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Semester : 1st   Year : ______   Class : ______   Roll No. : 2102126

S. No.	Experiment Description	Experiment Date	Submission Date	Remarks / Sign.
1.	Study of CRO (a) Measurement of amplitude time period and frequency of unknown continious signal (b) Use of Lissajous pattern for unknown frequency measurement of signal			
2.	Identification of active and passive component			
3.	Study of RC and CR filters			
4.	Study the characteristic of P-n junction diode under (a) Forward bias (b) Reverse bias			
5.	Study of Zener diode characteristic and load and line regulation of Zener voltage regulator			

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S. No.	Experiment Description	Experiment Date	Submission Date	Remarks / Sign.
6.	Study of clipping circuits and clamping circuits			

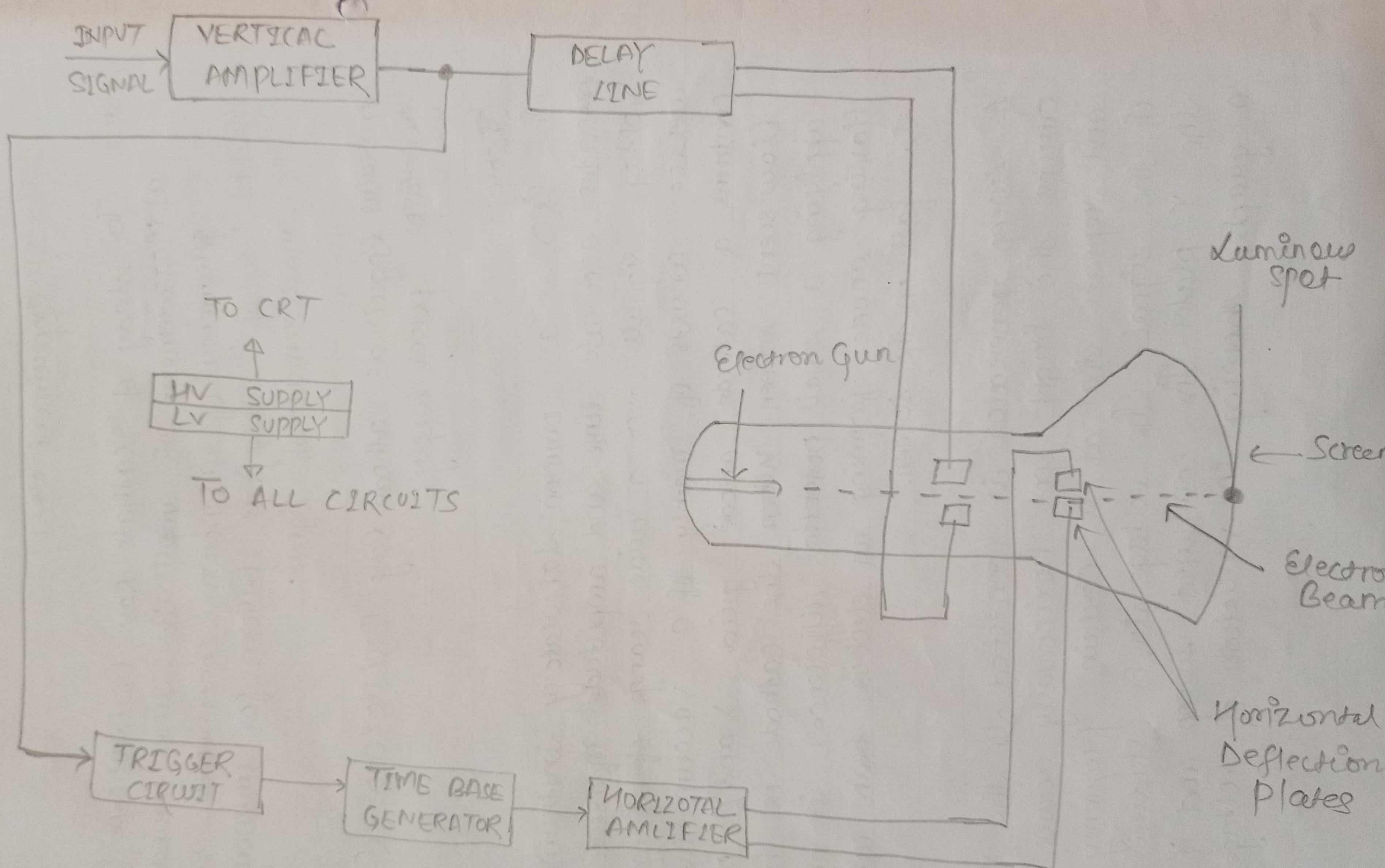
Experiment No-1

Aim: To study of cathode Ray Oscilloscope (CRO)
(a) Measurement of amplitude, time period and frequency of unknown continious signals.
(b) Use of Lissajous pattern for unknown frequency measurement of signal.

Apparatus Required: Cathode Ray Oscilloscope (CRO), function generator, power supply.

Theory:
The CRO is a common laboratory instrument that provides accurate time and amplitude measurement of voltage signals over a wide range of frequencies. The device consists of mainly of a vaccum tube which contains a cathode, anode, grid X and Y plates and a flourscent screen. When the cathode is heated (by applying a small potential difference), it emits electrons. Having anode, forming an electron beam which passes to fall on the screen.

A sweep generator is connected to the X plates, which curves the bright spot horizontally across the screen and repeats that at a certain frequency as the source of the signal. The voltage to be studied is applied to the Y-plates. The combined sweep and Y voltages produce a graph, showing the variation of voltage with time.


