INDEX

S.No.	Name of Experiments	Date	Sign	Remark
(1)	Study of CRO and measurement of voltage and frequency			
(2)	Study of component and component ~~ring~~ testing			
(3)	To plot V-I characteristic of PN-Junction Diode under forward and reverse bias condition.			
(4)	To plot the characteristics of Zener diode reverse Bias condition.			
(5)	Study of half wave rectifier, draw the input and output wave form and calculate the ripple factor.			
(6)	Study of full wave rectifier, Draw the input and output wave form and calculate the ripple factor.			

Experiment No-01

Object - Study of CRO and measurement of voltage and frequency.

Apparatus Used - CRO and function generator.

Cathode Ray Oscilloscope (CRO) - The cathode Ray Oscillascope is a common laboratory instrument that provide accurate timer and measurement of valitage provide signals over a wide range of frequency. The signals to be displayed is amplified by a vertical amplifier and applied to the vertical plate of the CRT sweep trigger generation pulse which switches on the sweep generator. Initially, it is a sawtooth waveform.

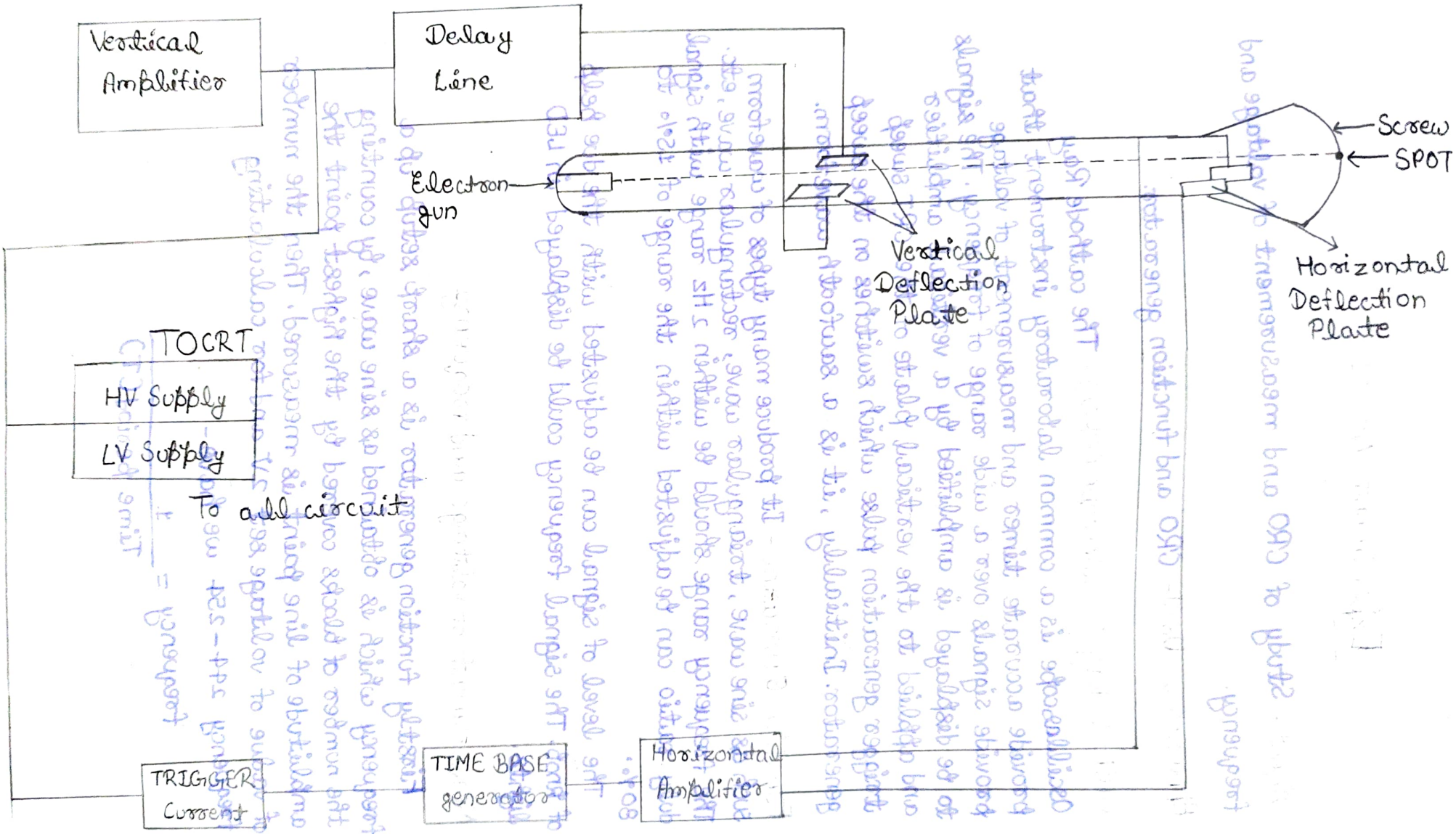
Function Generator - It produce many types of waveform such as sine wave, triangular wave, rectangular wave, etc. The frequency range should be within 2 Hz range with signal duly ratio can be adjusted within the range of 15% to 80%.

