Date 21/09/2020

Expt. No. 03 Page No. 01

V~I CHARACTERISTIS OF SEMICONDUCTOR DIODE

Aim of the experiment:-

To study the V~I characteristics of semi-conductor diode.

Objective of the experiment:-

i. Design the circuit diagram
ii. Draw the characteristics curve
iii. Determine the DC forward resistance.

Equipments required:-

i. voltmeter or digital multimeter
ii. Ammeter
iii. Bread board.
iv. 0-30v DC power supply

Components required:-

Diodes (Si-1N4007), Zener diode, Resistor-1KΩ and 470Ω each.

Theory:-

Diode: In electronic, a diode is a crystal of semiconductor connected to two electrical terminals that conducts electric ccurrents in only one direction. Today most diodes are made up of silicon, but other semiconductor such as germanium are also used.

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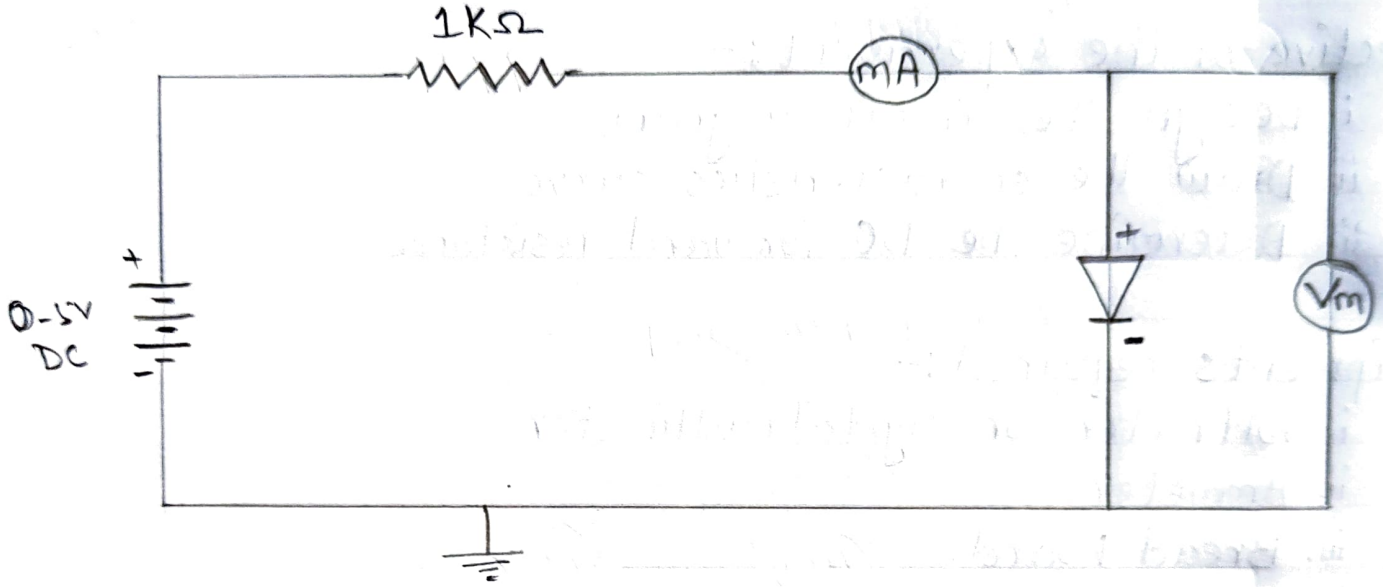

(Forward biased Silicon diode circuit diagram)

(119BM0004)

→ Diodes are used as rectifiers, voltage regulators, signal modulator etc.
→ Diodes are of different types such as zener, silicon, Germanium, LED etc.

DC forward resistance:

It is the opposition by the diode to the DC. It is measured by the ratio of DC voltage across the diode to the resulting DC current through it.

$$I = I_S (e^{V_d/\eta V_T} - 1)$$

where $V_T = KT/q$

I = diode current

V_d = vol. across diode.

V_T = Thermal diode.

