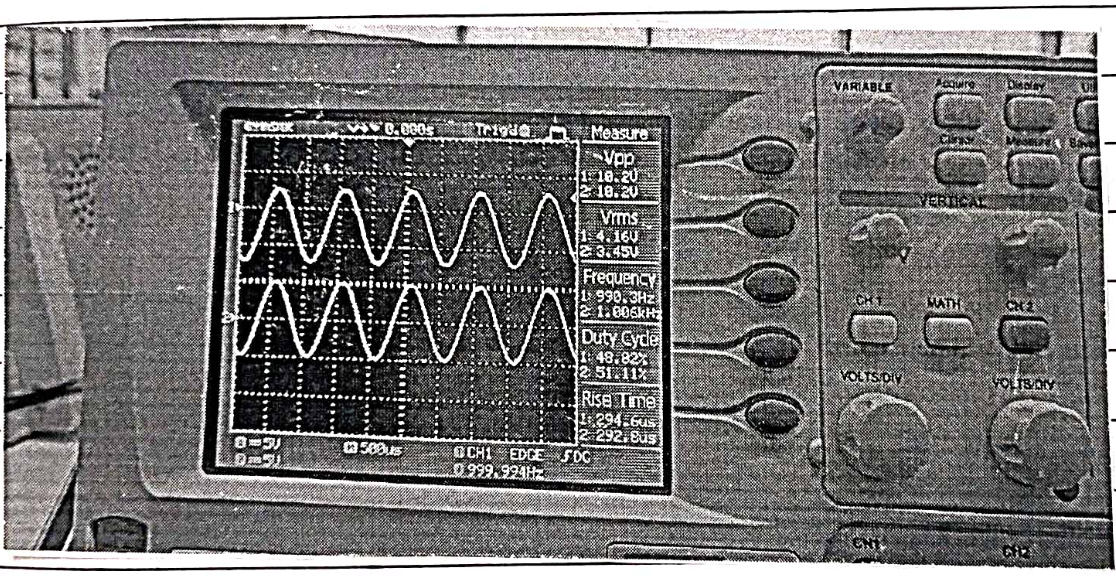
The clipper circuit using diode was studied.

Teacher's Signature

Experiment - 12

Aim
Study and perform Clamper circuit.

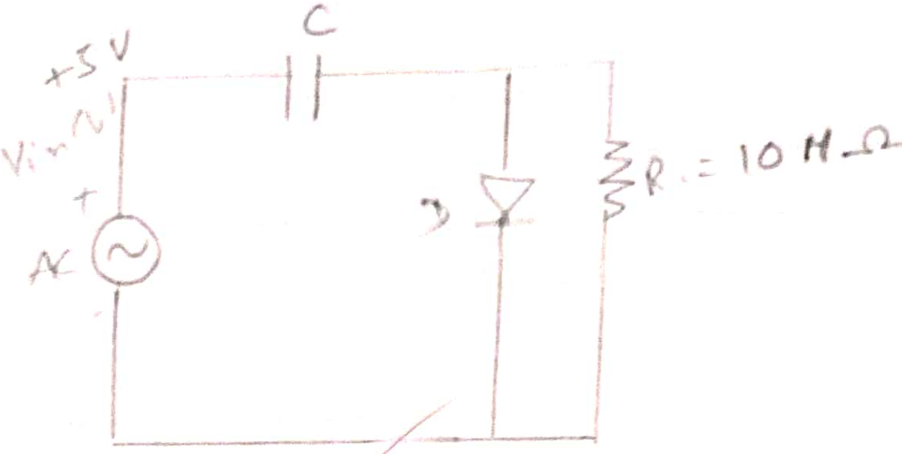
Apparatus Used
Function generator, DSO, capacitor (0.01 μF), resistance (10 M Ω), bread board, probe and connecting wire.