The level of signal can be adjusted with the due help of knob. The signal frequency could be displayed in LED lights.

Measurement of voltage and frequency

Firstly function generator is a sharp setup up a frequency which is obtained as sine wave, by counting the number of blocks covered by the highest point the amplitude of line point is measured. Then the number of value of voltage set 2V and for calculating frequency 244-254 we have -

$$\text{frequency} = \frac{1}{\text{Time period (T)}}$$



BLOCK DIAGRAM OF CRO

Onto Y-axis -

input voltage = 2V per cm

for 4 blocks (4cm) = 8V

Onto X-axis -

Time period per block (1cm) = 0.5mS

for 4 blocks (4cm) = 2mS

frequency = $\frac{1}{2mS}$ = 500 Hz

Calculations - % error in frequency = $\frac{(\text{Initial freq} - \text{observed freq}) \times 100}{\text{Initial freq.}}$

$= \frac{544 - 500}{544} \times 100$

$= 8.08\%$

Precautions - (1) While doing the experiment, do not exceed the ratings of the diode.

(2) Ensure all the connections are done properly and do not switch on the power supply unless you have checked the same.

Result - Voltage measured = 8 V

Frequency measured = 500 Hz

Error in observation = 8.08%.

Experiment - 2

Object - Study of component and component testing

Apparatus Used - CRO, resistor, transistor, capacitor, zener diode, p-n junction diode

Resistor - A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal level, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

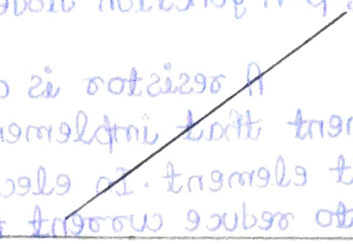
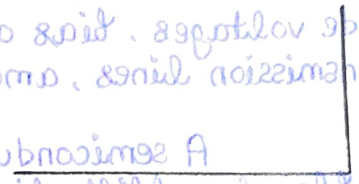
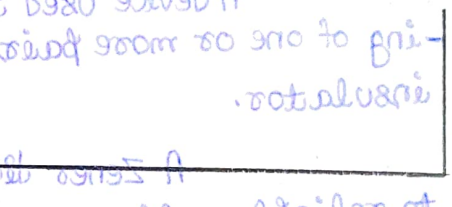
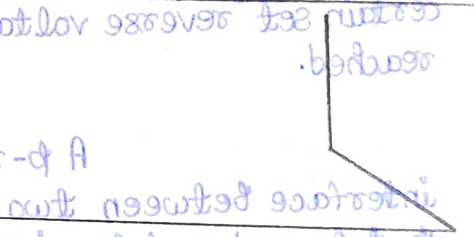
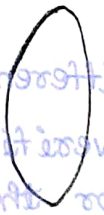
Transistor - A semiconductor device with three connections, capable of amplification in addition to rectification.

Capacitor - A device used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator.

Zener Diode - A Zener diode is a special type of diode designed to reliably allow current to flow "backwards" when a certain set reverse voltage, known as the Zener voltage, is reached.

p-n junction diode - A p-n junction is a boundary or interface between two types of semiconductor materials, p-type and n-type, inside a single crystal of semiconductor.

Result - Different figures of various circuit element has been verified through the experiment also while testing for the conductor.

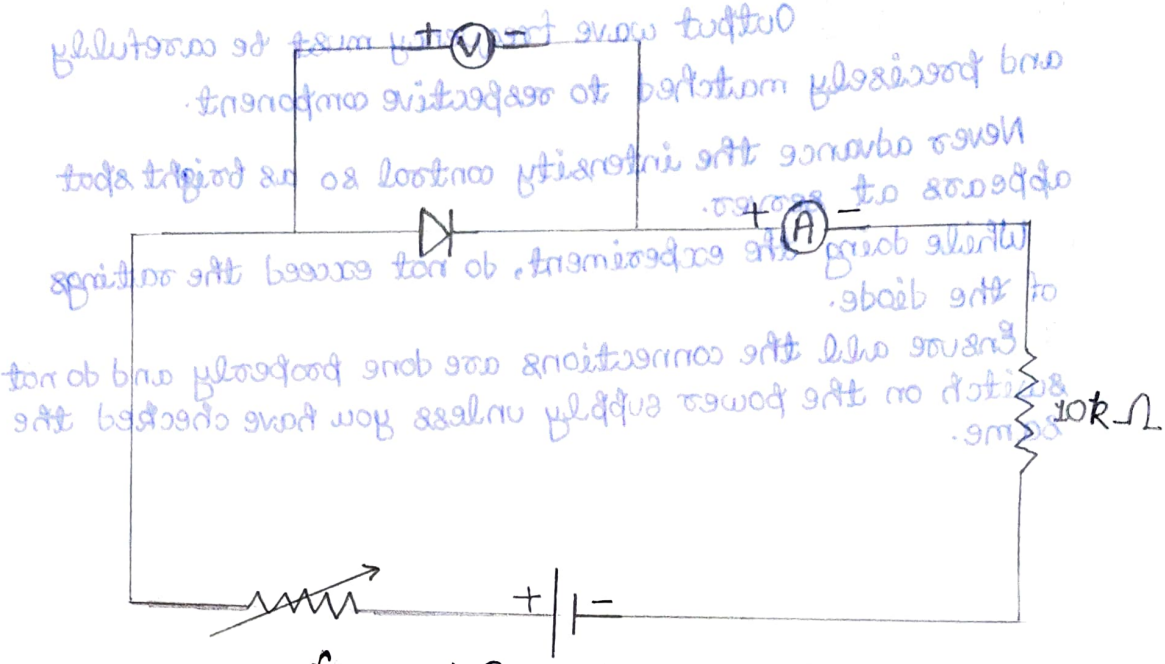
Serial Number	Name of element	Output wave obtained in CRO
1.	Resistor	
2.	Junction BC of transistor	
3.	Junction BE of transistor	
4.	Junction EC of transistor	
5.	Capacitor	
6.	Zener diode	

