Course Code: CSE251
Course Title: Electronic Devices and Circuits
Semester: Spring-2023

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Experiment Number: 03
Experiment Name: Study of IV Characteristics of Diode and Zener Diode
Group No: 03
Section: 12
Date of performance: 14/02/2023
Date of Submission: 20/ 02/ 2023

Submitted by: Md. Mahir Faisal, ID: 21301371

Experiment-03

Study of IV Characteristics of Diode and Zener Diode

Objective

1. To become familiar with a silicon p-n junction diode and understand its operation.
2. To study the current-voltage i.e. I-V characteristics of silicon p-n junction diodes.
3. To study the I-V characteristics of a zener diode and its application as a voltage regulator.

Equipments

1. p-n junction diode (1N4007) - ×1
2. Zener Diode (5 volt) ×1
3. Resistances (220Ω, 470Ω, 1kΩ, 10kΩ)
4. POT 10kΩ
5. DC power suply
6. Breadboard, Wires
7. Digital multimeter

Data Sheet:

Task-03: Report

1. Cover page [include course code, course title, name, student ID, group, semester, date of performance, date of submission]
2. Attach the signed Data Sheet.
3. Attach the graphs plotted using google sheets. Go to **'https://cutt.ly/l3QaTBf'** to know how to plot in google sheet.
4. Add a brief Discussion at the end of the report.

Data Sheet

Diode IV Characteristics

$R = 1k\Omega$ (measure the accurate resistance using the digital multi-meter)

R = 0.988KΩ

Supply Voltage, V_{DC} (v)	Diode Voltage, V_D (v)	Voltage across the Resistor, V_R (v)	Diode Current, $I_D = I_R = V_R/R$ (mA)
0	5.5×10^{-3} V	~~2.1~~ 0.00	0.00
0.1	86.8×10^{-3} V	0.00	0.00
0.2	178.7×10^{-3} V	0.00	0.00
0.3	285.1×10^{-3} V	0.00	0.00
0.4	369.9×10^{-3} V	0.00	0.00
0.5	0.438. V	51.6×10^{-3} V	0.0522
0.6	0.476 V	122.2×10^{-3} V	0.1237
0.7	0.494 V	179.9×10^{-3} V	0.1821
0.8	0.509 V	213.3×10^{-3} V	0.2163
0.9	0.527 V	361.1×10^{-3} V	0.3655
1	0.534 V	0.420 V	0.4251
2	0.593 V	1.358 V	1.3748
4	0.639 V	3.342 V	3.3826
6	0.662 V	5.310 V	5.3748
8	0.677 V	7.32 V	7.4089
10	0.699 V	9.30 V	9.4129
12	0.697 V	11.25 V	11.3866
13	0.701 V	12.28 V	12.4221
14	0.704 V	13.25 V	13.4109

$V_T = 25\times10^{-3}$ V

Calculation

Determining Ideality Factor, n

Let, $\alpha = \frac{1}{nV_T}$

Take any two data from the table: $I_{D1} = I_S \exp(\alpha V_{D1})$ and $I_{D2} = I_S \exp(\alpha V_{D2})$ $I_S = 8.956\times10^{-9}$

Taking ratio of I_{D1} and I_{D2},

$$\Rightarrow \frac{I_{D1}}{I_{D2}} = \exp(\alpha(V_{D1} - V_{D2}))$$

$$\Rightarrow \alpha = \frac{\ln\left(\frac{I_{D1}}{I_{D2}}\right)}{V_{D1} - V_{D2}} = \frac{1}{nV_T} \qquad \Rightarrow n = \frac{1}{\alpha V_T} = 1.92345$$

