INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Introduction to Electronics Laboratory

School of Electrical Sciences

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AIM:-

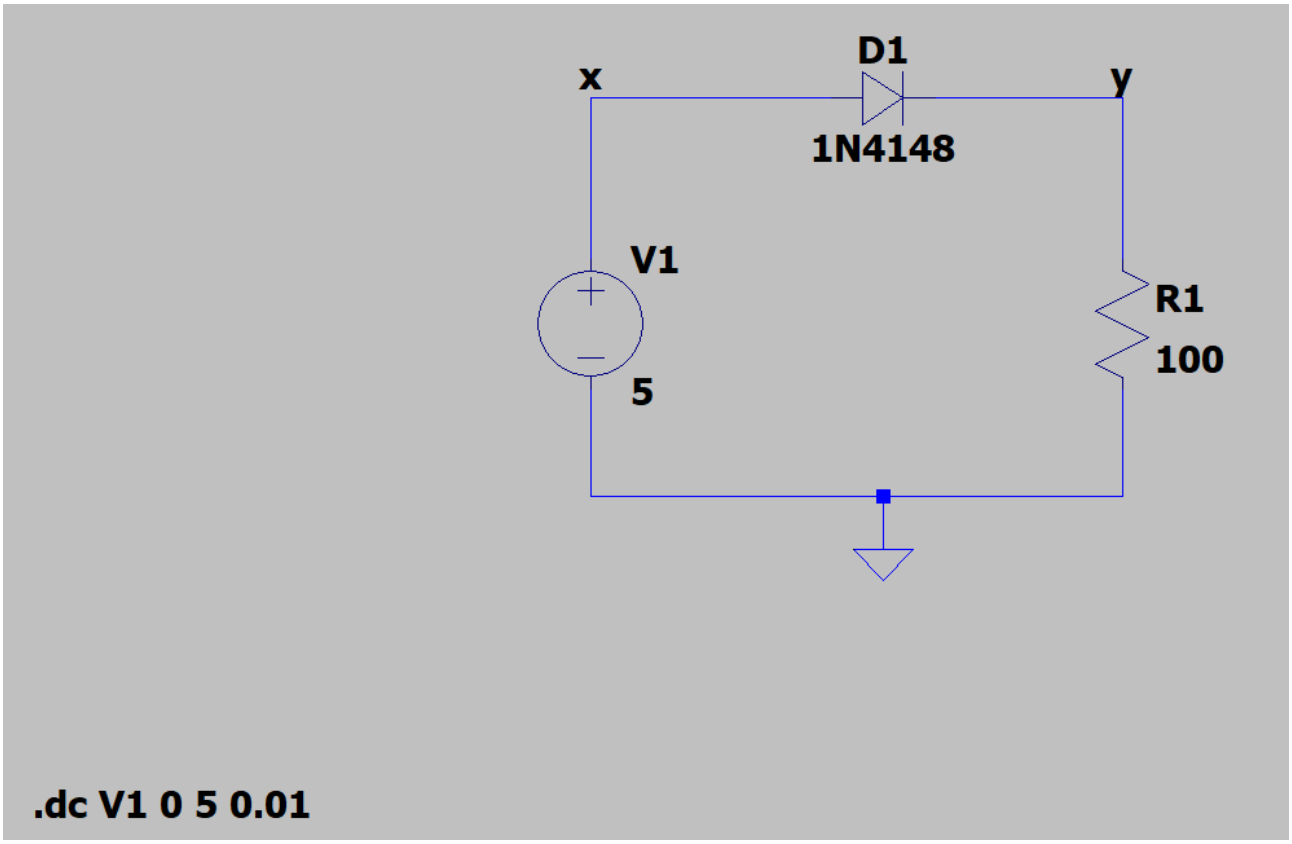
- To analyze Forward characteristics of all Diodes.
- To analyze Reverse characteristics of 4.7V Zener Diode.
- Drawing some conclusion from results