Precaution - ① Output wave frequency must be carefully and precisely matched to respective component.

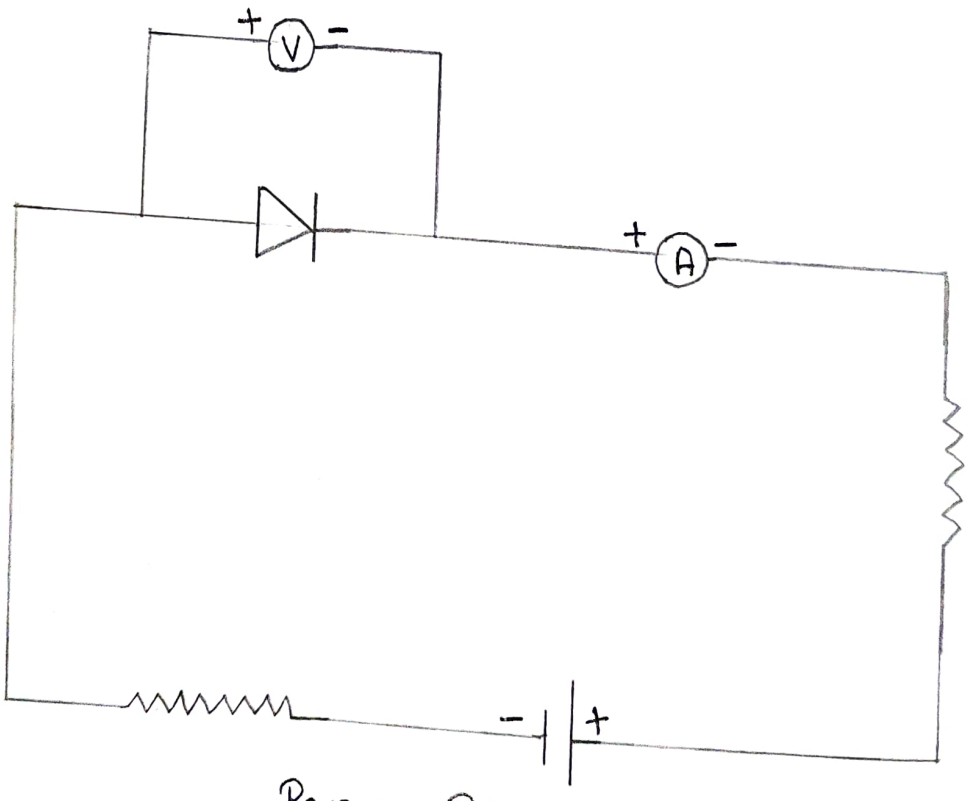
② Never advance the intensity control so as bright spot appears at server.

③ While doing the experiment, do not exceed the ratings of the diode.

④ Ensure all the connections are done properly and do not switch on the power supply unless you have checked the same.



Forward Biased



Reverse Biased

Experiment - 03

Object - To plot V-I characteristics of p-n junction diode under forward and reverse bias condition.

Apparatus Used - p-n junction diode, ammeter, voltmeter, power supply.

