Experiment # 2(b) Date:

V-I characteristics of Zener Diode

Aim:
To study the VI characteristics of the Zener diode using simulation and breadboard setup.

Apparatus required (simulation):
LTSpice software

Apparatus required (hardware setup):

Sl. No.	Item	Range	Quantity
1.	Zener diode	1N4739	1
2.	Resistor	470Ω 1 kΩ	1 1
3.	Ammeter	0-25 mA 0-500 µA	1 1
4.	Voltmeter	0-1 V 0-10 V	1 1
5.	Breadboard	-	1
6.	Wires	-	As required
7.	Regulated power supply	0-30 V	1

Theory:

Zener diodes are heavily doped silicon diodes that, unlike normal diodes, exhibit an abrupt reverse breakdown at relatively low voltages (typically less than 6V). A similar effect, called avalanche breakdown, occurs in less heavily doped diodes. These avalanche diodes also exhibit a rapid breakdown with negligible current flowing below the avalanche voltage and a relatively large current flowing once the avalanche voltage has been reached. For avalanche diodes, this breakdown voltage usually occurs at voltages above 6 V. In practice, however, both types of diodes are referred to as Zener diodes.

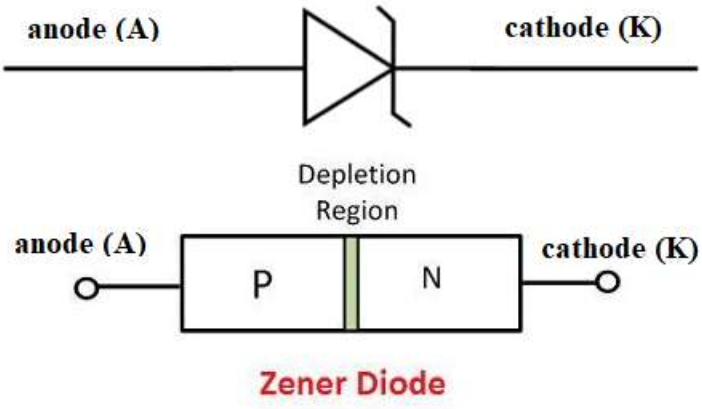

Fig.1

Whereas reverse breakdown is a highly undesirable effect in circuits that use conventional diodes, it can be extremely useful in the case of Zener diodes where the breakdown voltage is precisely known. When a diode is undergoing reverse breakdown,

provided its maximum ratings are not exceeded, the voltage appearing across it will remain substantially constant (equal to the nominal Zener voltage) regardless of the current flowing. This property makes the Zener diode ideal for use as a voltage regulator. Under forward bias condition, the Zener diodes behave as normal PN junction diodes.

A. Software Experiment

Circuit for Zener diode:

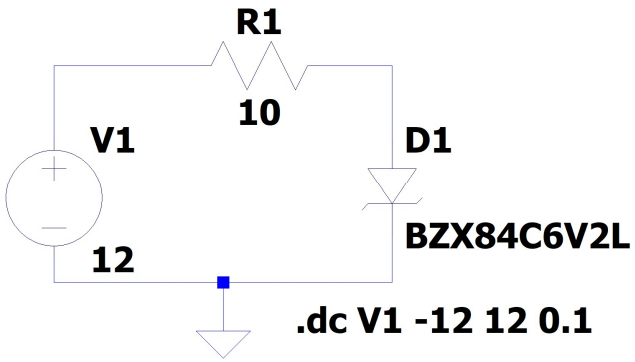

Fig.2

Procedure:

1. Launch LTSpice window.
2. Go to File and then New Schematic
3. Go to Edit and then components and choose the required components and draw the circuit diagram for obtaining the VI characteristics.
4. Set the values of the components as per the circuit diagram.
5. Then go to simulate, edit simulation command and choose DC sweep.
6. Then run the simulation.
7. Record the obtained VI characteristics

VI characteristics of Zener diode obtained after simulation :