Part 1

Analyzing Forward characteristics of all Diodes

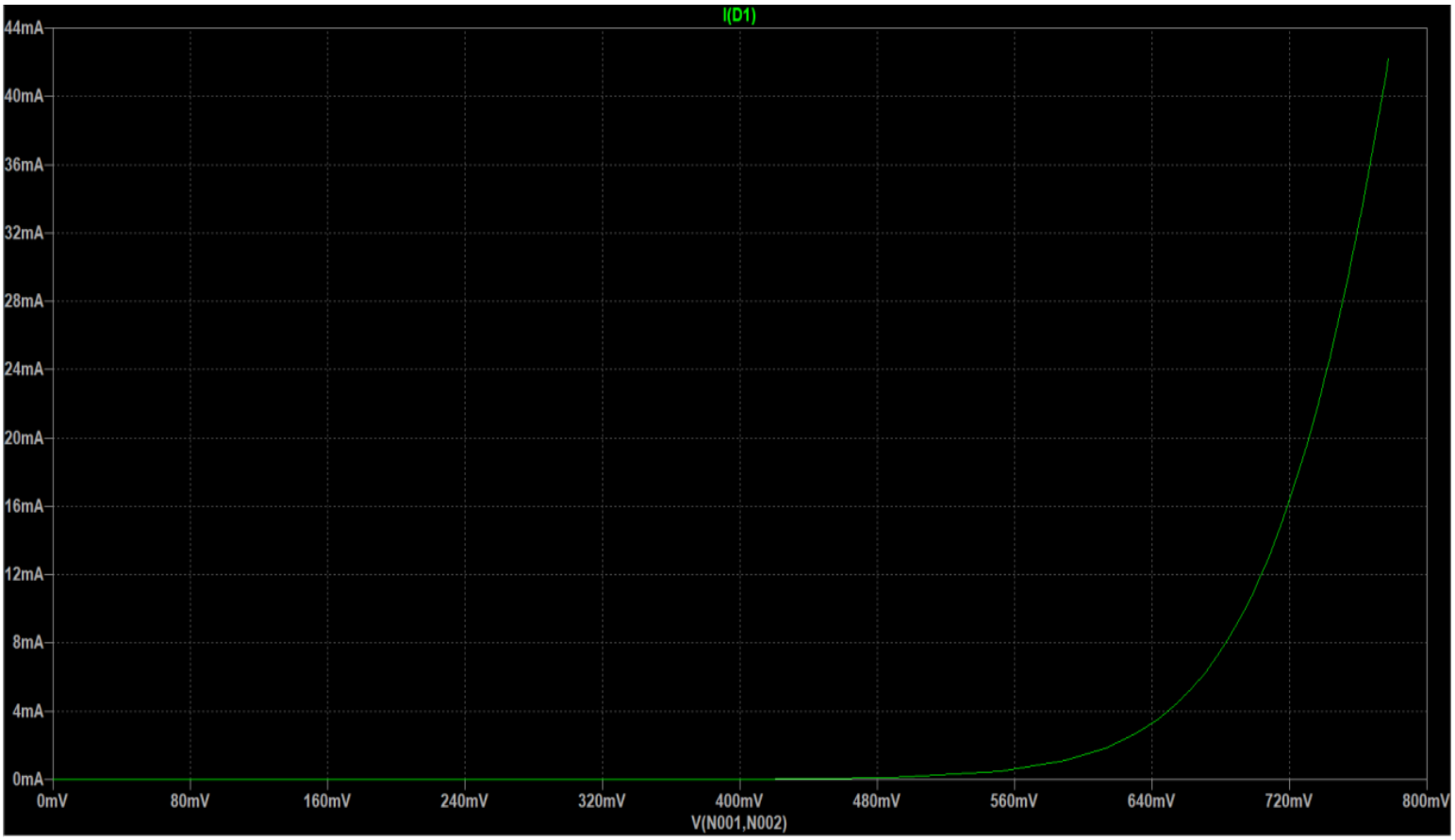
- Silicon Diode

Circuit Diagram



The model of Silicon diode, I used here is 1N4148 which has breakdown voltage of 75volts.