V-I characteristics of Zener diode:

A zener diode is a type of diode that permits current not only in the forward direction like normal diode, but also in the reverse direction. If the voltage is larger than breakdown known as "Zener knee voltage" or "Zener voltage". The forward characteristics of the Zener diode is same as that of a pn junction diode i.e as the applied potential increases the current increases exponentially. As the reverse bias the current increases rapidly in a direction opposite to that of the positive voltage region. Thus under reverse bias condition breakdown occurs after which the voltage remains constant and current increases. Thus it also act as a voltage regulator.

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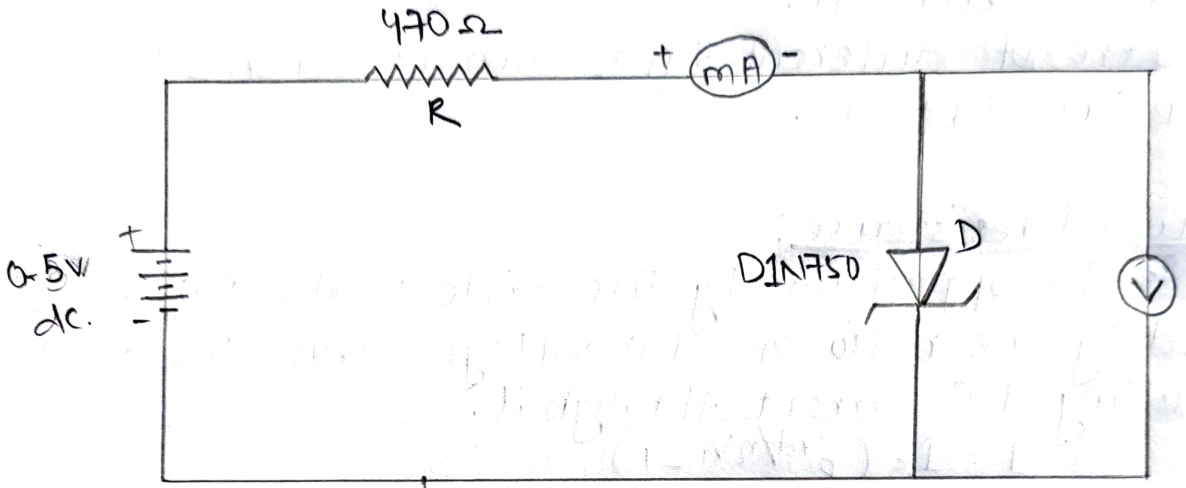
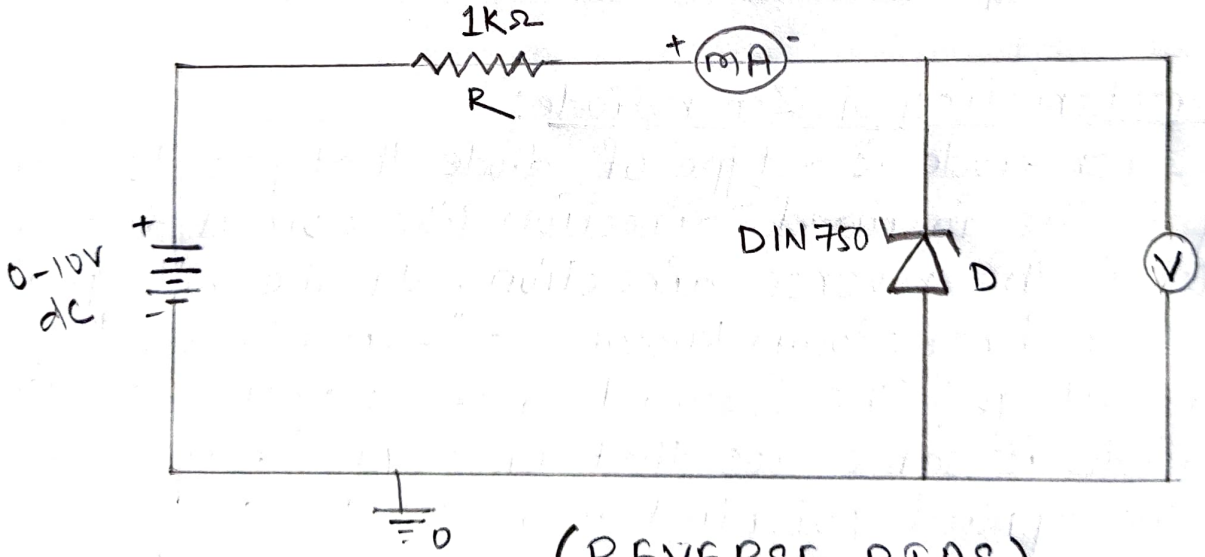
ZENER DIODE