INPUT SIGNAL
VERTICAC AMPLIFIER
DELAY LINE
TO CRT
HV SUPPLY
LV SUPPLY
TO ALL CIRCUITS
Electron Gun
Luminous spot
Screen
Electron Beam
Horizontal Deflection Plates
TRIGGER CIRCUIT
TIME BASE GENERATOR
HORIZOTAL AMLIFIER

Procedure (a):

(1) Connect function generator output at the input of CRO at channel 1 or at channel 2.
(2) Select proper channel, i.e, if signal is connected to channel 1 select CH1 or else CH2
(3) Adjust Time/div known to get sufficient time period displacement of the wave on CRO screen.
(4) With fine tuning of time/div, make the waveform steady on screen.
(5.) Keep voltage such that the waveform is visible on screen without clipping.
(6) Measure p-p reading along Y-axis. This reading multiplied with voltage/div gives peak to peak amplitude of ac i/p wave.
(7) Measure horizontal division for one complete cycle. This division multiplied by time/div, gives time period of i/p wave calculated frequency using $f = \frac{1}{T}$.
(9) Noted down the reading in the observation table.

Observation (a):

(1) Function generator o/p
$V_{pp} = 1V$
frequency = 1 KHz

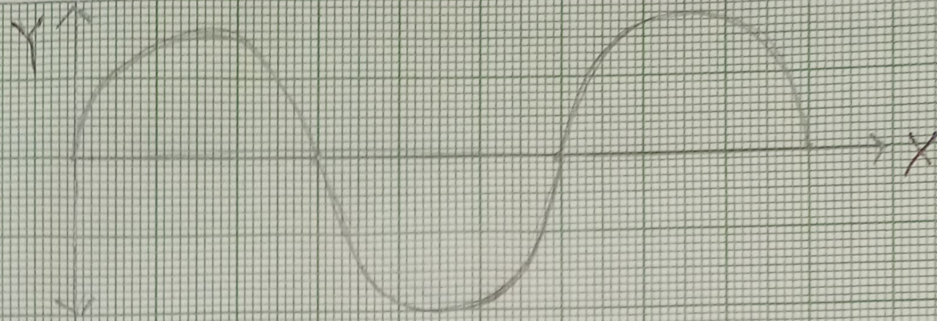
(2) Function Generator o/p
$V_{pp} = 1.5V$
frequency = 2.5KHz

Procedure (b):

(1) Two function generators are taken
(2) One is connected to X-probes and the other to Y.
(3) We keep the frequency of generator connected to X-prove

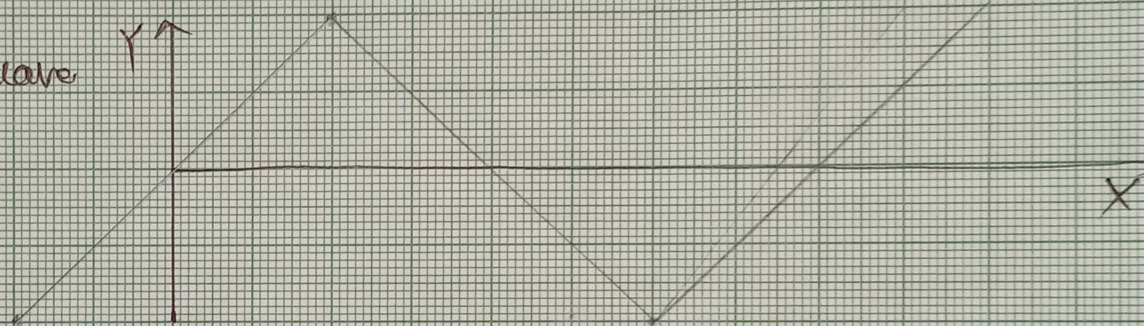
Functions	Obs No.	No. of division (Y)	Volt/Div (Volt)	Vpp = No. of div (X) V/D volt	No. of Div	T/Div	Time	$f = \frac{1}{T}$
Sine	1	2.2	0.5	1.1	1.1	1	1.1	909
	2	3.2	0.5	1.6	2.2	0.2	0.44	2273
Square	1	2.4	0.5	1.2	2.2	0.5	1.1	909
	2	3.2	0.5	1.6	2.2	0.2	0.44	2273
Ramp	1	2.2	0.5	1.04	2	0.5	1	1000
	2	3.2	0.5	1.6	2.2	0.2	0.44	2273
Triangular	1	5.2	0.5	1.04	2	0.5	1	1000
	2	3.2	0.5	1.6	2.2	0.2	0.44	2273
Pulse	1	2.8	0.5	1.1	2	0.5	1	1000
	2	3.2	0.5	1.6	2.2	0.2	0.44	2273

1 Sine wave

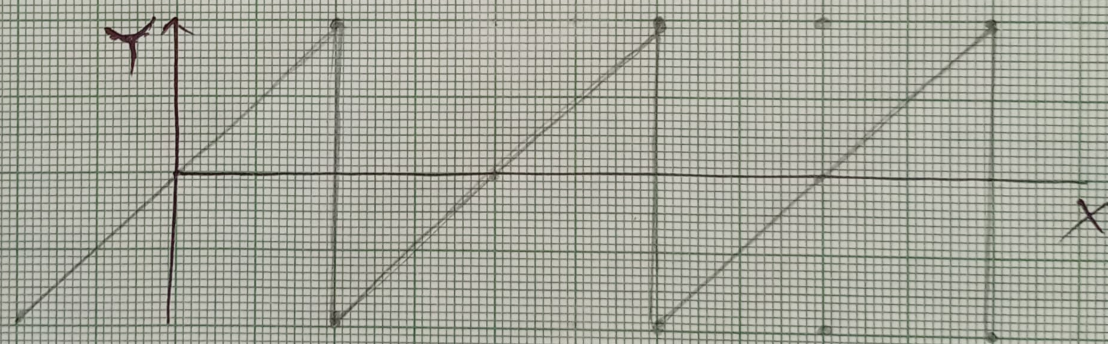


2 Square Wave

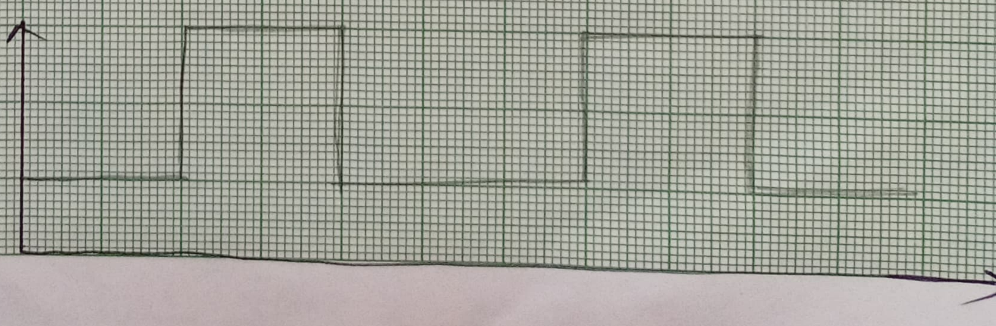
3 Triangular wave



4 Ramp Wave



5 Pulse Wave



visible and hide the frequency of generator connected to Y.