Output from LTspice simulation

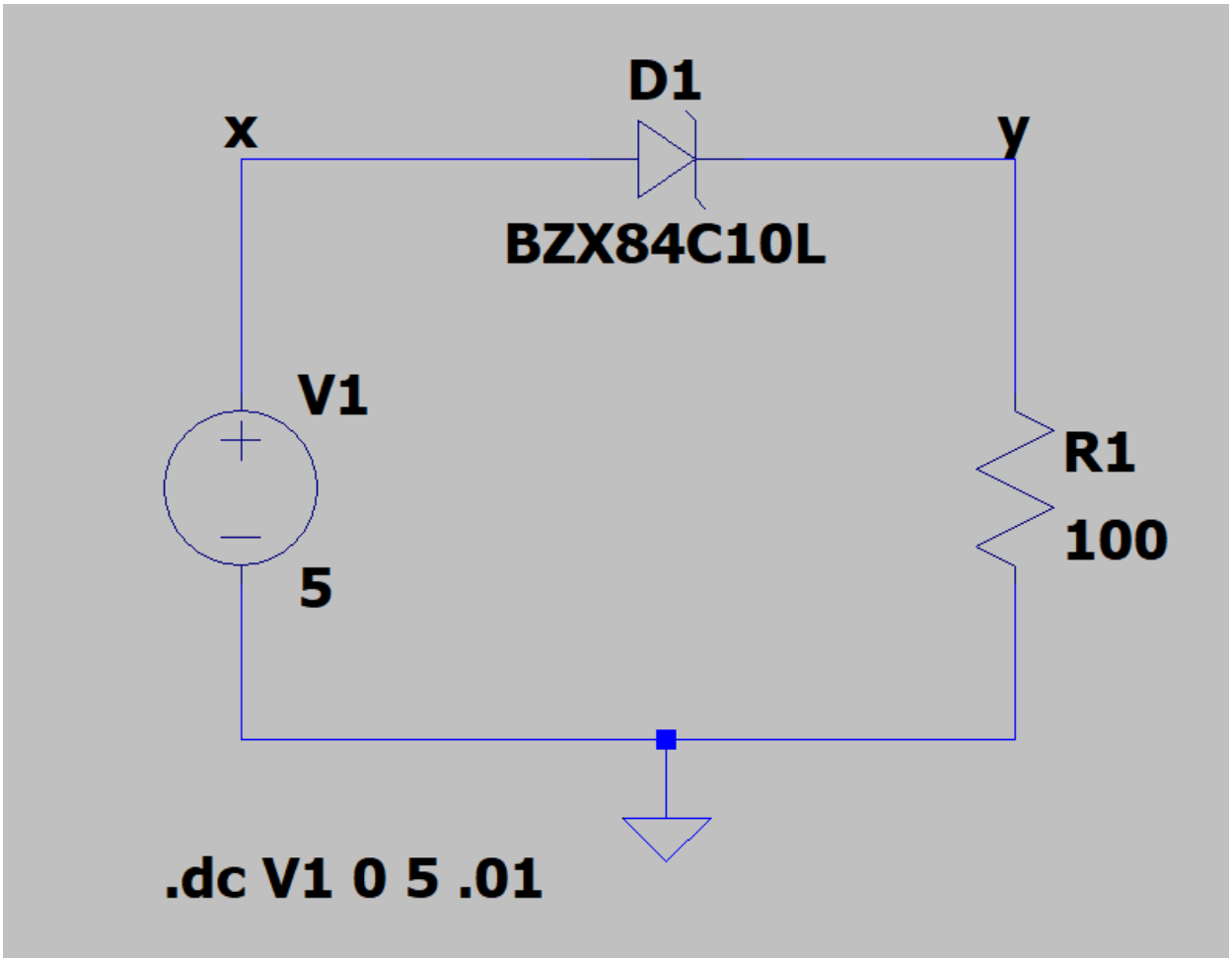


Observation Table:

Characteristics of silicon diode	
Voltage across diode VD(volts)	Diode Forward current ID(mA)
0	0
0.24	0.00087
0.4	0.0184
0.48	0.11
0.56	0.622
0.64	3.3
0.72	16.33
0.751	28.06
0.774	40

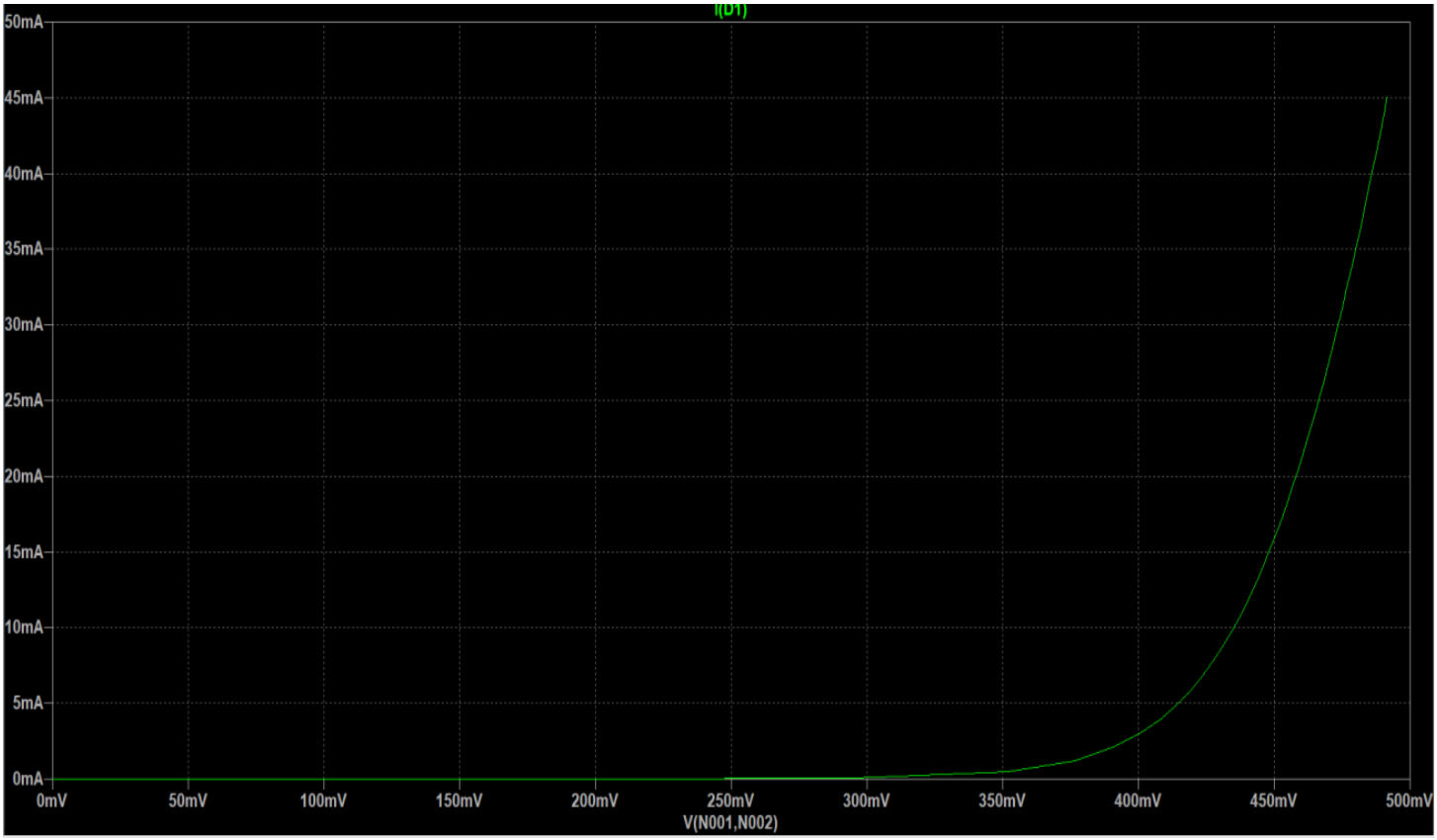
- Zener Diode

Circuit Diagram



The model of Zener diode, I used here is BZX84C10L which has breakdown voltage of 10volts.