(FORWARD BIAS)



(REVERSE BIAS)

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Procedure :-

A) For silicon diode forward bias

i. The circuit was connected as shown in figure.

ii. The supply voltage was increased in steps at 0.5 V starting from 0 to 5V, then the current was measured I_o and voltage across diode V_d and the result was recorded in the table.

iii. In graph paper I_o verses V_o was ploted for the silicon diode to see the forward characteristics. complete curves by extending the lower region of each curve to the intersection of the axis at $I_o = 0mA$ to $V_D = 0V$.

B) Zener diode :-

Forward bias -

i) The circuit was constructed as shown in figure for forward biased Zener diode.

ii) The reading was taken from the voltmeter and the ammeter from the output side and the result was taking by increasing the input DC voltage.

iii) Id Vs Vb was plotted in a graph to get the forward bias characteristics.

Reverse bias -

i) The circuit was constructed as shown in fig. for reverse biased Zener diode.

ii) The reading was taken from the voltmeter and the ammeter from the out-put side and the table was filled by increasing the input DC voltage.

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iii) Id Vs Vd was plotted on the graph to get the reverse biased characteristics.

iv) The voltage was bind at the point where Id decreases sharply to get zener voltage.

Observation:-

Table-1:

Vd and Id of silicon diode connected in forward bias.

Sl. No.	Vsource (in volt)	Diode voltage (Vd) in volt	Id (in mA)
1	0.1	0	0
2	0.2	0.23	0
3	0.3	0.31	0.002
4	0.4	0.43	0.042
5	0.5	0.45	0.065
6	0.6	0.49	0.168
7	0.7	0.50	0.195
8	0.8	0.52	0.299
9	0.9	0.54	0.398
10	1.0	0.547	0.473
11	2.0	0.604	1.463
12	3.0	0.628	2.397
13	4.0	0.645	3.415
14	5.0	0.65	4.432