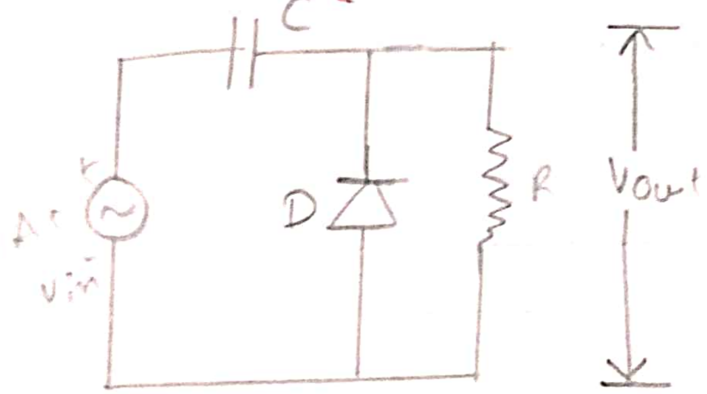
Theory

Clamping circuit are used to change the dc levels of an alternating waveform without changing the shape of waveform. This is one more application of a diode ~~circuit~~.

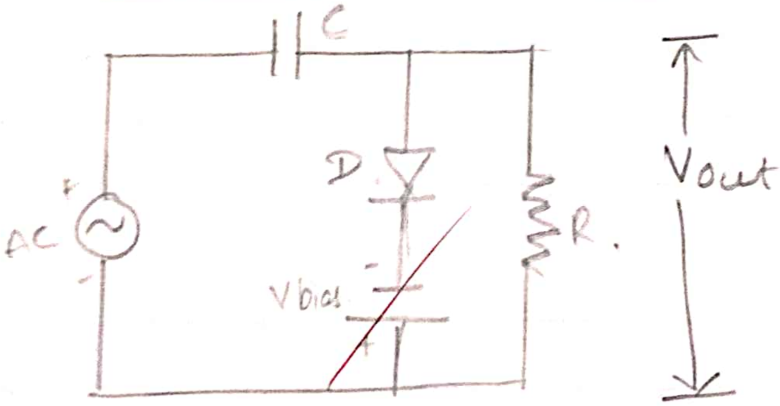
1


C
+5V
Vin
+
AC
D
R. = 10 MΩ

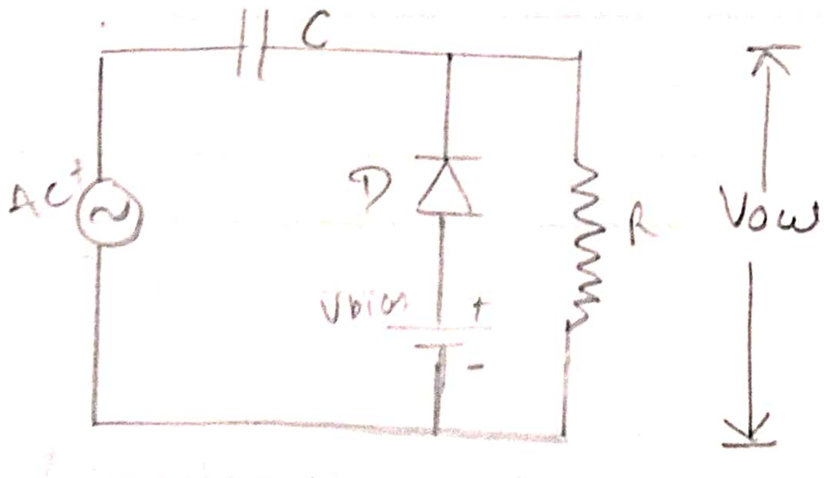
2

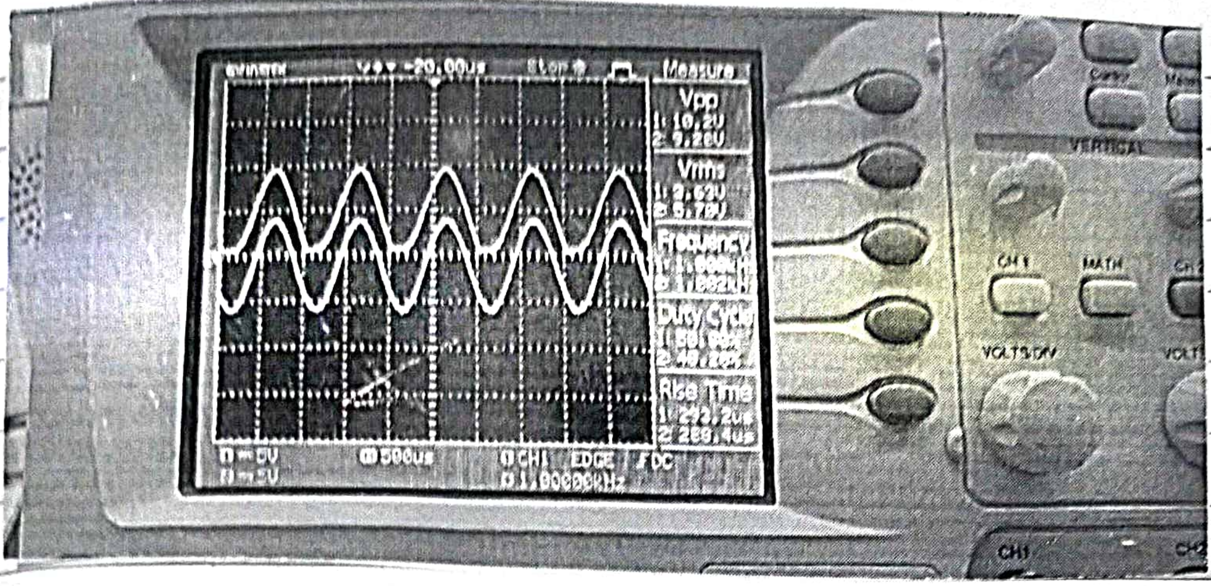

C
+
AC
Vin
D
R
Vout

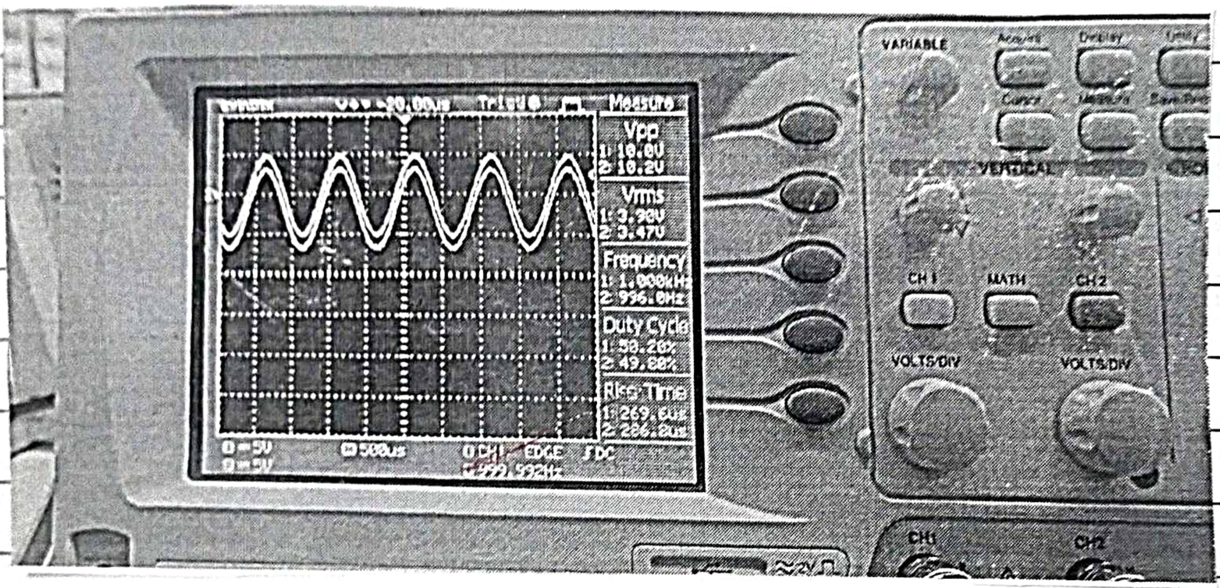
3

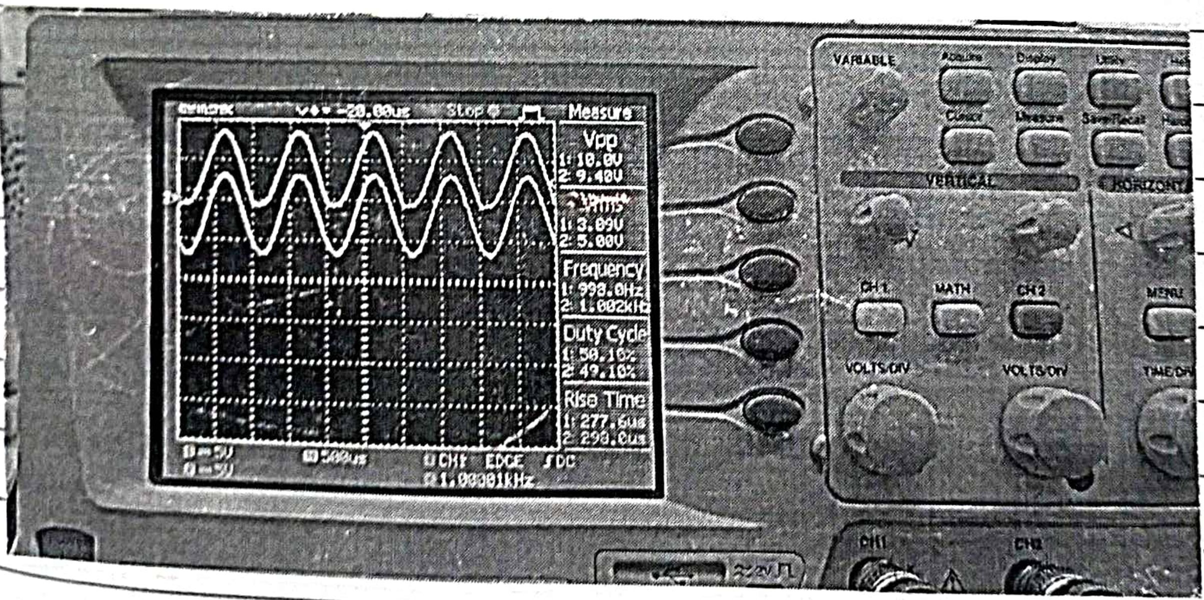

C
+
AC
-
D
Vbias
-
+
R.
Vout

4


C
AC
+
D
Vbias
+
-
R
Vout







Result.

Circuit have been designed.

Waveform have been obtained.

1	Study of various measurement equipment.	01	21/3/22	
2.	Verification of ohm's law Kirchoff's current law and voltage law.	07	28/3/22.	
3.	To study and verification of Thevenin's Theorem.	11	4/4/22	
4	Study and perform superposition theorem.	14	11/4/22.	
5	Verification of maxima power Transfer theorem.	17	18/4/22	
6	Study of Low Pass High Pass characteristics of RC filter circuit	21	25/4/22	
7	~~To study and measurement of~~			
7	To study and measurement of current (I-V) (V-I) characteristic of P-n junction diode (Ge or Si)	25	2/5/22	
8	① To study V-I characteristic of zener diode ② To study zener diode as voltage regulator	27	16/5/22	
9	To design and study of half wave rectifier	30	21/5/22	
		34	23/5/22	
10	To design a bridge rectifier circuit.			

11	Design and study dipper circuit	37	30
12	Study and perform clamper circuit	40	30