Output from LTspice simulation

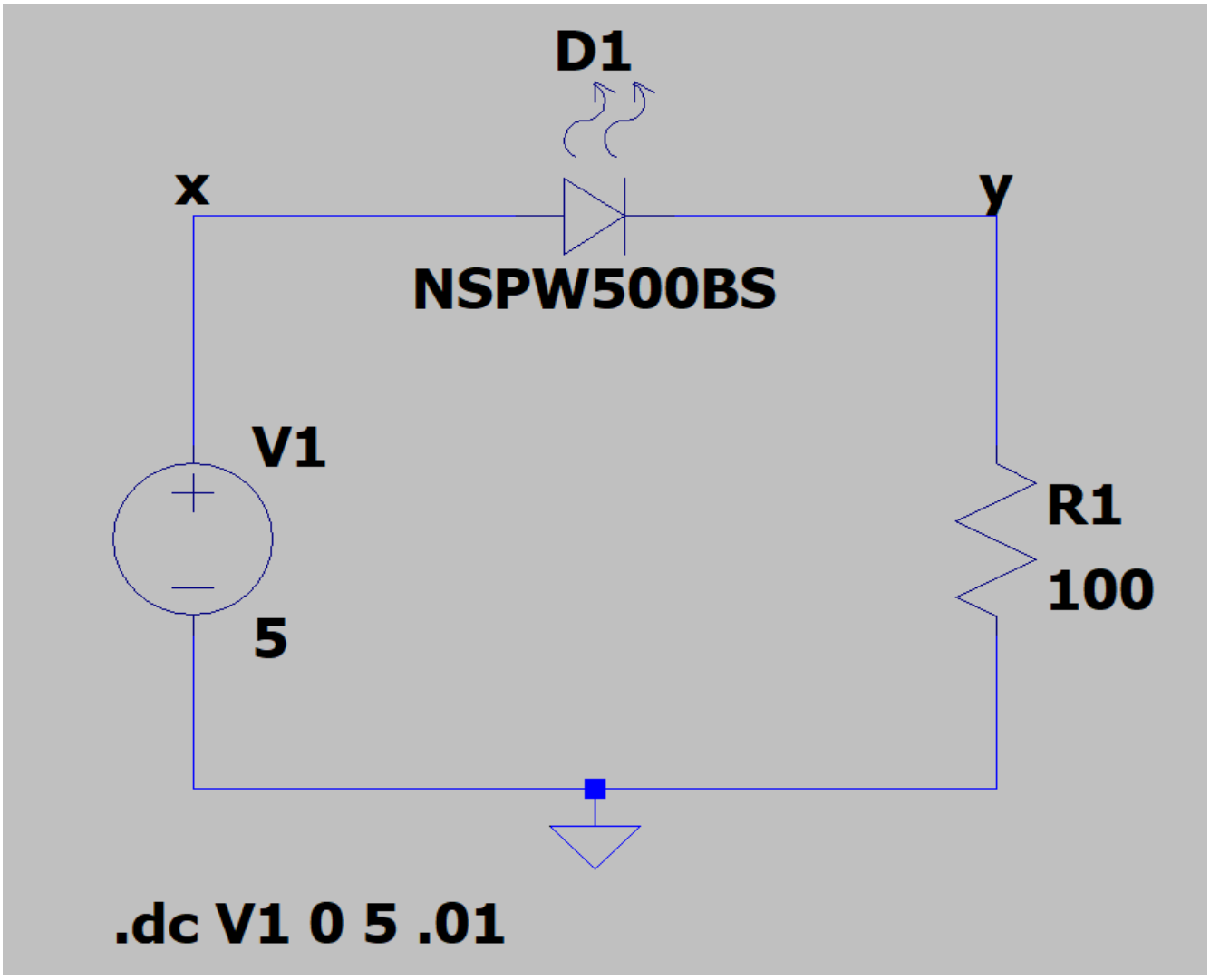


Observation Table:

16	Characteristics of Zenor diode Forward Bias	
17		
18	Voltage across Zenor diode VD(volts)	Diode Forward current ID(mA)
19	0	0
20	0.15	0.00069
21	0.2	0.00143
22	0.25	0.028
23	0.3	0.092
24	0.35	0.467
25	0.4	2.955
26	0.45	15.88
27	0.473	30.078
28	0.48	35