Theory -

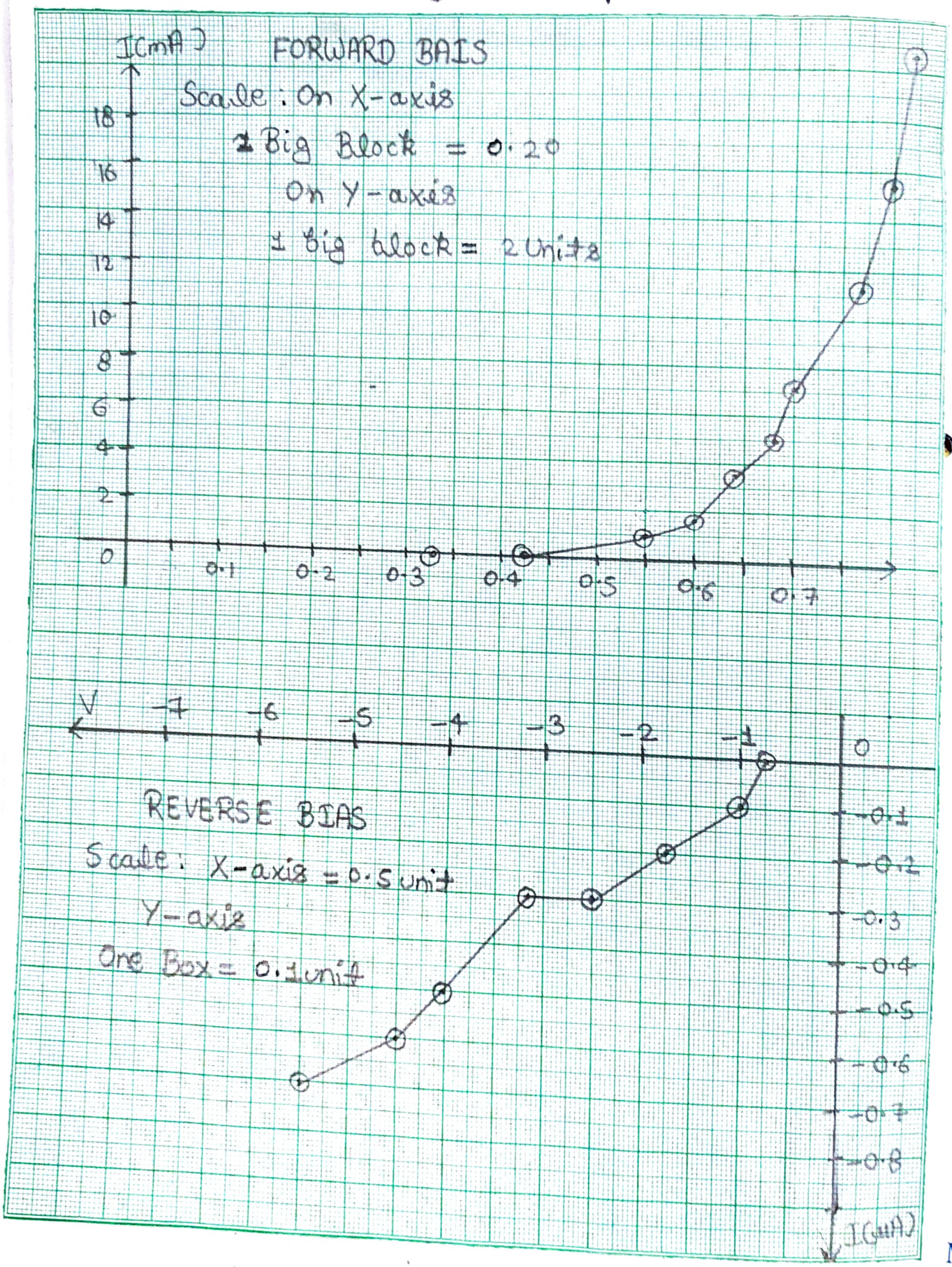
(1) Zero External voltage - When external voltage is zero i.e. the circuit is open the potential barrier at junction does not permit circuit current is zero.

(2) Forward Biased - The potential barrier depletion region is reduced by applying forward biased resulting in heavy majority flow across the junction.

(3) p-n junction diode - A p-n junction diode is a two terminal or two electrode semiconductor device which is formed when p-type and n-type extrinsic semiconductor are joined. It allows current flow in one direction only.

(4) Reverse Biased - In reverse biasing, negative of diode is connected to positive of battery and positive of diode is connected to negative of battery. The current flowing in this condition is called leakage current.

Knee Voltage - Knee voltage can be defined as max. voltage applied to a p-n junction in forward biased region for which the diode starts conducting.


I(mA)
FORWARD BAIS
Scale: On X-axis
1 Big Block = 0.20
On Y-axis
1 big block = 2 Units
18
16
14
12
10
8
6
4
2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
V
-7
-6
-5
-4
-3
-2
-1
0
REVERSE BIAS
Scale: X-axis = 0.5 unit
Y-axis
One Box = 0.1 unit
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
I(μA)

Observations

Forward Bias		Reverse Bias	
Voltage (V)	I (mA)	Voltage (V)	I (μA)
0.38	0	0.11	0
0.42	0	0.62	0
0.55	1	1.0	0.1
0.59	1.5	1.7	0.2
0.61	3	2.5	0.3
0.68	5.1	3.1	0.3
0.70	6.3	4	0.5
0.76	11.2	4.5	0.6
0.80	15.3	4.5	0.7