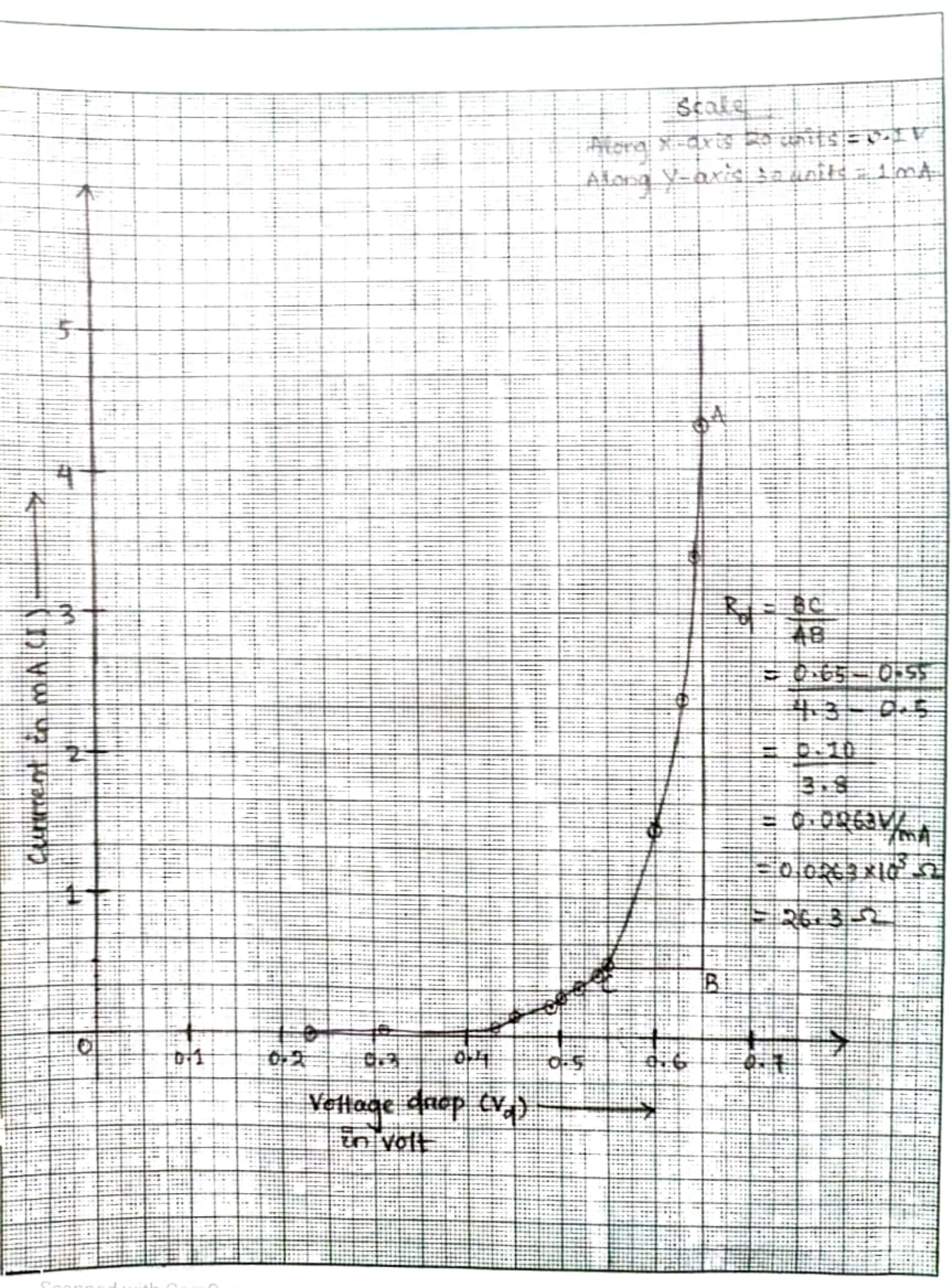
Scale
Along X-axis 20 units = 0.1 V
Along Y-axis 20 units = 1 mA
Current (mA)
Voltage drop (V_d) in volt
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1
2
3
4
5
A
B
C
$R_d = \frac{BC}{AB}$
$= \frac{0.65 - 0.55}{4.3 - 0.5}$
$= \frac{0.10}{3.8}$
$= 0.0263 V/mA$
$= 0.0263 \times 10^3 \Omega$
$= 26.3 \Omega$

Table-2

Vd and Id of Zener diode connected in forward bias at different source voltage.

SL.No.	Vsource (in volt).	Vd (in volt)	Id (in volt)
1	0.1	0.169	0
2	0.2	0.239	0
3	0.3	0.329	0
4	0.4	0.42	0.001
5	0.5	0.52	0.008
6	0.6	0.61	0.039
7	0.7	0.64	0.130
8	0.8	0.69	0.258
9	0.9	0.69	0.485
10	1.0	0.7	0.651

Table-3

Vd and Id of Zener diode connected in reverse bias at different source voltage.

SL.No.	Vsource (in volt)	Vd (in volt)	Id (in mA)
1	1.0	1	0
2	2.0	2	0
3	3.0	2.9	0.030
4	4.0	3.79	0.250
5	5.0	4.1	0.912
6	6.0	4.3	1.691
7	7.0	4.43	2.643
8	8.0	4.49	3.55
9	9.0	4.5	4.508
10	10.0	4.5	5.478