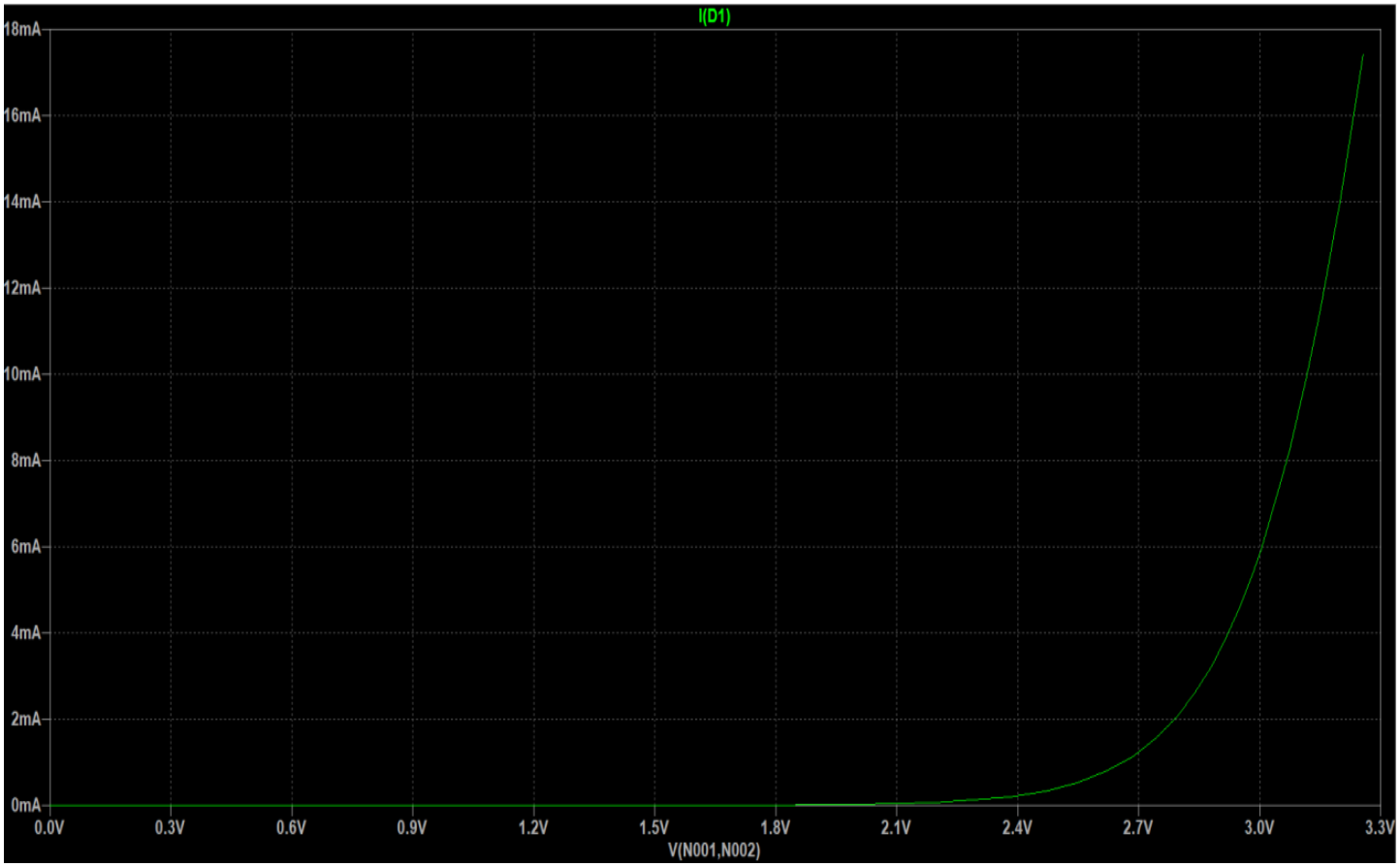
- LED(Light emitting Diode)

Circuit Diagram



The model of LED, I used here is NSPW500BS which has breakdown voltage of 5volts.

Output from LTspice simulation



Observation Table:

33	Characteristics of LED	
34		
35	Voltage across LED VD(volts)	LED Forward current ID(mA)
36	0	0
37	0.9	0.000045
38	1.2	0.00025
39	1.5	0.0013
40	1.8	0.007
41	2.1	0.042
42	2.4	0.237
43	2.7	1.255
44	3	5.88
45	3.12	10
46	3.2	14.01
47	3.23	16.31

Results and Interpretation:

Forward Resistance = $r_{on} = dV_D/dI_d = 1/m$

Ln I_D = $(V_D/\eta V_T)$ + ln I_s (I_s is the saturation current)

V_T = 26mV.