(4) The frequency was adjusted until we get a circle or ellipse.

Formula used:

$$\frac{f_x}{f_y} = \frac{\text{No of tangencies (Vertical)}}{\text{No. of tangencies (Horizontal)}}$$

Observation (b)

S.No.	No. of Vertical Tangents	No. of Hor tang	frequency (X)	frequency (Y)
1	1	1	1800	1800
2	1	2	1950	3900
3	2	1	2200	1100

Conclusion

We got an idea about how to calculate time period and frequency of a given wave. And how to measure the unknown frequency using frequency of one function generator and lissajous figure.

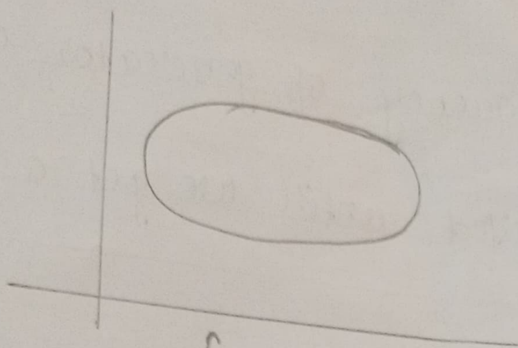
Error (a):

Sine wave 1st case

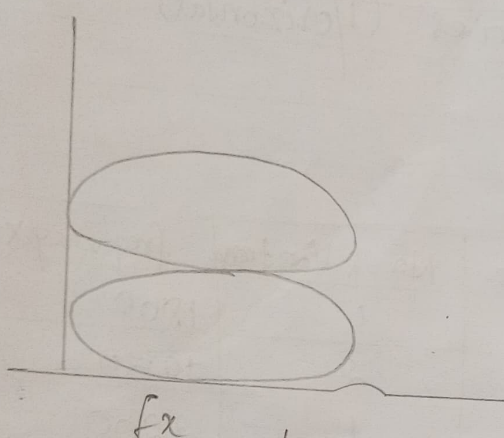
Amplitude given = 1 Vpp

" Obtained = 1.1 Vpp

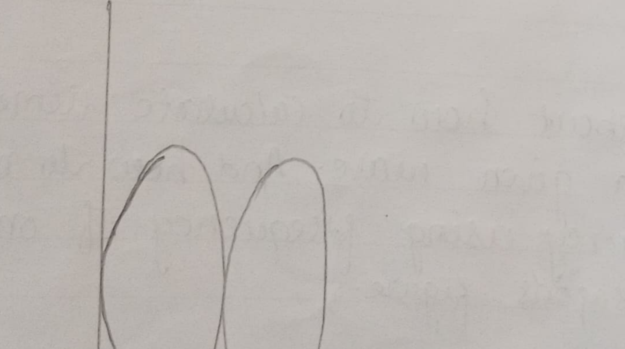
$$\% \text{ Error} = \frac{1.1-1}{1} \times 100 = 0.1 \times 10 = 10\%$$



$\frac{f_x}{f_y} = \frac{1}{1}$



$\frac{f_x}{f_y} = \frac{1}{2}$



$\frac{f_x}{f_y} = \frac{2}{1}$

Experiment No.-2

Aim: To identify active or passive components using CRO.

Apparatus Required: Resistor, Capacitor, Diode, Zener-Diode, Transistor.

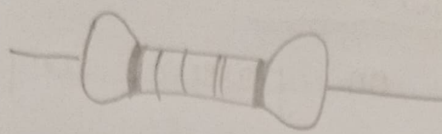
Theory:

Resistor: A resistor is a passive two terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistors terminals. This relationship is represented by Ohm's law. They are mostly colour coded.

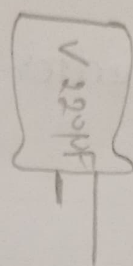
Capacitor: A capacitor (commonly known as conductor) is a positive two-terminal electrical component used to store energy electrostatically in an electric field. They contain at least two electrical conductors separated by dielectric.

Diode: In electronics, a diode is a two terminal electronic component with assymetric conductance, it has low (ideally zero) resistance to current flow in one direction and high (ideally infinite) resistance in the other

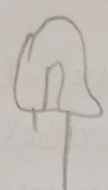
Zener diode: This diode, unlike a normal one, allow current to flow not only from its anode to cathode



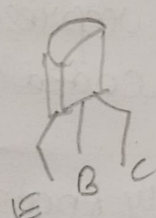
Resistor



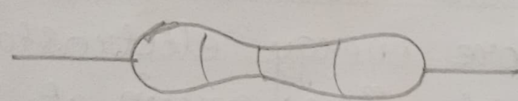
Capacitor



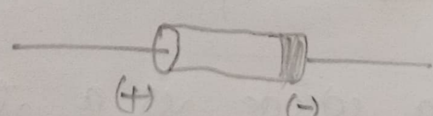
LED



BJT



Inductor



Diode

Zener diode

but ~~it~~ also in the reverse direction, when zener voltage is reached. They are also passive component and have a highly doped p-n junction.

