	LAB
Zener Diode Characteristics	4
	WEEK 5

LEARNING OUTCOMES

A) To observe and draw the static characteristics of a Zener diode

B) To find the regulation characteristics of a given Zener diode

EQUIPMENT AND MATERIALS

1. Zener diode
2. Regulated Power Supply (0-30v)
3. Voltmeter (0-20v)
4. Ammeter (0-100mA)
5. Resistor (1kΩ)
6. Bread Board
7. Connecting wires

DESCRIPTION

A Zener diode is heavily doped p-n junction diode, specially made to operate in the break down region. A p-n junction diode normally does not conduct when reverse biased. But if the reverse bias is increased, at a particular voltage it starts conducting heavily. This voltage is called Break down Voltage. High current through the diode can permanently damage the device

To avoid high current, we connect a resistor in series with Zener diode. Once the diode starts conducting it maintains almost constant voltage across the terminals whatever may be the current through it, i.e., it has very low dynamic resistance. It is used in voltage regulators.

EXPERIMENTAL SETUP

Circuit Diagram: STATIC CHARACTERISTICS (A)

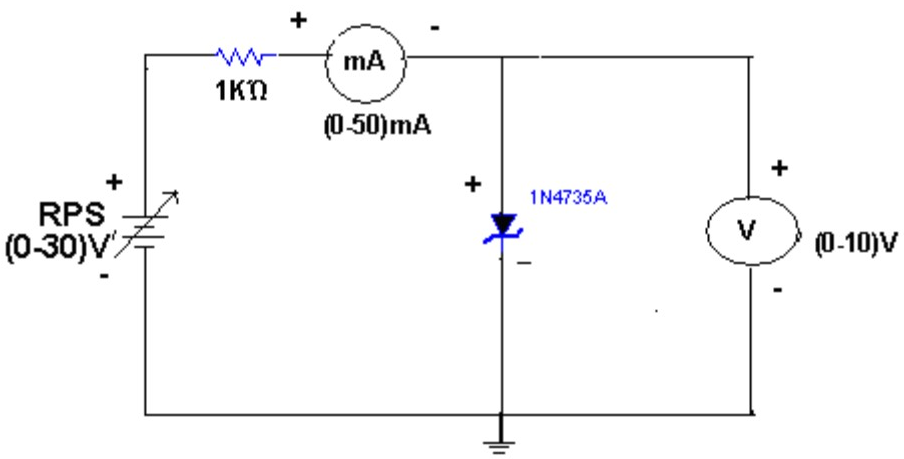


Fig. 4.1

Circuit Diagram: REGULATION CHARACTERISTICS (B)

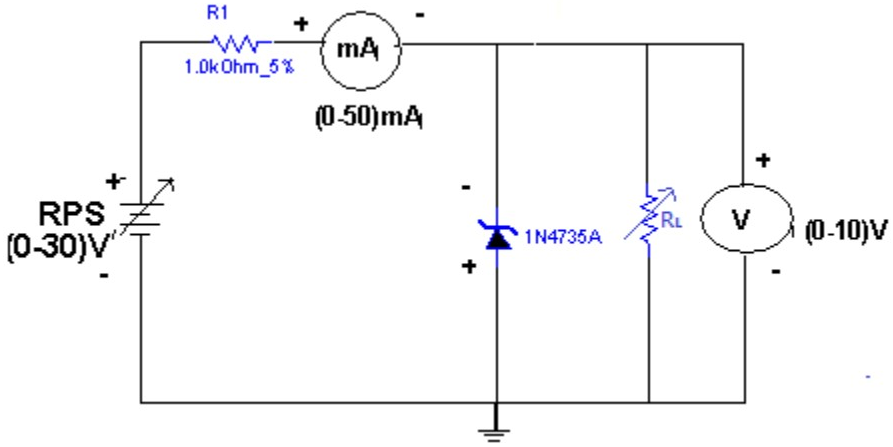


Fig. 4.2

PROCEDURE

Part A: Static characteristics:

1. Connections are made as per the circuit diagram of Fig. 4.1
2. The Regulated power supply voltage is increased such that Vz increases in steps of 0.1v .
3. The zener current (lz), and the zener voltage (Vz.) are observed and then noted in the Table 4.1
4. A graph is plotted between zener current (Iz) and zener voltage (Vz) as shown in Fig. 4.3

Part B: Regulation characteristics:

1. The voltage regulation of any device is usually expressed as percentage regulation
2. The percentage regulation is given by the formula

   percentage regulation = ((VNL-VFL)/VFL)X100

   VNL=Voltage across the diode, when no load is connected.