Calculations

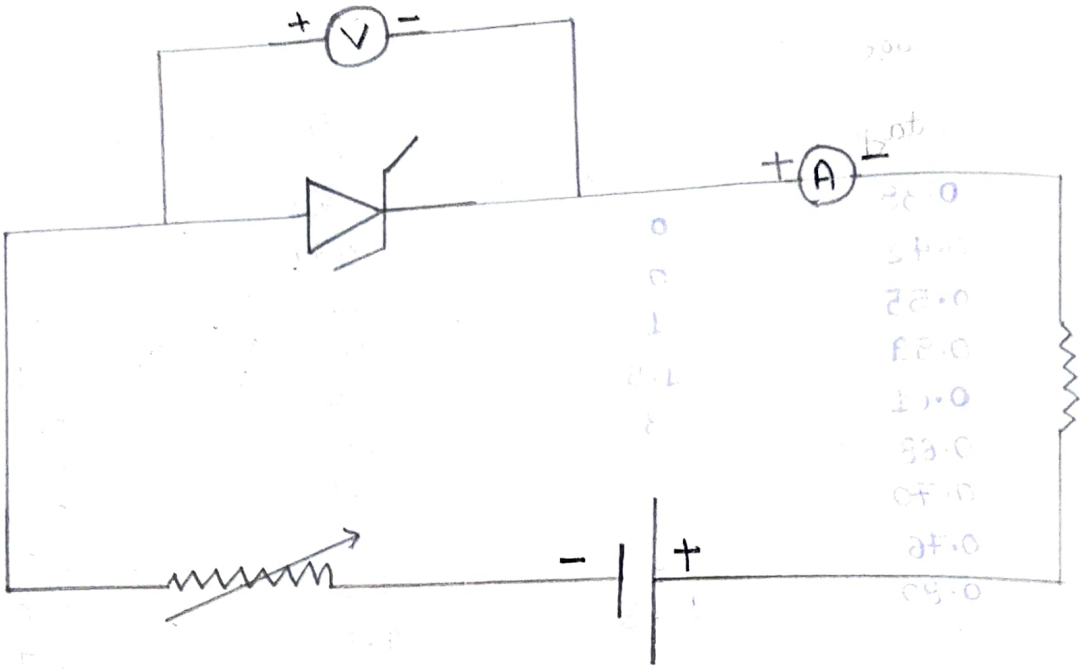
$$\% \text{ Error} = \left(\frac{0.7 - 0.68}{0.7}\right) \times 100 = 2.85\%$$

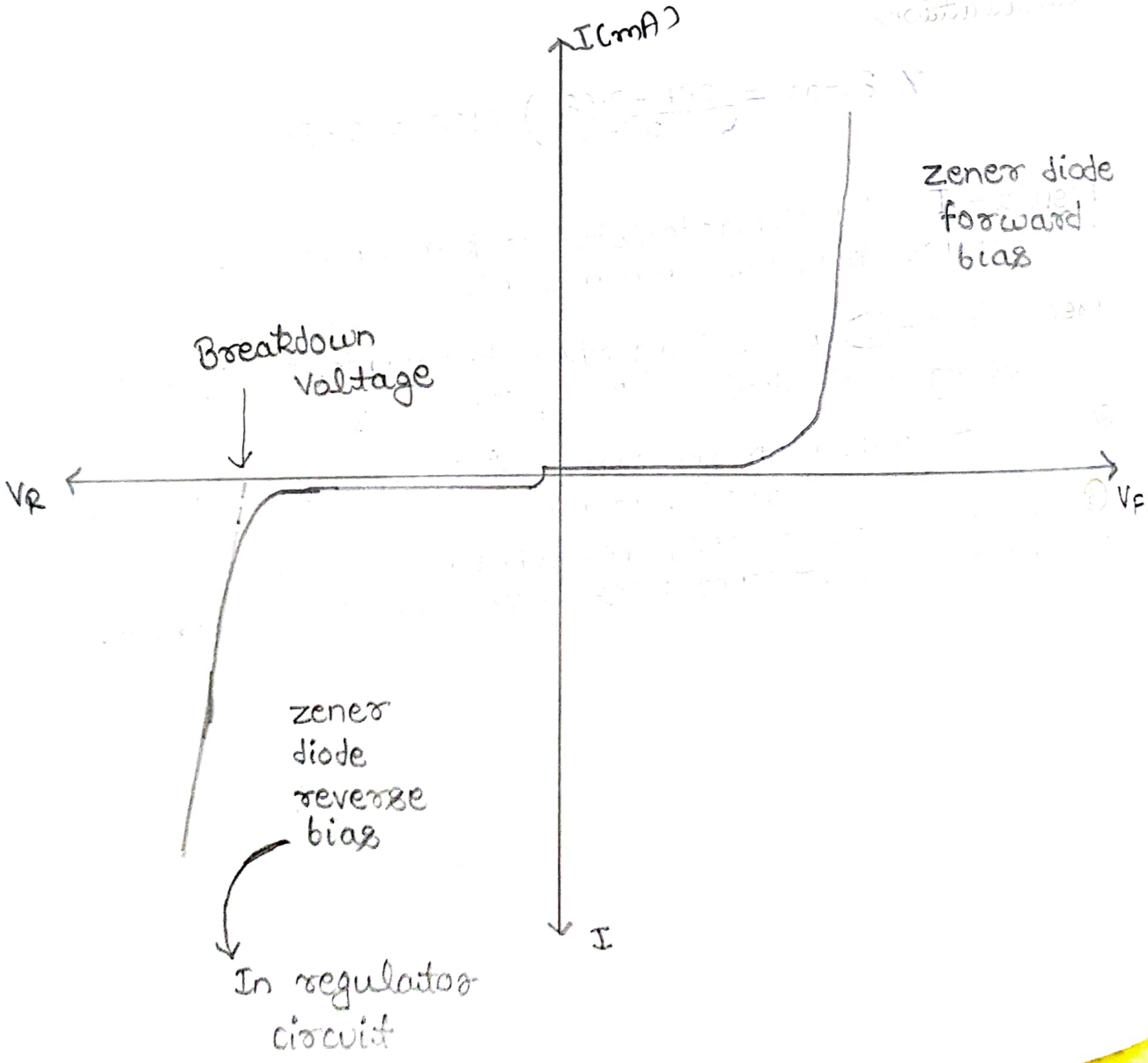
Result - The VI characteristic of p-n junction in reverse and forward bias has been verified.