BJ Transistor: A type of transistor that uses both the electrons and hole charge carriers. They are manufactured in two types, NPN and PNP. Basic function of a BJT is to amplify current, hence used as amplifiers or switches.

Observation:
Graphs corresponding to each component was observed as shown.

Conclusion:
We get to know electric components used in a circuit and their graphs.

Precautions:
(i) Always check that the power switch is off before plugging into outlet.

(ii) Also turn instrument or equipment off before unplugging the outlet

(iii) Report any damage to equipment to the laboratory instructor.

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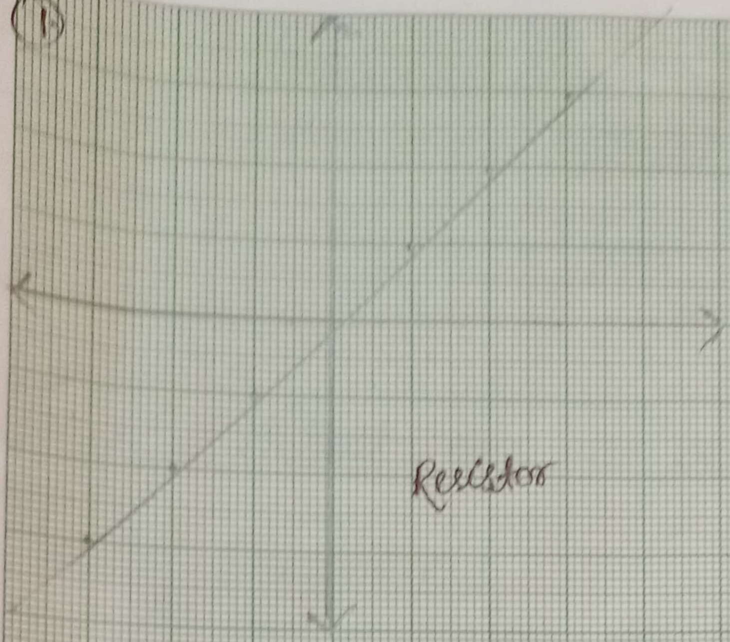
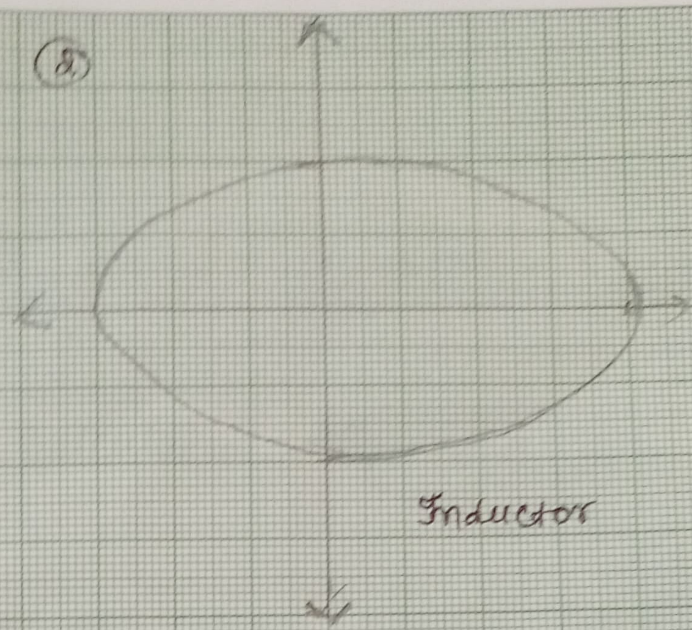
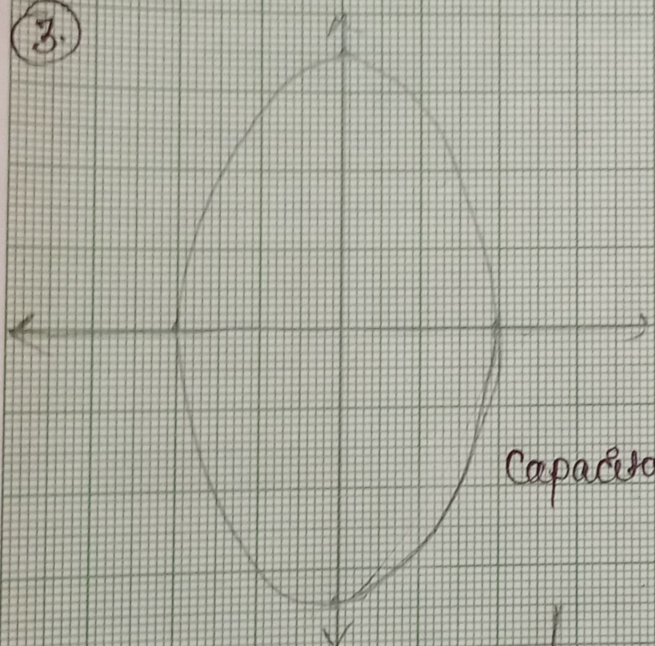
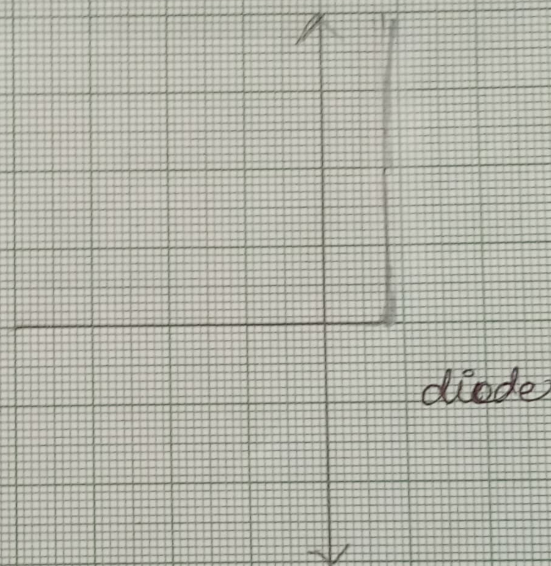
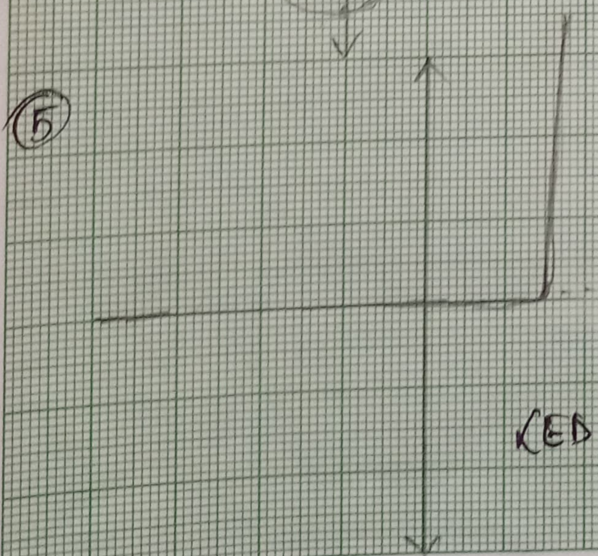
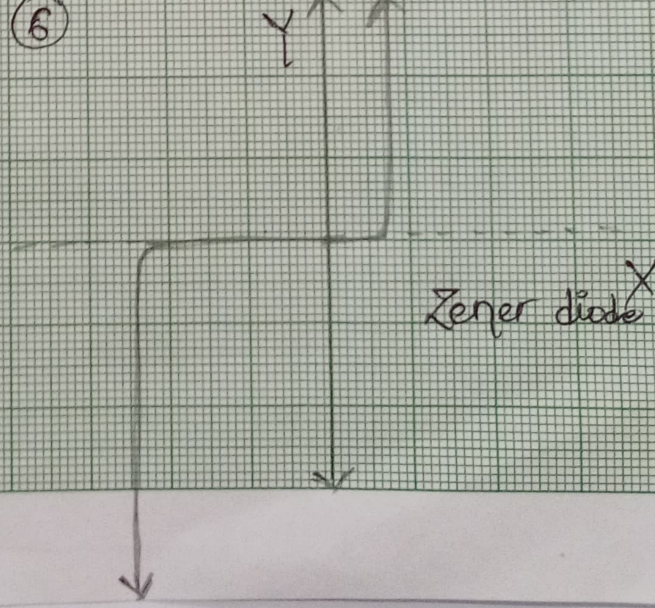