$= 20.79587$

Determining Static (R_D) and Dynamic (r_D) Resistance

$$R_D = V_D/I_D$$

$$r_D \approx \frac{nV_T}{I_D} =$$

Zener Diode IV Characteristics

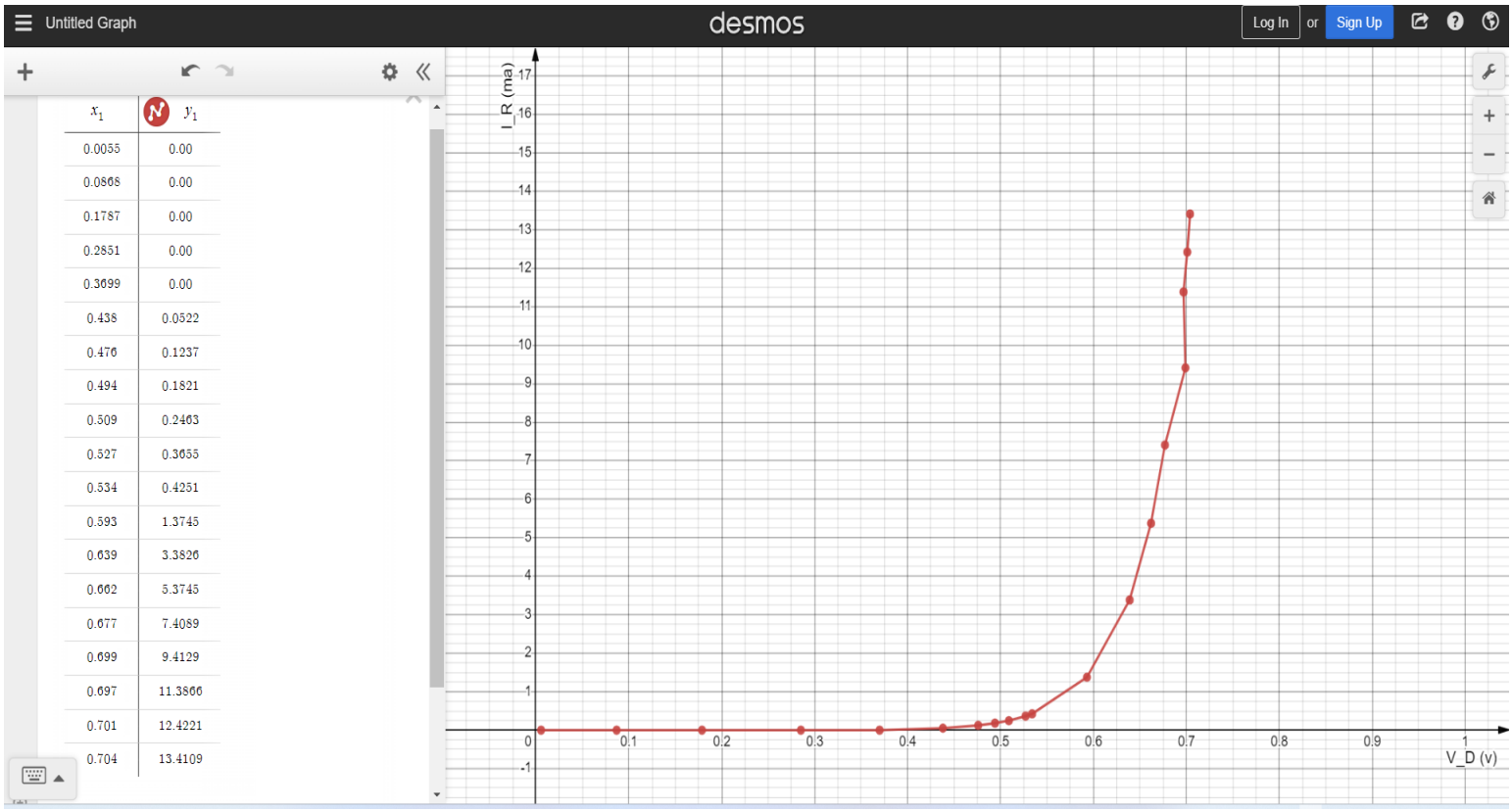
$R = 470\ \Omega$ (measure the accurate resistance using the digital multi-meter)