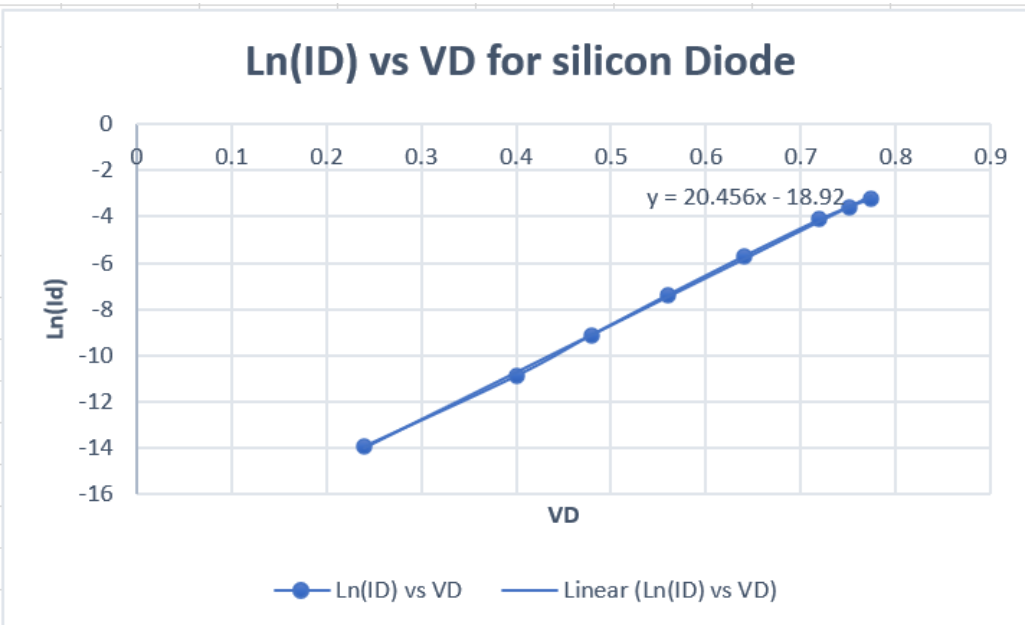
- ## Silicon Diode

I_D = 30.77 mA V_D = 756.923 mV

Slope 'm' at the above mentioned point is 0.481.

r_{on} = 2.079 ohms.

Ln I_D v/s V_D plot



From the graph $1/\eta V_T$ = 20.456

Therefore η = 1.88 .

And $I_s = e^{-18.92}$

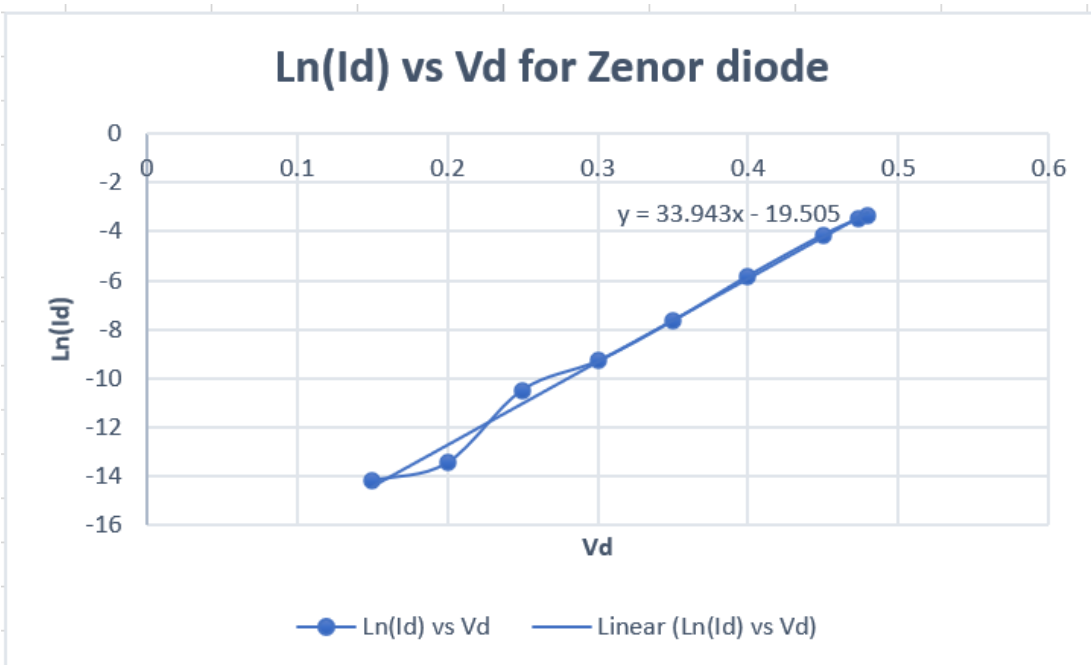
- # Zenor Diode

I_D = 30.77 mA V_D = 756.923 mV

Slope 'm' at the above mentioned point is 0.791.

r_{on} = 1.26 ohms.

Ln I_D v/s V_D plot



From the graph $1/\eta V_T$ = 33.943

Therefore η = 1.133 .