Frequency given = 1000 Hz
Frequency obtained = 909 Hz

$$\% \text{ Error} = \frac{1000 - 909}{1000} \times 100 = \frac{91}{1000} \times 100 = 9.1\%$$

Result can also be calculated like this.

Precautions

* Always switch the power off before plugging into outlet.
* Also turn instrument or equipment off before unplugging the outlet.

Experiment No - 3

Aim: To study RC and CR filters and their frequency response using CRO.

Apparatus Required: Cathode Ray Oscilloscope (CRO), functions generator, capacitor, resistor, bread board, wires

Theory:

(i) R-C Circuit:

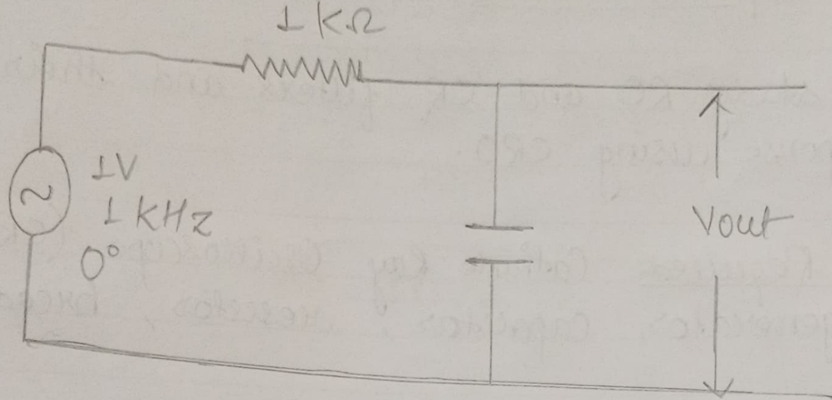
It is an electric circuit composed of resistors and capacitors and capacitor is driven by a voltage or current source. A first order RC circuit is composed of one resistor and one capacitor and is the simplest type of RC circuit, RC circuit can be used to filter a signal by blocking certain frequencies and passing others like high pass filters, low pass filters, band pass etc

For the simplest configuration:

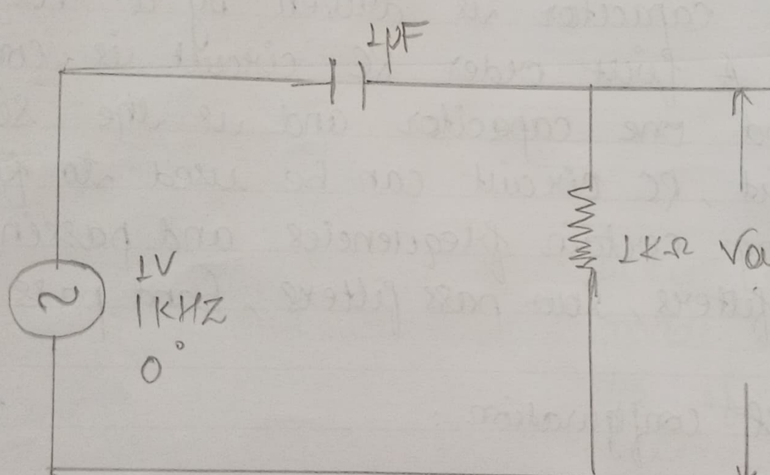
$$V_{out} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} V_{in} \quad \text{or} \quad V_{out} = \frac{V_{in}}{j\omega RC + 1}$$

(ii) CR Circuit

A C-R circuit is one that contains both capacitors and resistors (either in series or parallel). The action of a C-R circuit upon a sine wave is to change both amplitude and phase of output signal as compared to



R-C Circuit



C-R Circuit

input signal. Universal amplitude / Phase tables can be prepared using the time constant of CR circuit upon a sine wave i.e to change both amplitude and phase of output signal. Universal amplitude / phase tables can be prepared using the time constant of CR circuit and the frequency of sine wave.