Precautions - (1) While doing the experiment do not exceed the rating of the diode.

(2) Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

(3) Do not switch on the power supply unless you have checked the circuit connections as per the circuit diagram.


+
V
−
+
A
−
−
+


I(mA)
zener diode
forward
bias
Breakdown
voltage
VR
VF
zener
diode
reverse
bias
I
In regulator
circuit

Experiment - 04

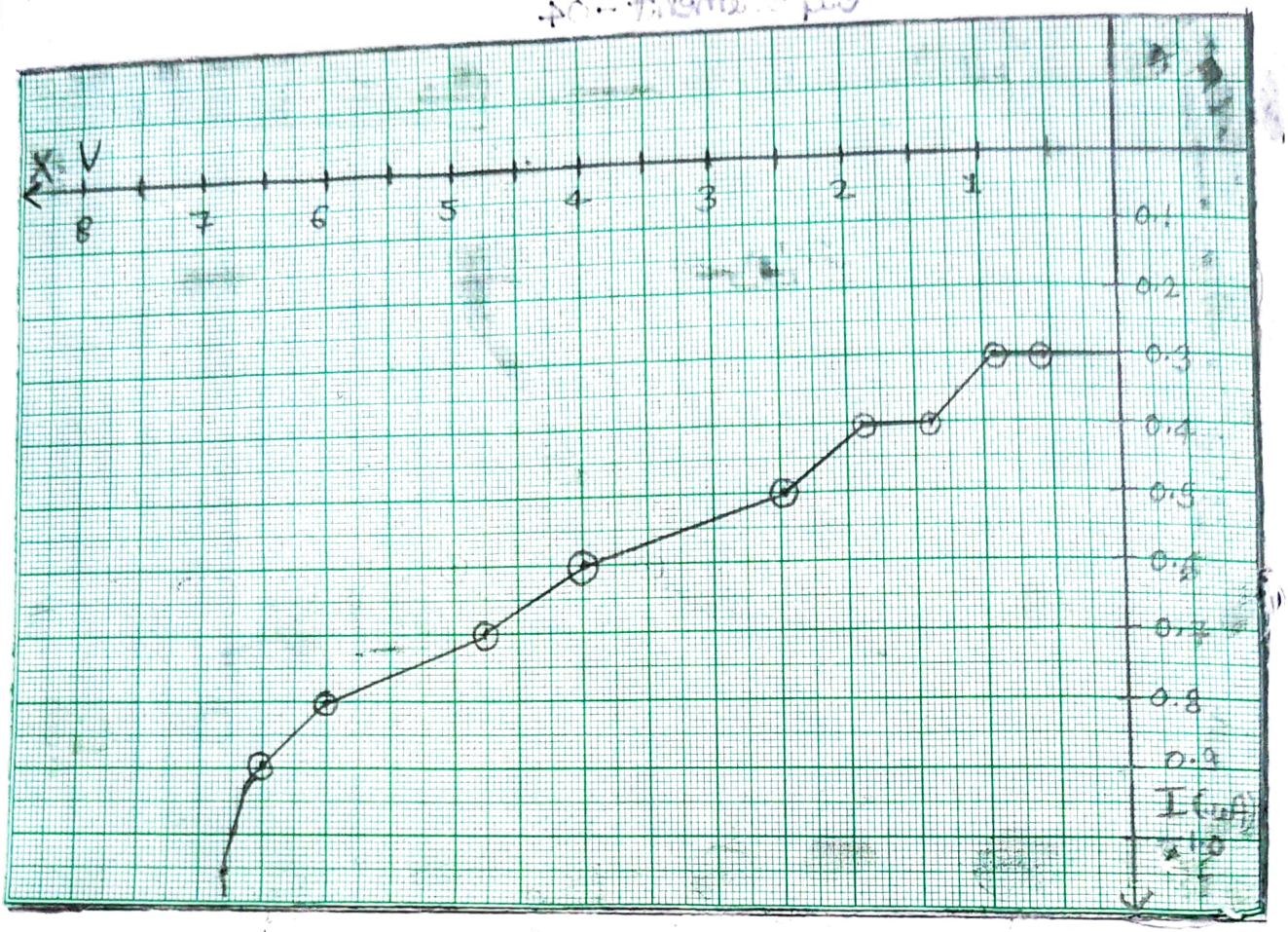
Object - Study and plot the characteristics of zener diode or voltage regulator.

Apparatus Used - Zener diode, resistor, valtmeter, Ammeter, Rheostat, connecting wires, bread board.