R = 0.470kΩ (470Ω

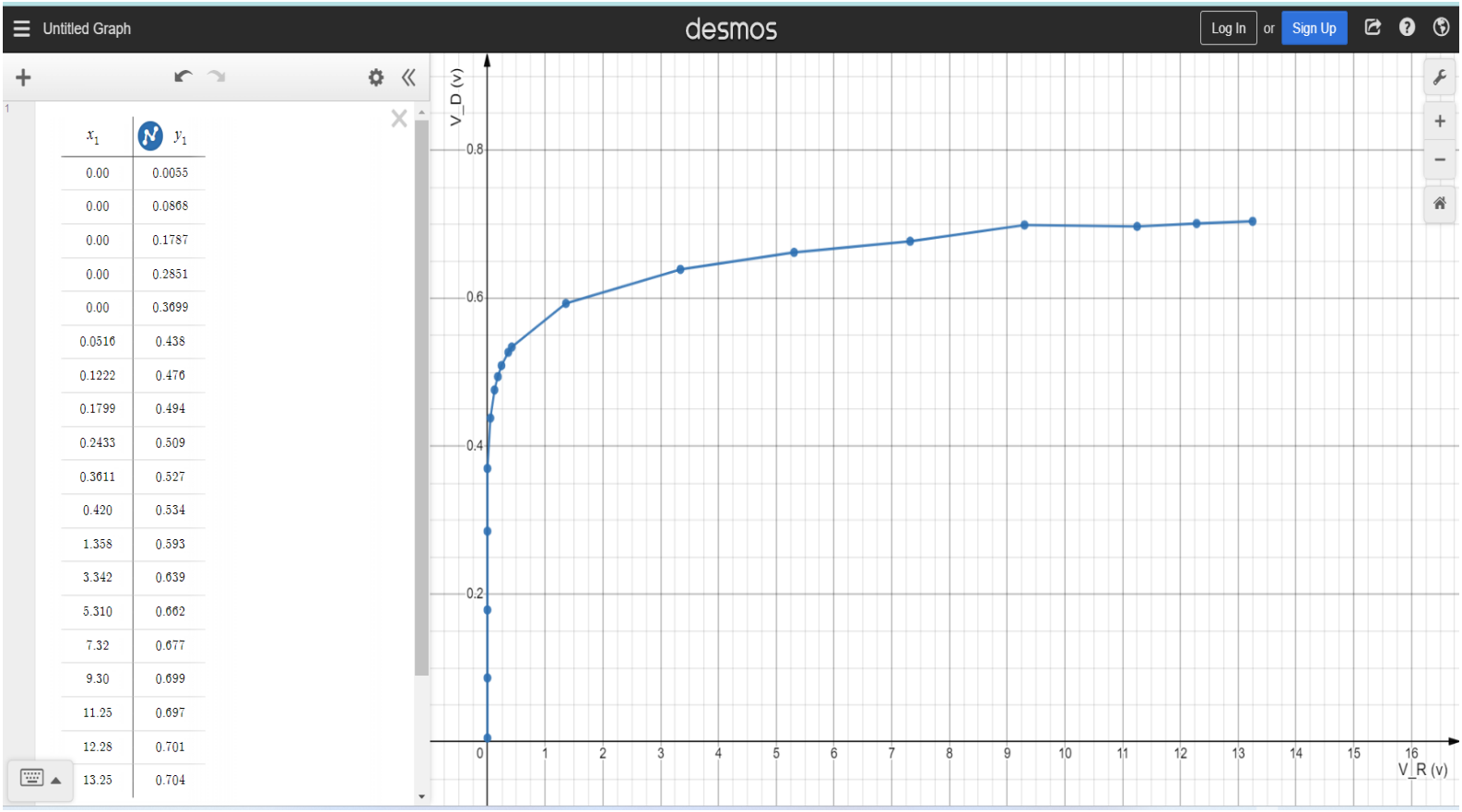
V (volt)	V_R (volt)	V_Z (volt)	$I_Z = V_R/R$ (mA)
0	0	5.4×10^{-3}	0
1	0	0.991	0
2	0	2.00	0
3	1.5×10^{-3}	3.043	3.19×10^{-3}
4	22×10^{-3}	3.96	0.0468
4.9	172.9×10^{-3}	1.72	0.3679
5	0.234	4.82	0.4979
5.1	0.265	4.86	0.5638
5.2	0.313	4.90	06659
5.3	0.378	4.95	0.8043
5.4	0.406	4.97	0.863383
5.5	0.510	5.02	1.0638
6	0.827	5.12	1.7596
7	1.804	5.22	3.8383
8	2.781	5.25	5.917
9	3.78	5.27	8.0426
10	4.68	5.28	9.9574

Diode IV Characteristics:

V_D (v) vs. I_D = I_R (mA)