VFL=Voltage across the diode, when load is connected.

3. Connections are made as per the circuit diagram of Fig. 4.2. Supply input voltage V_E = 10v and note down the voltage V_Z, which is termed as VNL.
4. Now place a load of 10kΩ across diode by keeping V_E = 10v and note down the voltage V_Z, which is termed as VFL
5. The above step is repeated by decreasing the value of the load in steps of 1kΩ
6. All the readings are noted in the Table 4.2.
7. The percentage regulation is calculated using the above formula

OBSERVATION AND CALCULATIONS

Table 4.1: Static characteristics (A)

S.NO	APPLIED VOLTAGE [V_E](volts)	VOLTAGE ACROSS DIODE [V_Z](volts)	ZENER CURRENT [I_Z](mA)
1		0	
2	0.1	0.1	0
3	0.2	0.2	0
4	0.3	0.3	0
5	0.4	0.4	0
6	0.5	0.5	0
7	0.6	0.6	0
8	1.3	0.7	0.6
9	22	0.8	21
10	30	~~0.9~~ 0.81	29

Table 4.2: Static characteristics (reverse biase)			
S.NO	APPLIED VOLTAGE [V_E](volts)	VOLTAGE ACROSS DIODE [V_Z](volts)	ZENER CURRENT [I_Z](mA)
1.	1	-1	0
2.	1.5	-1.5	0
3.	2	-2	0
4.	2.5	-2.5	0
5.	3	-3	0
6.	3.5	-3.5	0
7.	4	-4	0
8.	4.5	-4.5	0
9.	5.5	-5	-0.5
10.	30	~~-5.5~~ -5.15	-15

MODEL WAVEFORMS:

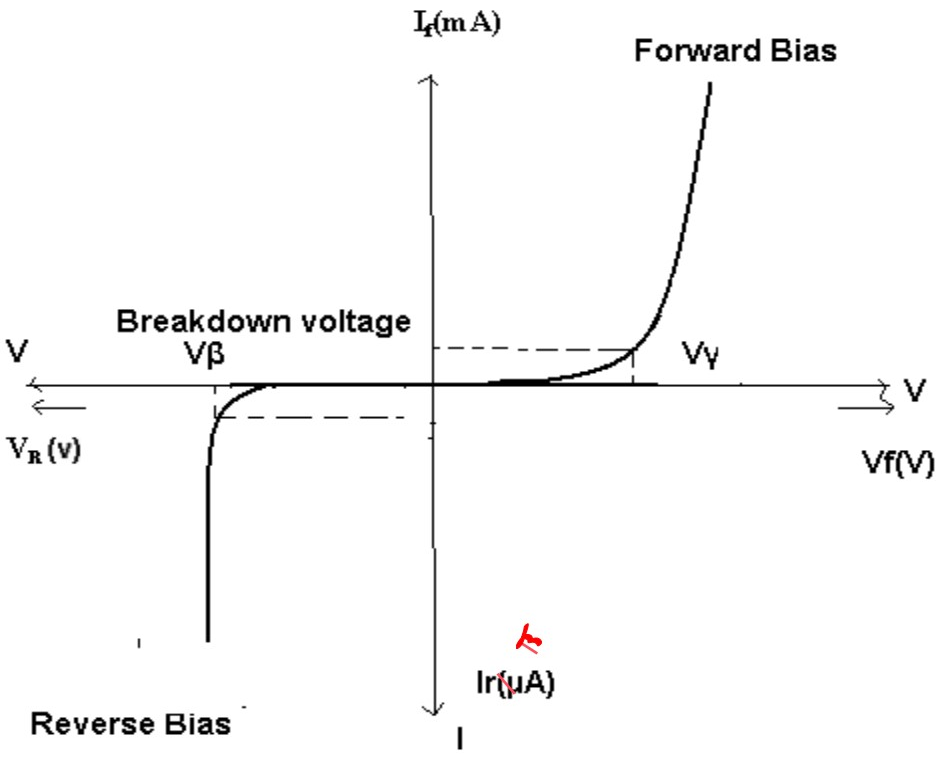


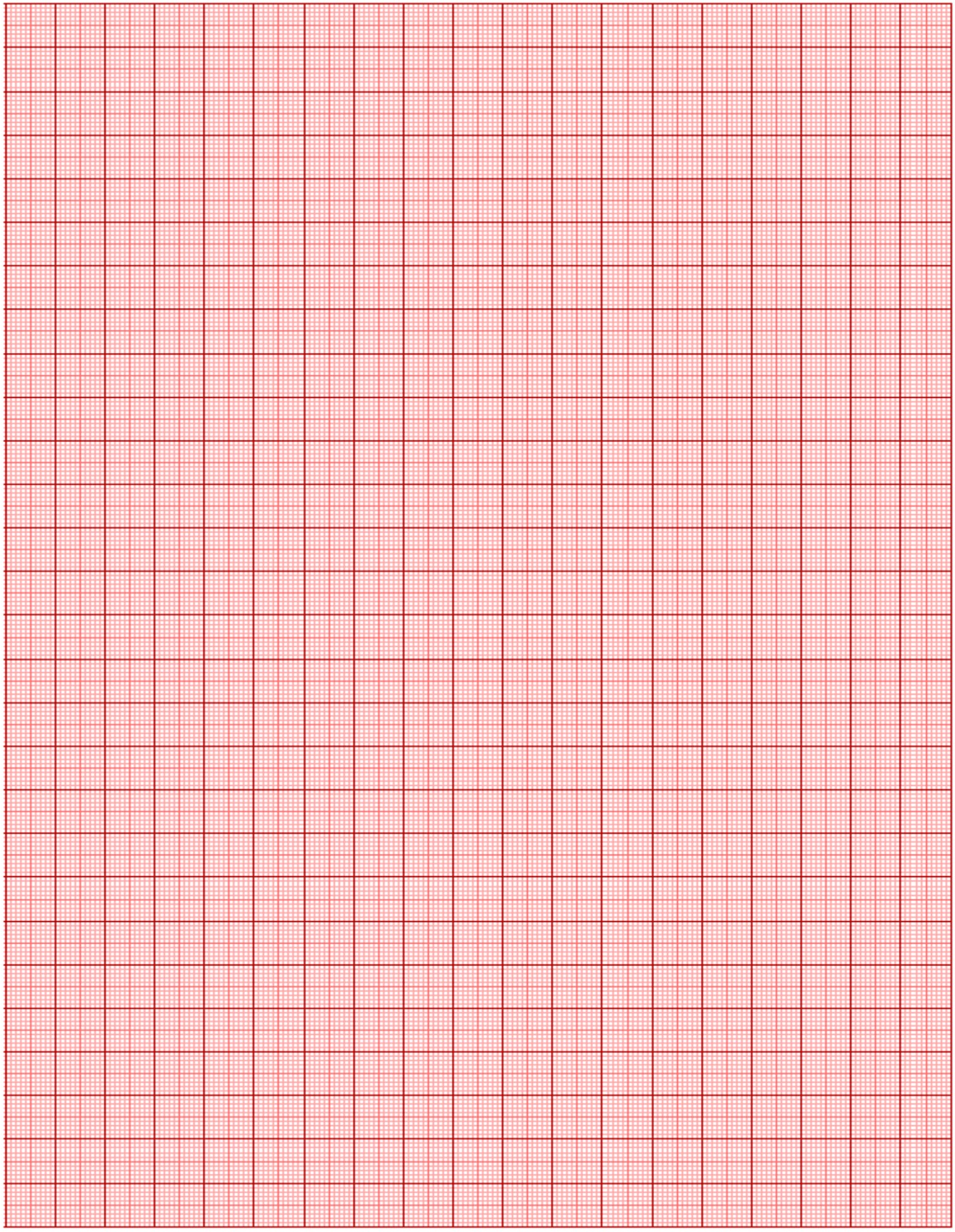
Fig. 4.3

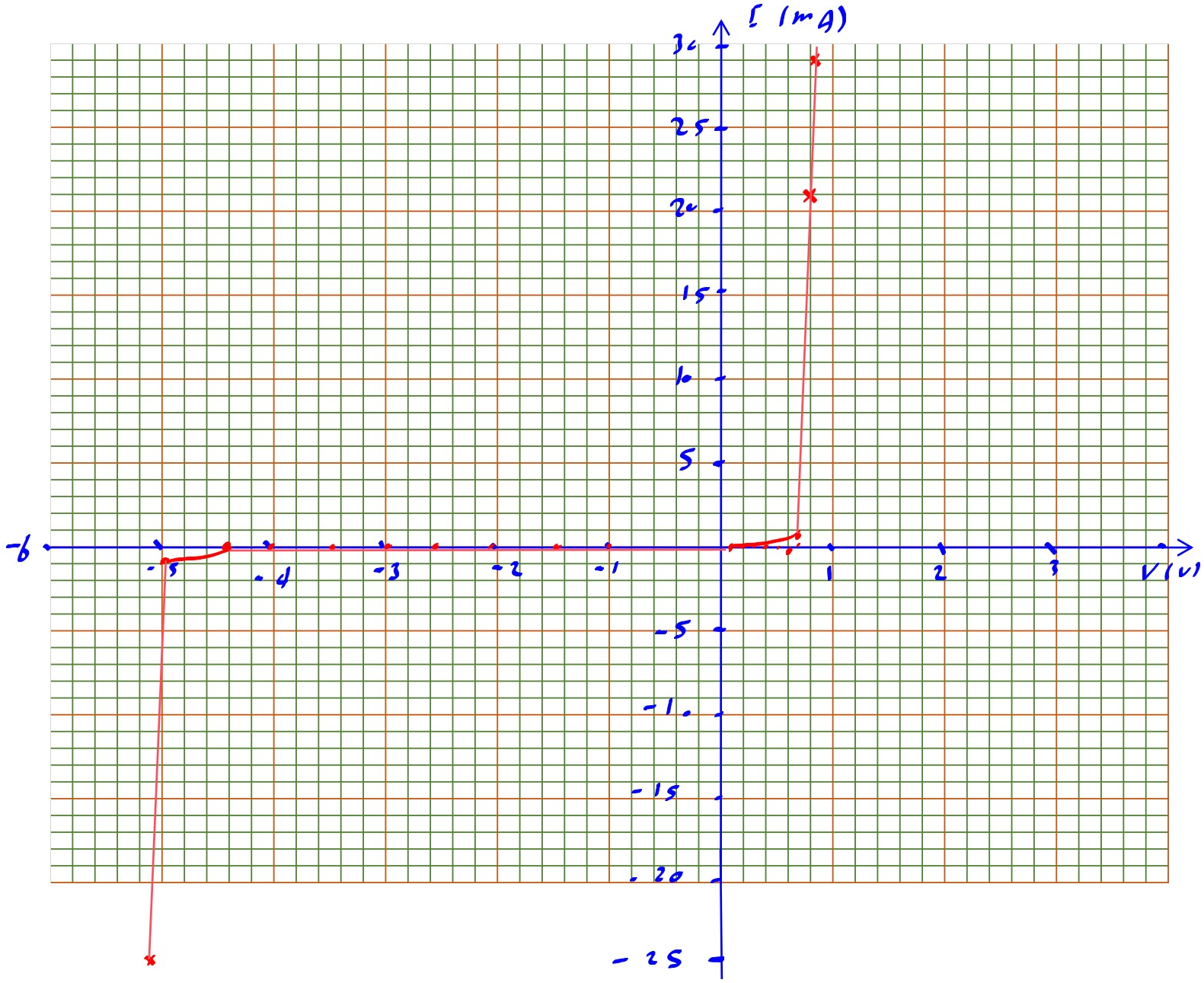
RESULT & CONCLUSION

In forward bias
There are no current in the circuit in till the volt is less than threshold voltage, when voltage across the diode rise to 0.7 volt , current will flow as I rise the voltage