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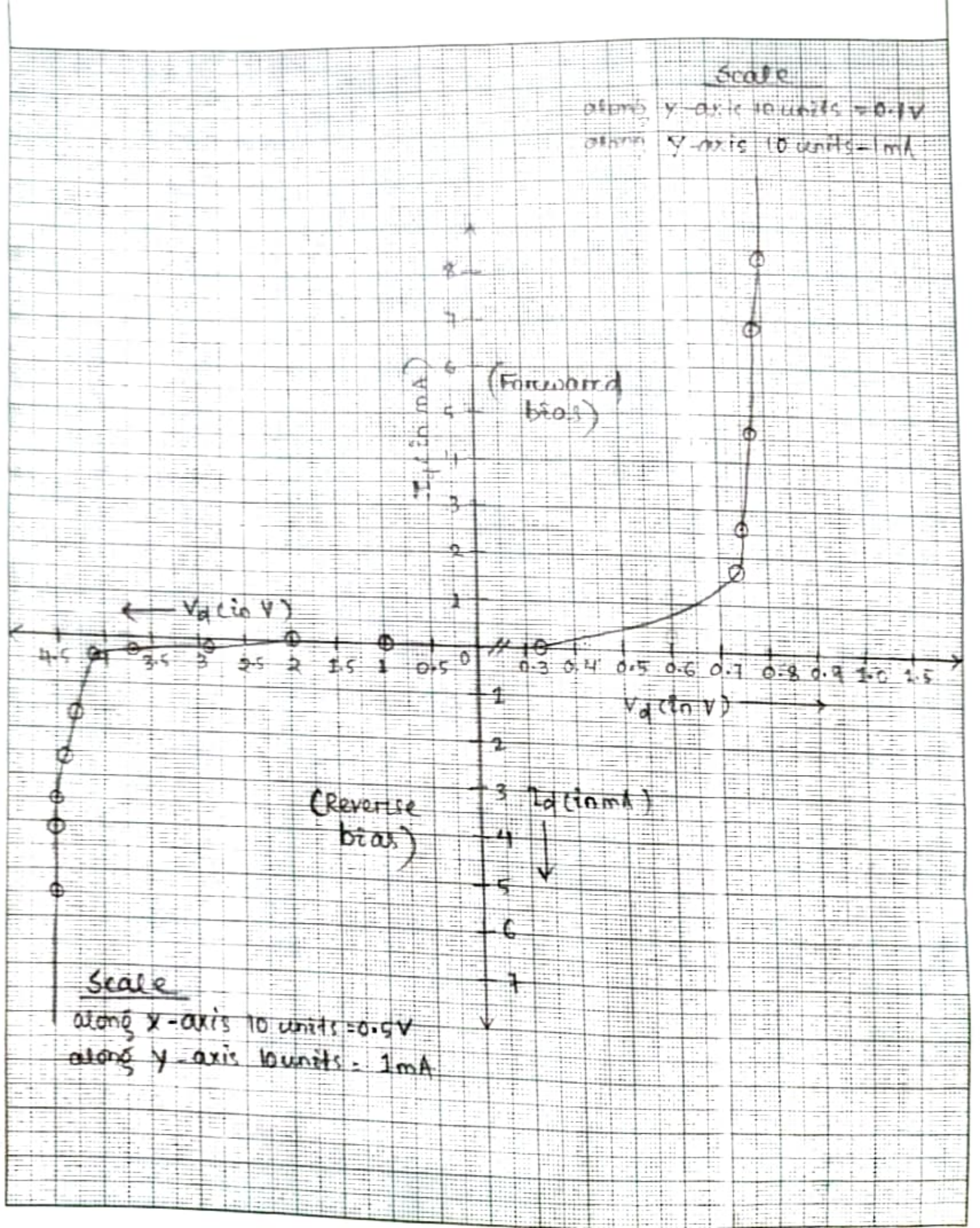
Scale
along y-axis 10 units = 0.1V
along Y-axis 10 units = 1mA
(Forward bias)
I_d (in mA)
V_d (in V)
(Reverse bias)
I_d (in mA)
Scale
along X-axis 10 units = 0.5V
along y-axis 10 units = 1mA

Discussion :-

By drawing the $V_d \sim I_d$ graph in forward bias, there is an exponential increase in current w.r.t voltage. In case of Zener diode, there is a sharp change in current after a certain voltage. This basic principle of Zener diode is the Zener principle.

Conclusion :-

By performing the experiment, the V-I characteristics of the Zener diode and silicon diode were analyzed and plot of V_d v/s I_d were made. The forwarded dynamic resistance for Si diode was found to be 26.3 Ω.

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