Theory - A zener diode is constructed for operation in the reverse breakdown region from the I-V characteristic curve. We can study that the zener diode has a region in its reverse bias characteristics of almost a constant negative voltage regardless of the value of current flowing through the diode and remains nearly constant with large changes in current as long as the zener diode current remains between the breakdown current and max. current. This ability to control itself can be used to great effect to regulate or stabilise a voltage source against supply or load variation voltage source against supply or load variation voltage source against supply or load variation. Therefore it is known as voltage regulation.

Observation Table

S.No.	V(Volt)	I(mA)
1	0.19	0.3
2	0.43	0.3
3	1.2	0.4
4	1.9	0.4
5	2.5	0.5
6	4.0	0.6
7	4.6	0.6
8	6	0.8
9	6.5	0.9
10	7.9	1.0
11	8.2	1.0
12	8.8	74


V
8
7
6
5
4
3
2
1
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
I(mA)

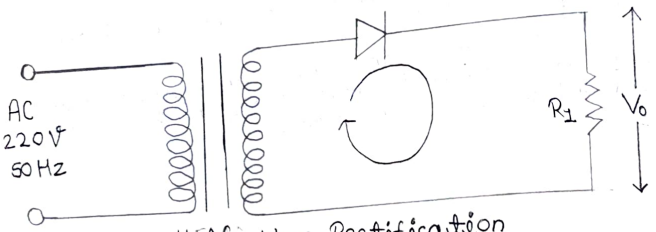
Result - Breakdown potential also called zener potential
i.e. $V_Z = 8.8V$

Precautions

(1) While doing the experiment do not exceed the rating of the diode.

(2) Connect voltmeter and ammeter in current polarimeter.

(3) Do not switch on the power supply unless you have checked the circuit connections.



Half Wave Rectification

Experiment - 05

Object - Study of half wave rectifier, draw the input and output wave form and calculate the ripple factor.

Apparatus Used - Cathode ray oscilloscope, halfwave rectifier, transistor.

Theory - The half wave rectifier converts an AC voltage to DC voltage. The primary coil of the transformer is connected to AC supply this ideas an AC voltage across the secondary coil.

During positive half cycle diode is forward biased or a result current flows across the load resistance.

During negative half cycle diode is reversed biased hence act as open circuit. No current flow across load resistance.

Ripple Factor - It is defined as the ratio of r.m.s. value of A.C. component to the DC component in output

$$R = \frac{V_{AC}}{V_{DC}} = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

$$I_m = \frac{V_m}{R_L}, \quad I_{DC} = \frac{I_m}{\pi} \Rightarrow I_{RMS} = \frac{I_m}{2}$$

Observation

$R_L = 1k\Omega = 10^3\Omega$

$V_m = 26.6\,V$

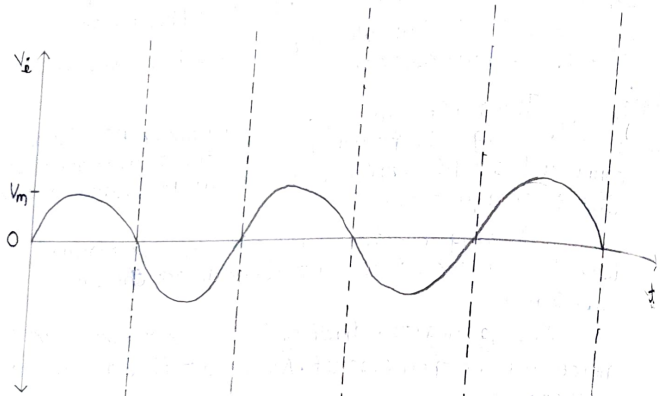
Calculations

$$I_m = \frac{V_m}{R_L} = \frac{26.6\,V}{10^3\Omega} = 26.6 \times 10^{-3}\,A$$

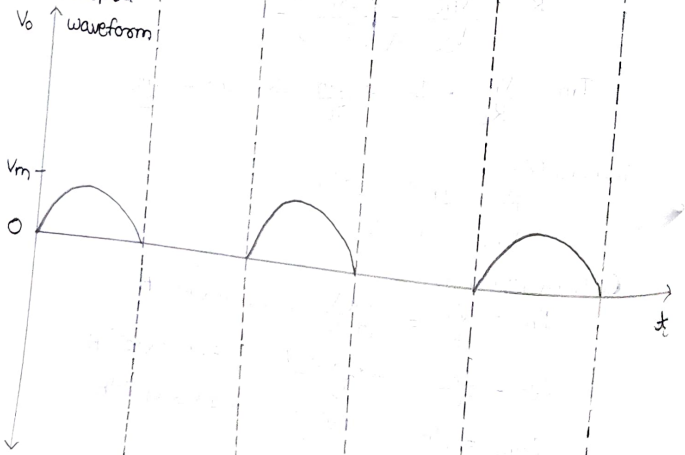
$$I_{dc} = \frac{I_m}{\pi} = \frac{26.6 \times 10^{-3}\,A}{\pi} = 8.467 \times 10^{-3}\,A$$

$$I_{rms} = \frac{I_m}{2} = \frac{26.6 \times 10^{-3}}{2} = 13.3 \times 10^{-3}\,A$$

Input waveform



Output waveform



TUTORIAL / PRACTICAL No.

