Experiment No. 3.

AIM: To Plot the Volt-Ampere (V-I) Characteristic curve of Zener Diode.

APPRATUS REQUIRED: Trainer kit comprising of voltmeter, ammeter, Zener diode, connecting wires, Power supply etc.

THEORY: A zener diode is a heavily doped p-n junction designed to operate in the breakdown region under reverse bias condition. In other words a p-n junction diode normally does not conduct when it is reverse biased. If the reverse bias is increased, a point is reached when the junction breaks down and starts conducting heavily. This break down may occur due to avalanche mechanism or zener mechanism or both. When operated in the breakdown region, the zener diode maintains a constant voltage across its terminal. The breakdown voltage depends upon the width of the depletion region which in turn depends upon the doping level of the p-region and n-region with other type of semiconductor. Working of the zener diode in forward bias condition is similar to that of the p-n junction. Symbolically it is represented as shown in the fig 3.1 it is same as that of the simple p-n diode, only the negative terminal is denoted by Z symbol.

Fig. 3.1

The voltage at which a zener diode breaks in the reverse bias condition is known as zener voltage (V_Z) and the range of the voltage about the breakdown voltage in which a zener diode conducts in reverse direction is called tolerance.

Characteristic curve of a zener, between voltage and current both in forward and reverse bias conditions are shown in fig 3.3. It is similar to the p-n junction diode except that it has a sharp (or distinct) breakdown voltage known as zener voltage (V_Z). It operates in three regions: forward, leakage or breakdown and the voltage (V_Z) is almost constant over the operating region.

CIRCUIT DIAGRAM:

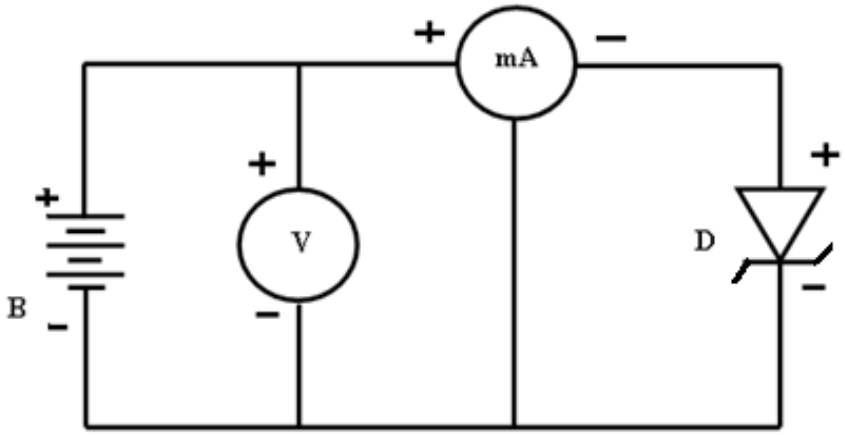

Fig 3.2 (a)

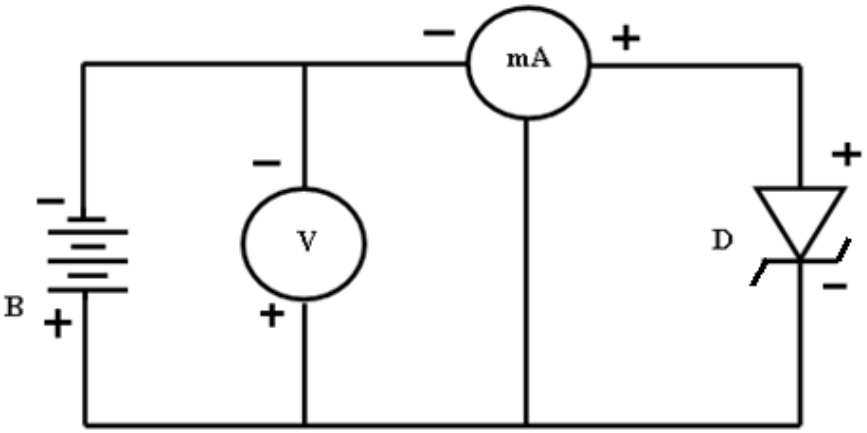

Fig 3.2 (b)