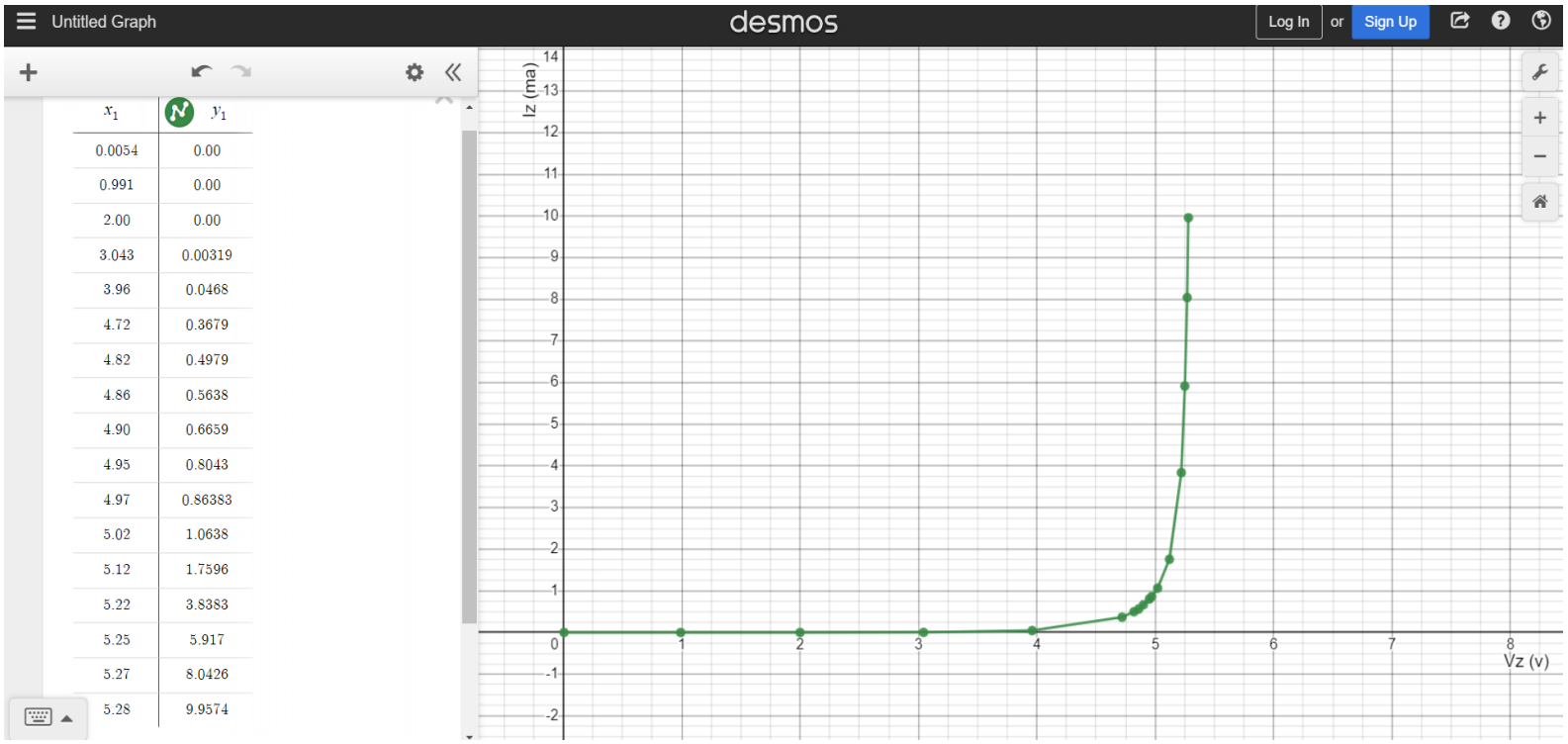
V_R (v) vs. V_D (v):