In reverse bias
Current equal to zero till I rise to breakdown voltage current will increase and the voltage across Zener diode is constant

In regulation characteristics voltage is constant across the variable resistance


Free Multi-color Graph Paper from http://incompetech.com/graphpaper/multicolor/


I (mA)
30
25
20
15
10
5
-6
-5
-4
-3
-2
-1
1
2
3
V(V)
-5
-10
-15
-20
-25

Multisim Simulation:

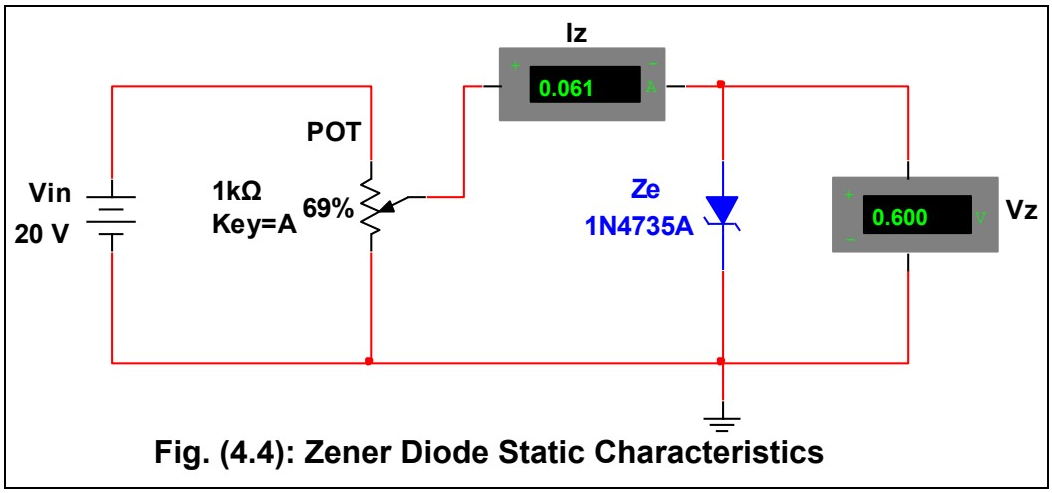


Fig. (4.4): Zener Diode Static Characteristics

Table 4.1a: Static characteristics (A)

S.NO	APPLIED VOLTAGE [V_E](volts)	VOLTAGE ACROSS DIODE [V_Z](volts)	ZENER CURRENT [I_Z](mA)
1	0	0	0
2	0.1	0.1	0
3	0.2	0.2	0
4	0.3	0.3	0
5	0.4	0.4	0
6	0.5	0.5	0
7	0.6	0.6	0
8	0.94	0.7	0.2
9	5.1	0.8	4.4
10	30	~~0.9~~ 0.85	30

Table 4.2: Static characteristics (reverse biase)

S.NO	APPLIED VOLTAGE [V_E](volts)	VOLTAGE ACROSS DIODE [V_Z](volts)	ZENER CURRENT [I_Z](mA)
1.	2	- 2	0
2.	4	- 4	0
3.	6	- 6	0
4.	8	- 8	0
5.	10	- 10	0
6.	11	- 11	0
7.	12	- 12	0
8.	21.3	- 12.5	9
9.	30.8	- 13	17
10.			