For the selected circuit,

$$V_{out} = \left(\frac{R}{R + \frac{1}{j\omega C}} \right) \times V_{in} = \left(\frac{j\omega RC}{j\omega RC + 1} \right) V_{in}$$

Also, cut-off voltage is the voltage at which $V_{out} = 0.7 \times V_{in}$.

(5) **Bread Board:**

Bread Board is a construction base for prototyping of electronics. It is mostly made of plastic. Wires can be inserted into free holes of the circuit. Some holes are horizontally connected while the others are vertically connected to each other. All the circuits are made on the Breadboard.

Procedure:

Tape the prongs and connect it to CRO, and function generators, Resistors and capacitors are connected according to the required circuit, using wires. The input side was connected with connecting probes connecting with the function generator and the output wires to the CRO. Next, we vary frequency keeping the input voltage trend, and also calculated the cutoff frequency using $f_c = \frac{1}{2\pi RC}$.

Experiment No-4

Aim: To draw the I-V characterestics of p-n junction diode and Zener diode & draw the interference from these studies

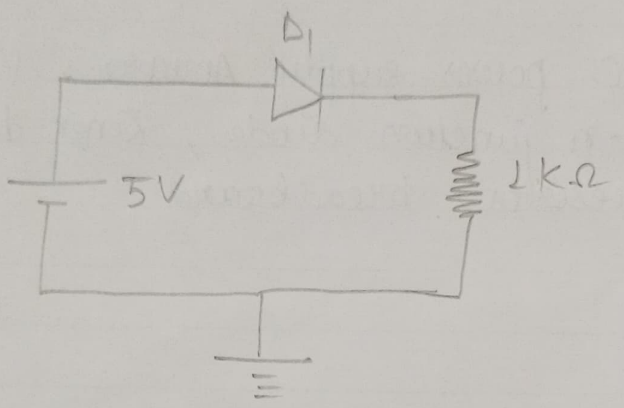
Instruements:

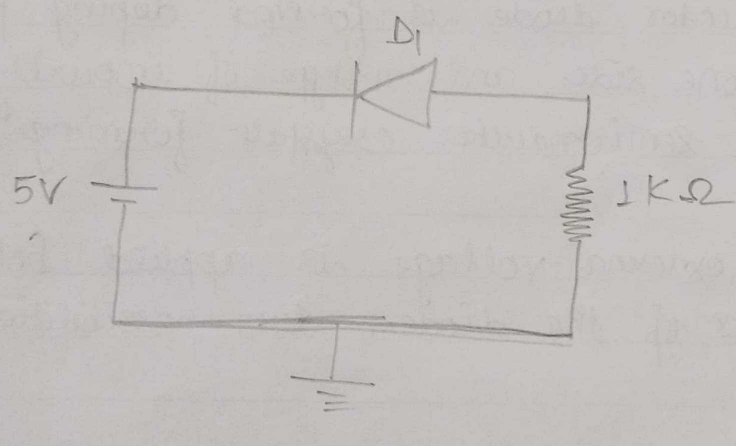
(a) Equipments: DC power supply, Ammeter, Voltmeter, Multimeter
(b) Components: p-n junction diode, Zener diode, wires, resistor, breadboard

Theory:

(1.) P-n junction diode:
The semiconductor diode is formed doping p-type impurity in one side and n-type of impurity in the other side of semiconductor crystals forming a p-n junction.
When no external voltage is applied between the two terminals of the diode, two possibilities arise:

(a) Forward bias
The positive terminal of the battery is connected to P-type material and negative terminal to N-type terminal as shown in the circuit diagram, the diode is said to be in forward bias. This forward bias voltage will force the electrons in N-type and holes in P-type to recombine with the ions near the boundary and to flow crossing junction. This reduces width of depletion region. Further increasing the voltage the depletion region width continue to decrease


D1
5V
1KΩ


D1
5V
1KΩ

resulting in exponential rise in current.

(b) Reverse bias

If the negative terminal of battery (DC power supply) is connected with p-type terminal at diode and the terminal of battery is connected to N-type then diode is said to be reversed biased. Here, free charge carriers will move away from junction widening the depletion region width. The minority carriers can cross the depletion region resulting in minority carrier current flow called as reverse saturation current. Ideally, current in reverse bias is zero.

(2.) Zener Diode:

The Zener diode is designed to operate in reverse breakdown region. Zener diode is used for voltage regulation purpose. Zener diodes are designed for specific ~~purpose~~ reverse breakdown voltage called Zener breakdown voltage (V_Z), which depends on amount of doping. Breakdown current is limited by power dissipation capacity of the Zener diode. Forward characterstics of the Zener diode is similar to normal p-n junction diode.