GRAPH:

When diode is forward biased it behaves normally as a p-n junction diode. When it is reversed biased a small reverse saturation current flow through diode. Current remains constant, with increasing voltage upto a certain value, called zener voltage V_Z. In the vicinity of V_Z it grows rapidly and at V_Z breakdown occurs. As a

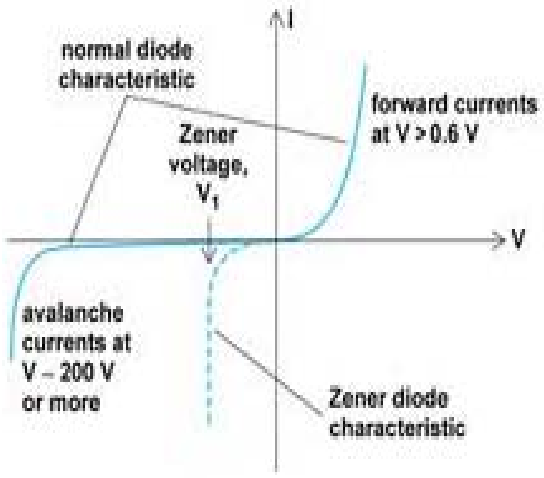

Fig 3.3

result, a large current flows through the diode. V_Z does not change once the diode gets into the breakdown condition as seen in the fig 3. Zener breakdown does not result in the damage of the junction. The phenomenon is reversible provided the temperature does not rise to a point as to destroy the diode material. When the reverse bias is reduced below the break down value the diode is restored to the saturation current level. Usually a series resistor R_S, called limiting resistor, is connected in series with the diode to avoid passing of very large current through the diode.

PROCEDURE:

Forward Biasing :

i) Make the connections as shown in circuit diagram (figure 3.2.a).
ii) Keep the potentiometer towards minimum (i.e. at 0 V).
iii) Keep switches towards forward bias low volt and current.
iv) Now put on the toggle switch.
v) Now vary in small step the forward bias voltage with the help of forward bias control and note voltage and current readings.
vi) Now plot the V-I graph for the readings noted.

Reverse Biasing:

vii) Make connections as shown in circuit diagram (figure 3.2.b).
viii) Keep the potentiometer towards minimum (i.e. at 0V).
ix) Keep switches towards reverse bias high voltage and low current.
x) Now put on the toggle switch.
xi) Now vary in small step the reverse bias voltage with the help of reserve bias control and note voltage and current readings.
xii) Now plot the V-I graph for the readings noted.

OBSERVATION:

Reading of meters in forward bias condition:

i) L.C. of Voltmeter = ……. iii) Range of Voltmeter for F.B. =……
ii) L. C. of Ammeter = ……..…... iv)Range of Ammeter in F. B. =……...

Reading of meters in reverse bias condition:

v) L.C. of Voltmeter = ……. vii) Range of Voltmeter for R. B. =……..….

vi) L. C. of Ammeter = ……..…... viii) Range of Ammeter in R. B. =…….....

S. No.	Forward Bias		Reverse Bias	
	Voltage (in V)	**Current (in mA)**	**Voltage (in V)**	**Current (in µA)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

RESULT

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PRECAUTIONS

1. While doing the experiment do not exceed the ratings of the diode. This may lead to the damage of the diode.
2. Connect the voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Put ON the toggle switch when circuit is completed.
4. Reading of voltmeter and ammeter should be taken from the top view of the meters.
5. Zero error should be removed before taking the reading.

VIVA-VOCE

1. What do understand by zero error of the instrument?

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2. What is the Zener diode?

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3. What is the difference between p-n junction and Zener diode?

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4. How does the Zener diode behave in forward bias condition?

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5. Give the application of Zener diode.

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6. What is Zener breakdown?

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7. What do you understand by breakdown voltage?

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8. What will happen if voltage is applied to the diode after breakdown voltage?

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9. How is the negative terminal of the diode denoted in the symbol?

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10. Can Zener diode be as used for voltage stability?

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