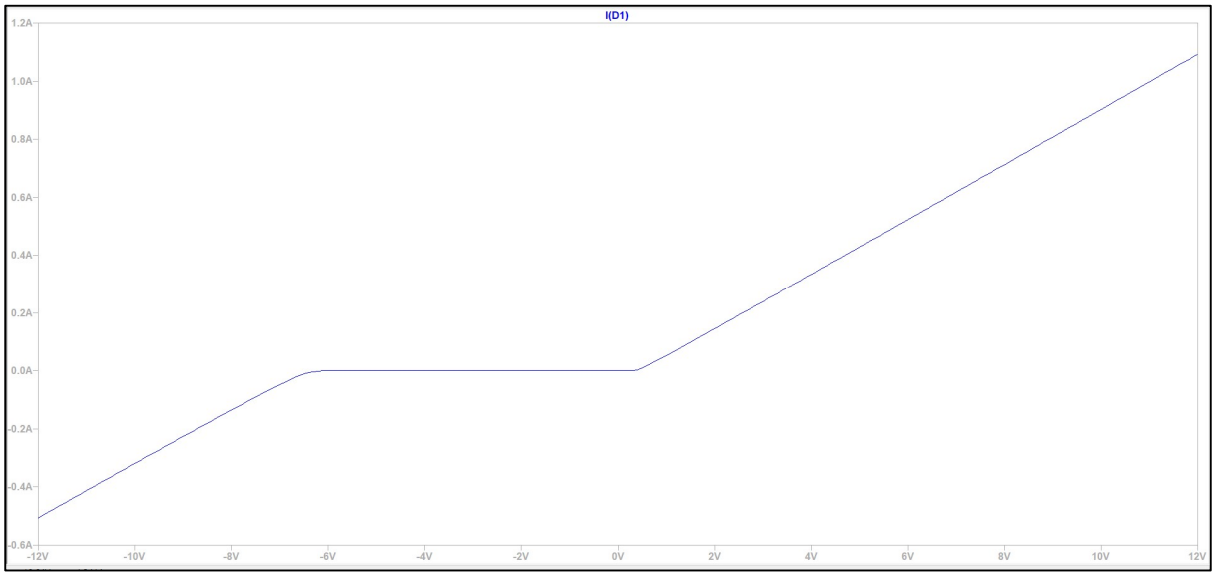

Fig.3

B. Hardware Experiment

Circuit diagram:

1) Forward bias of Zener diode

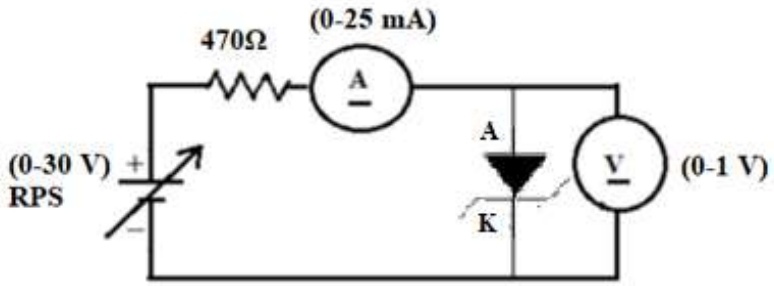

Fig.4

2) Reverse bias of Zener diode

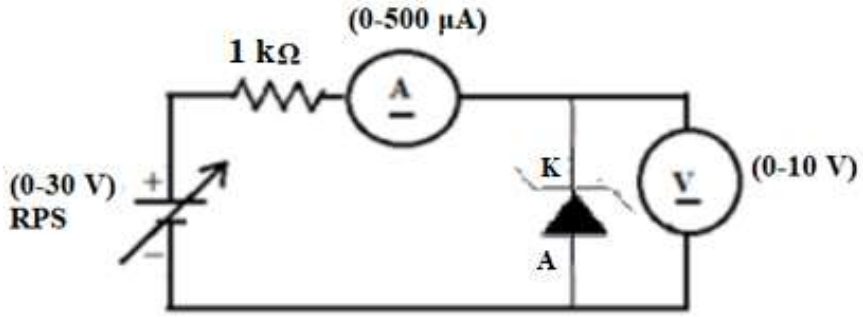

Fig.5

Experimental Procedure:

Forward characteristics:

1. Construct the circuit as per the circuit diagram.
2. Vary the voltage in steps by using the regulated power supply and note down the current in each step correspondingly.
3. Plot the characteristics between forward voltage and forward current, showing the turn-on voltage (cut in voltage / knee voltage) explicitly.

Reverse characteristics:

1. Construct the circuit as shown in the circuit diagram.
2. Vary the voltage in steps by using the regulated power supply and note down the current in each step correspondingly.
3. Plot the characteristics between reverse voltage and reverse current, showing breakdown voltage explicitly.

Tabular column:

1) Forward bias

Sl. No.	Voltage, VF (V)	Current, IF (mA)

2) Reverse bias

Sl. No.	Voltage, VR (V)	Current, IR (μA)

Model Graph:

VI characteristics of Zener diode

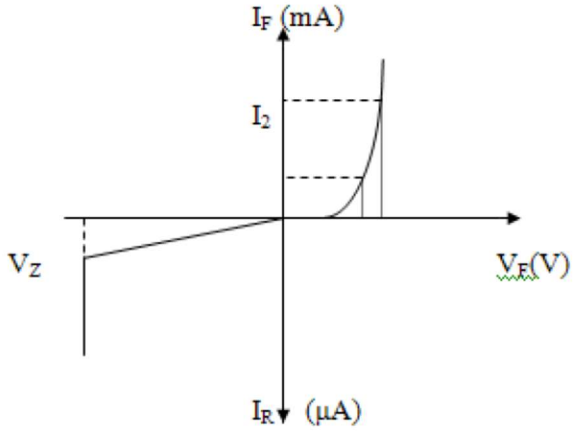

Fig.6

Result:

Thus, the VI characteristics of the Zener diode were studied using software and hardware setups.