Procedures

(1.) Connect power supply, Voltmeter, Current meter with the diode as shown in the figure for forward bias diode. You can use two multimeters for its use as an ammeter

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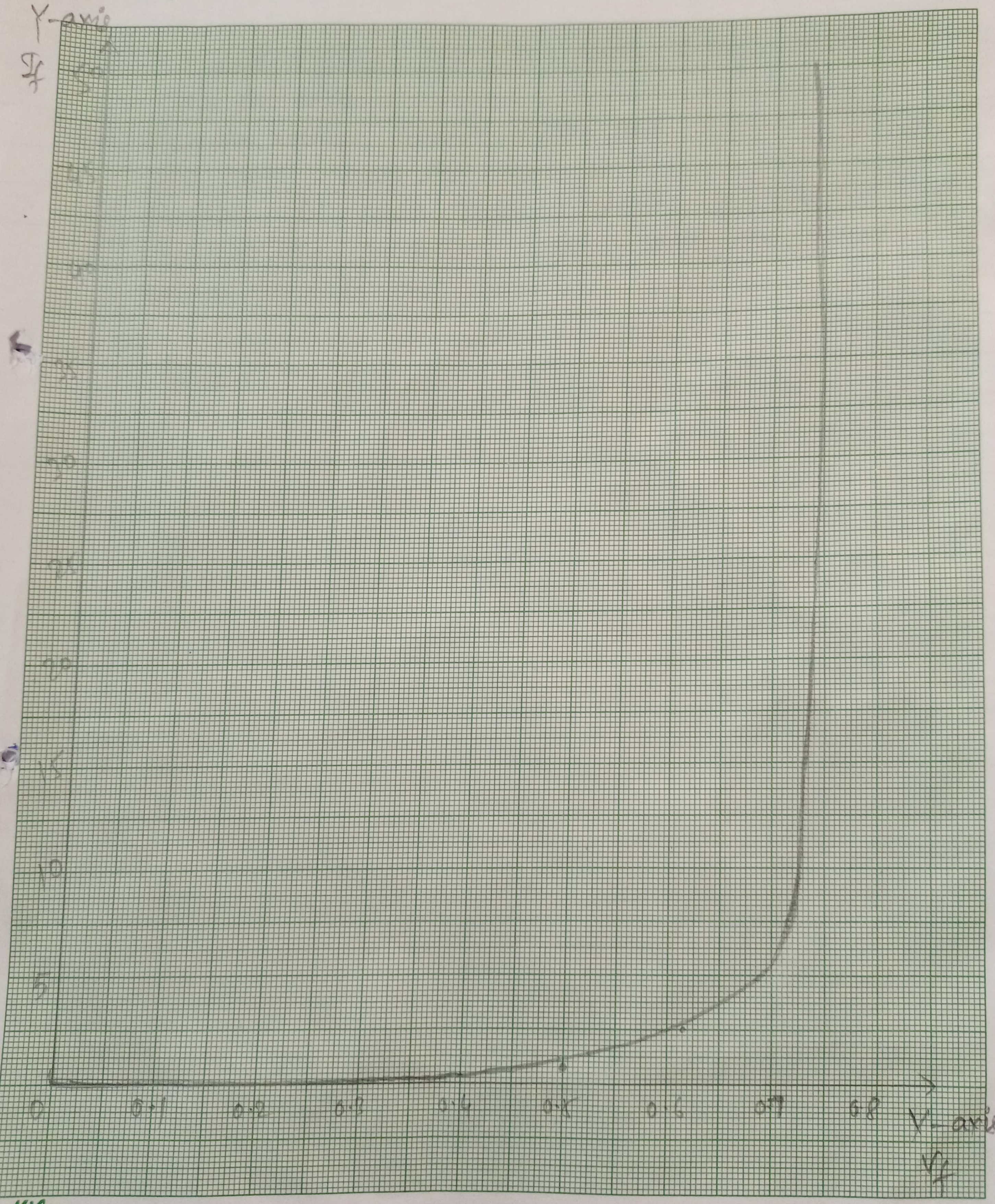
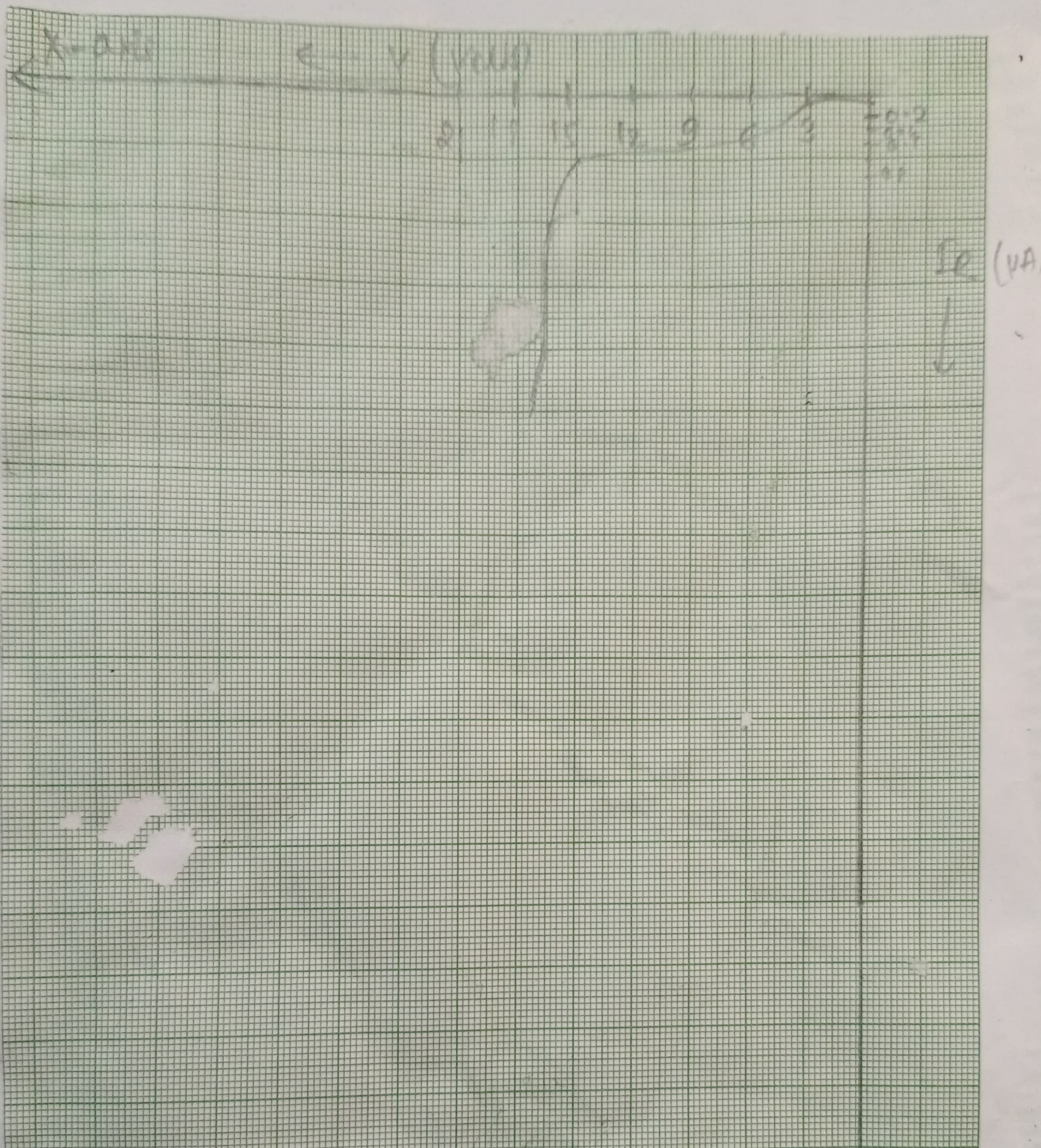