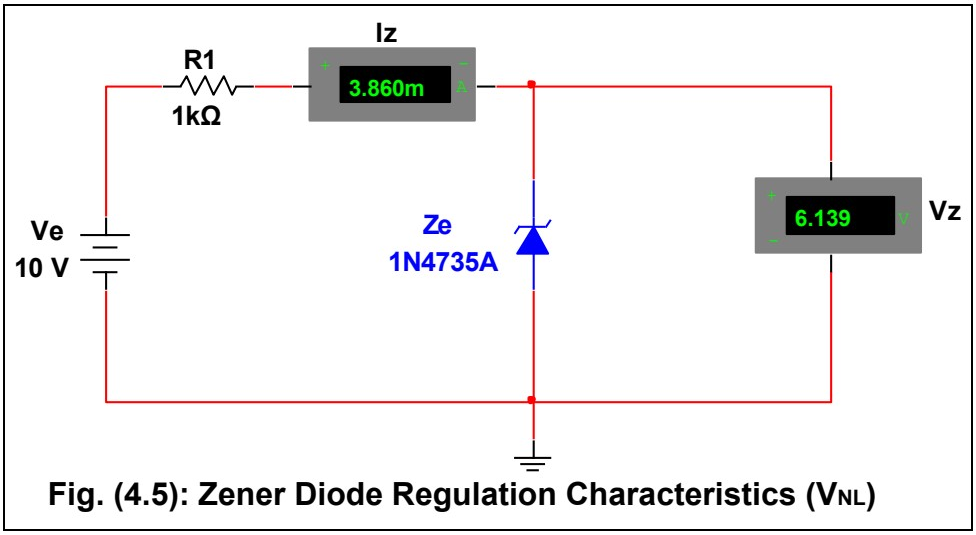


Fig. (4.5): Zener Diode Regulation Characteristics (V_{NL})

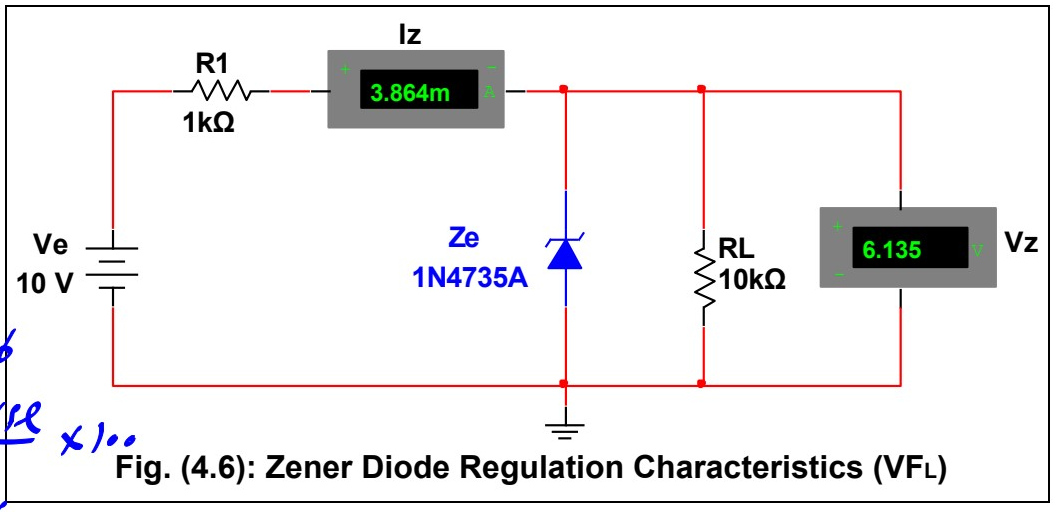


Fig. (4.6): Zener Diode Regulation Characteristics (V_{FL})

$V_{fl} =$

$V_{NL} = 5.106$

$\% = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$

Table 4.2a: Regulation characteristics (B)				
S.N0	V_{NL} (volts)	V_{FL} (volts)	R_L (kΩ)	% REGULATION
1	5.106	5.103	10	0.0588
2		5.102	9	0.0784
3		5.102	8	0.0784
4		5.101	7	0.0980
5		5.1	6	0.118
6		5.099	5	0.137
7		5.098	4	0.157
8		5.094	3	0.235
9		5.086	2	0.393
10		4.98	1	2.530