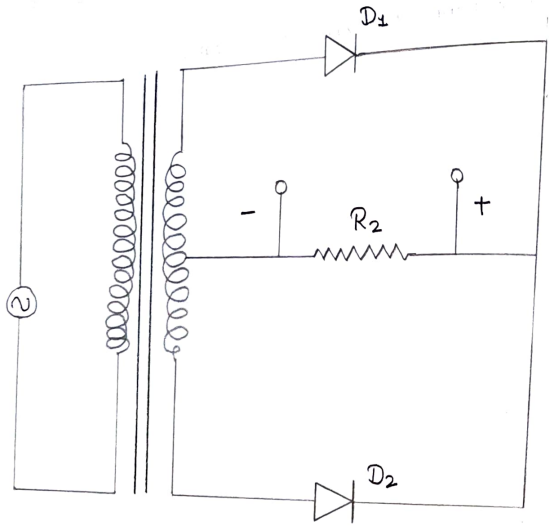
Ripple factor $= \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1} = 1.2103$

Result

The output wave form may be given in the diagram and ripple factor of halfwave rectifier is 1.2108

Precautions

All the connection should be tight.



Full wave rectifier circuit

Experiment - 06

Object - Study of full wave rectifier, Draw the input and output wave form and calculate the ripple factor

Apparatus Used - Cathode ray oscilloscope, full wave rectifier, connecting wire.

Theory - A full wave-rectifier is used to convert an A.C. voltage it uses two diodes out of which one conducting during first half cycle and other during other half cycle.

During positive half cycle D_1 is in forward bias while D_2 is in Reverse Bias. Hence, we get current across R_L due to D_1 during negative half cycle D_2 is in Forward Bias while D_1 is in reverse bias. Hence we get current across R_L due to D_2.

$$I_m = \frac{V_m}{R_L} \quad , \quad V_{AC} = \frac{2V_m}{\pi}$$

Ripple Factor -

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

where $I_{rms} = \frac{I_{max}}{\sqrt{2}}$

$$I_{dc} = \frac{2I_{max}}{\pi}$$

Calculation

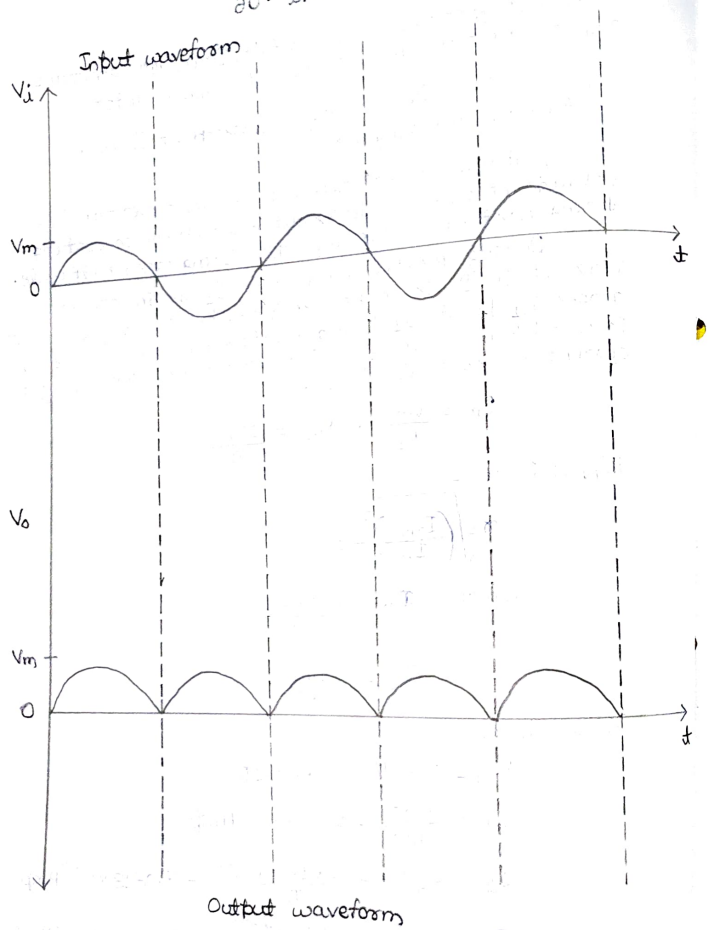
$V_m = 12.5\,V \qquad R_L = 1K\Omega$

$I_m = \frac{1.25}{10^3} = 1.25 \times 10^{-3}$ Amp

$I_{dc} = \frac{2I_m}{\pi} = \frac{2 \times 1.25 \times 10^{-3}}{\pi} = 7.9618 \times 10^{-3}$ Amp

$I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{1.25 \times 10^{-3}}{\sqrt{2}} = 8.8402 \times 10^{-3}$ Amp

80 - Waveforms



80

$$\gamma = \sqrt{\left(\frac{8.8402 \times 10^{-3}}{7.9818 \times 10^{-3}}\right) - 1} = \sqrt{1.2395 - 1}$$

$$\gamma = \sqrt{0.2345} = 0.4841$$

Result – The ripple factor of full wave rectifier is 0.4841

Precautions –

1. Connection should be verified before clicking run button.
2. There should be continuous supply of electricity.