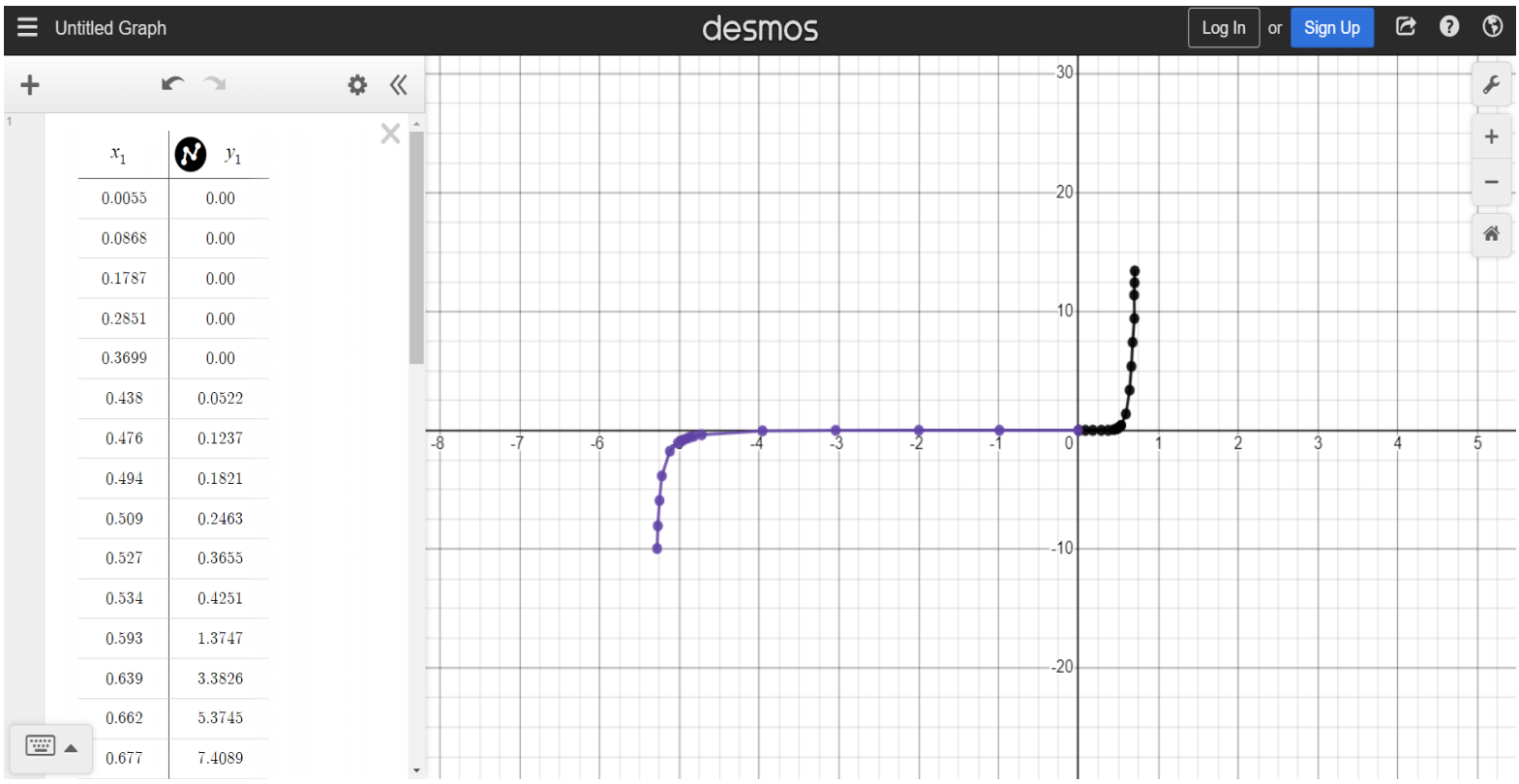
x_1	y_1
0.00	0.0055
0.00	0.0868
0.00	0.1787
0.00	0.2851
0.00	0.3699
0.0516	0.438
0.1222	0.476
0.1799	0.494
0.2433	0.509
0.3611	0.527
0.420	0.534
1.358	0.593
3.342	0.639
5.310	0.662
7.32	0.677
9.30	0.699
11.25	0.697
12.28	0.701
13.25	0.704

Zener Diode IV Characteristics:

V_Z (v) vs. I_Z (mA)



x_1	y_1
0.0054	0.00
0.991	0.00
2.00	0.00
3.043	0.00319
3.96	0.0468
4.72	0.3679
4.82	0.4979
4.86	0.5638
4.90	0.6659
4.95	0.8043
4.97	0.86383
5.02	1.0638
5.12	1.7596
5.22	3.8383
5.25	5.917
5.27	8.0426
5.28	9.9574



x_1	y_1
0.0055	0.00
0.0868	0.00
0.1787	0.00
0.2851	0.00
0.3699	0.00
0.438	0.0522
0.476	0.1237
0.494	0.1821
0.509	0.2463
0.527	0.3655
0.534	0.4251
0.593	1.3747
0.639	3.3826
0.662	5.3745
0.677	7.4089

Discussion

A diode conducts current (IF) forward when it is forward-biased. Otherside, value of IF is dependent on the amount of forward voltage. Zener diodes are advantageous for voltage regulation because the voltage drop across the diode is constant over a broad voltage range.

A diode's characteristics can be changed without hurting it by applying a sizable amount of current to it for a long time. On the other hand, Zener diodes are employed in the circuit to regulate the voltage. This implies that their voltage is often constant, even at high current flows. Theoretical values and the graph demonstrate how the graphical values deviate slightly from the theoretical values that are close to them.