And $I_s = e^{-19.505}$

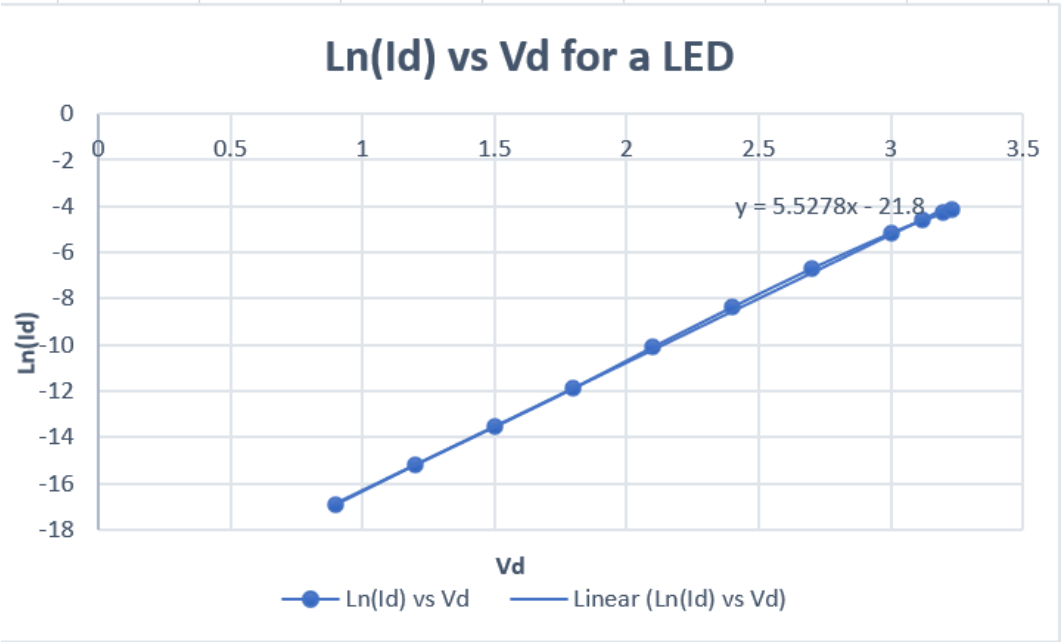
- ## LED (light emitting diode)

I_D = 30.77 mA V_D = 756.923 mV

Slope 'm' at the above mentioned point is 0.791.

r_{on} = 1.26 ohms.

Ln I_D v/s V_D plot



From the graph $1/\eta V_T$ = 5.5728

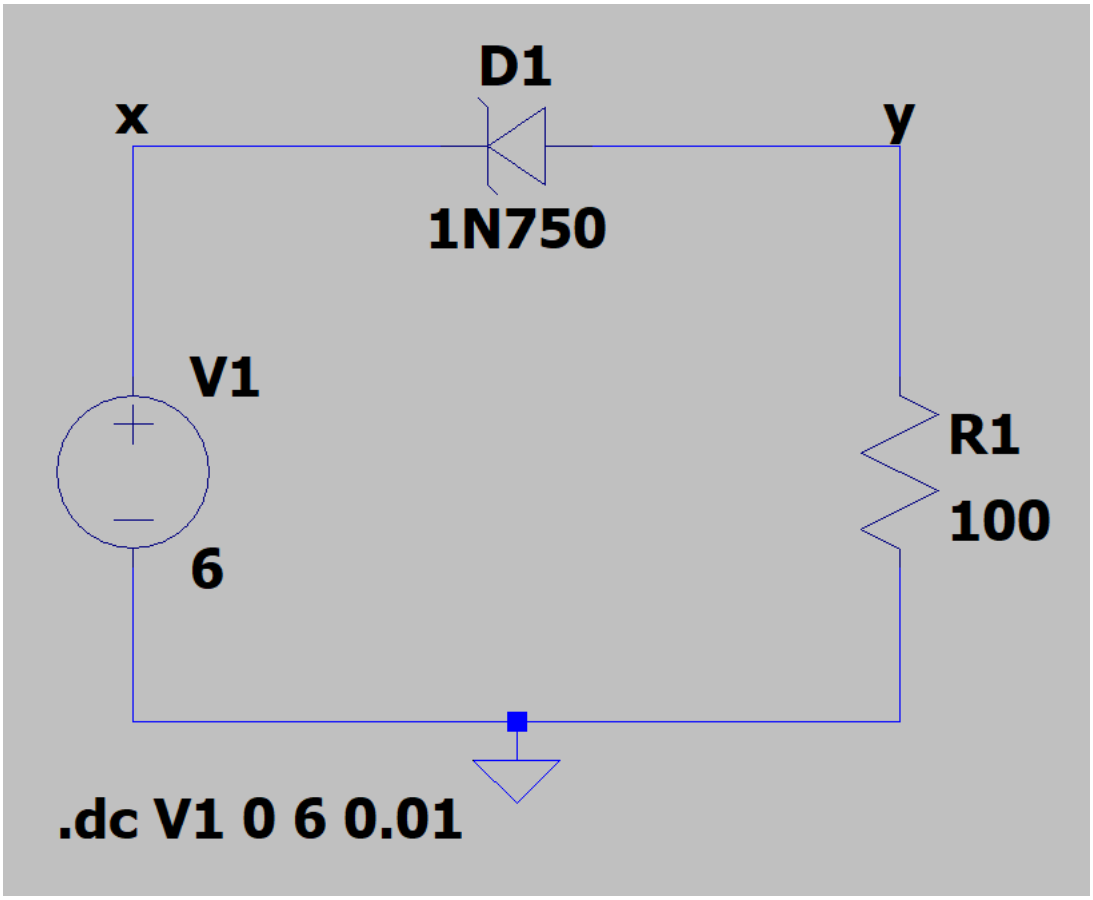
Therefore η = 6.9956 .