(2) Increased voltage from the power supply, starting from 0V, in steps.
(3) Measure voltage across diode and current through diode and note down the readings.
(4) Reverse DC power supply polarity for reverse bias.
(5) Repeat the procedure and draw the forward and reverse bias in one graph.

Observation Table:

(1) (a) P-n Junction Diode (Forward bias)

S.No	V_f (V)	I_f (mA)
1	0.117	0.0002
2	0.23	0.0003
3	0.313	0.0031
4	0.411	0.0359
5	0.508	0.286
6	0.568	0.94
7	0.593	1.55
8	0.616	2.41
9	0.632	3.4
10	0.644	4.3
11	0.675	8.42
12	0.697	13.02
13	0.712	17.98
14	0.722	22.35
15	0.729	26.97
16	0.74	32.34
17	0.761	41.704
18	0.765	51.31
19	0.767	60.71


X-axis
V (volt)
3
6
9
12
15
Ie (μA)
Y-axis

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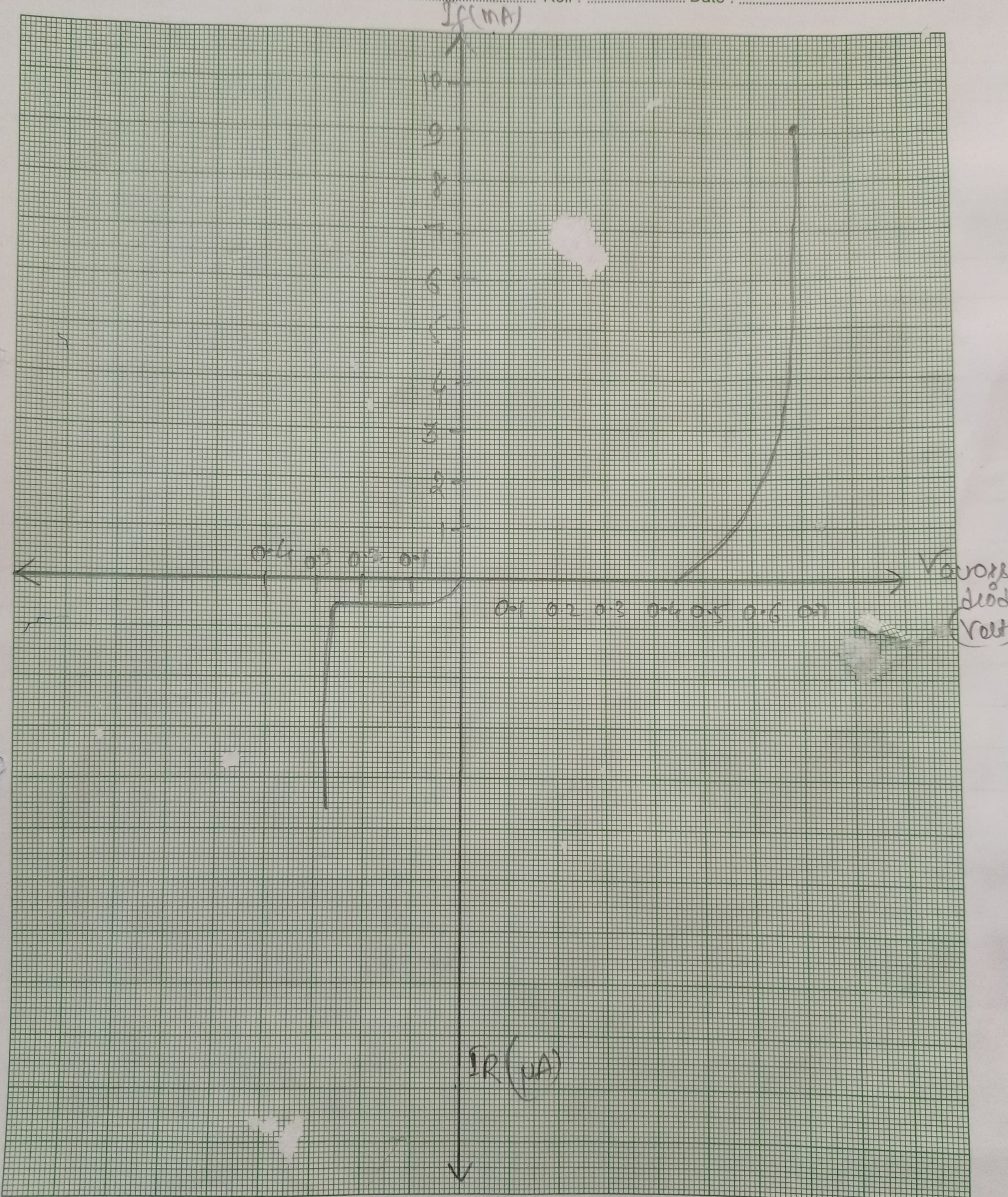

Milan