And $I_s = e^{-21.8}$

Part 2

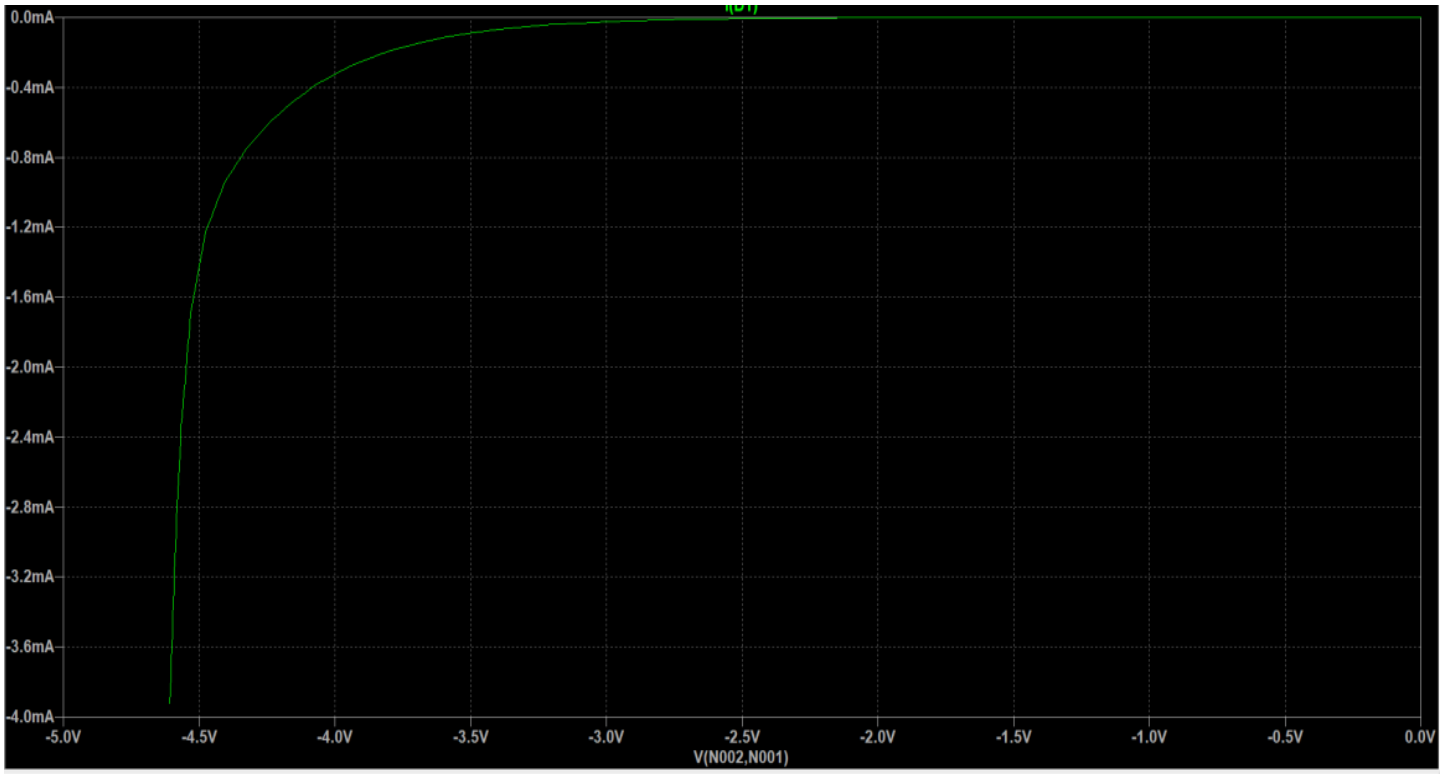
Analyzing Reverse characteristics of 4.7V Zener diode

Circuit Diagram



The model of Zener diode, I used here is 1N750 which has breakdown voltage of 4.7volts.

Output from LTspice simulation



Observation Table:

Characteristics of Zenor Diode Reverse Bias	
Diode Reverse voltage VR(volts)	Diode Reverse Current IR(mA)
0	0
-1.495	-0.0005
-2	-0.00185
-2.5	-0.00672
-3	-0.024
-3.5	-0.088
-4	-0.324
-4.35	-0.8
-4.47	-1.2
-4.58	-3.21

Results:

From the LTspice simulation graph the cutoff voltage of the Zener diode is approximately around -4.65 V.

Discussion:

In the forward characteristics of the diodes used in the experiment are all non-linear. Semiconductor diodes are characterized by non-linear current–voltage characteristics as the current flowing through a forward-biased common silicon diode is limited by the ohmic resistance of the PN-junction. In each forward characteristic current is suddenly increased at a particular voltage difference across the diodes.

Conclusion:

Here we plotted the forward and reverse characteristics of various diodes. We found respective forward resistance and cutoff voltage of Zener diode. In all the graphs the current across the diode is increased suddenly at a particular voltage difference across the diode.

Generally, we don’t use Breakdown voltage as a application but Zener diode is a special case. It behaves as normal diode in forward case.