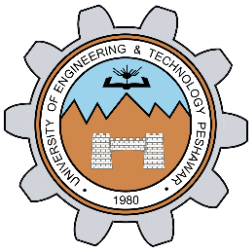
ZENER DIODES

LAB # 07



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CSE-206L Electronic Circuits Lab

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"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Submitted to:

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Date: 7th July 2023

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OBJECTIVES:

- To study the characteristics of Zener diode.
- To study the voltage regulation in Zener diode regulation circuit.

EQUIPMENT:

- Oscilloscope
- Function Generator
- Digital Multimeter (DMM)

COMPONENTS

- Zener Diode
- Resistors: 1kΩ
- Potentiometer
- Variable Voltage Source

THEORY:

DIODE:

A diode is a two-terminal electronic component that conducts current primarily in one direction. it has low resistance in one direction, and high resistance in the other.

ZENER DIODE:

The Zener diode is a specialized P-N junction diode designed to function in the reverse biased mode. While forward biased, it behaves like a regular diode. However, it possesses a specific voltage called the breakdown voltage, at which it experiences breakdown in the reverse biased state. Unlike regular diodes that get damaged at the breakdown voltage, the Zener diode is specifically engineered to operate in the reverse breakdown region.

The fundamental principle behind the Zener diode is known as Zener breakdown. When a diode is heavily doped, its depletion region becomes narrow. When a high reverse voltage is applied across the junction, a strong electric field is created at the junction, leading to the generation of electron-hole pairs. As a result, a substantial current flows, which is referred to as Zener breakdown.

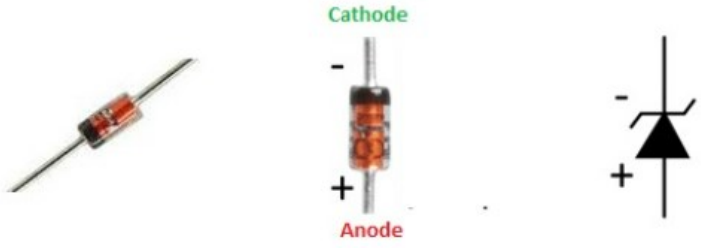

Figure 1, Zener Diode Diagram and Symbol

PROCEDURE:

Part A: Zener Diode Characteristics:

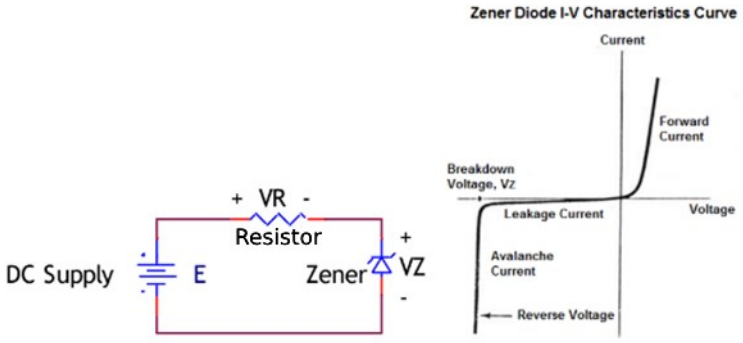

Figure 2, Zener Diode Series Circuit

- Construct the circuit of Fig. 2. Set the DC supply to 0 V and record the measured value of R.
- Set the DC supply (E) to the values appearing in Table 1, 2 and 3 and measure both V_Z and V_R. Calculate the Zener current, I_Z using the Ohm's law given in the table and complete the table.

Part B: As A Voltage Regulator:

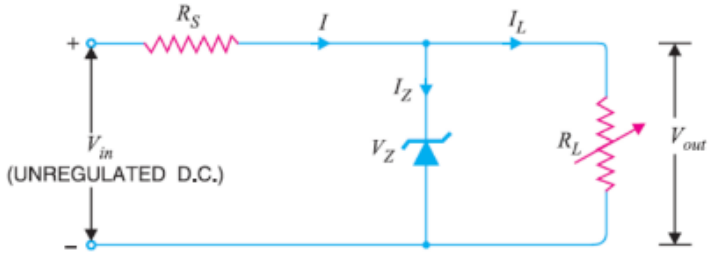

Figure 3, Voltage Regulator Circuit

- Construct the circuit of Fig. 3. Record the measured value of each resistor
- Measure the value of $V_L(V_{out})$ and V_R.
- Using the measured values, calculate the value for current across R i.e I, current across R_L i.e I_L, and current across the Zener Diode i.e Iz and complete the table 4.

RESULTS:

PRACTICAL:

Forward Bias (Resistance=1 KΩ):

Source Voltage	Voltage Across Diode (Vz)	Current Across Diode (Iz)
5 Volts	0.42Volts	0.42 mA

Table 1.1

Reverse Bias (Resistance=1 MΩ):

Source Voltage	Voltage Across Diode (Vz)	Current Across Diode (Iz)
5 Volts	5.3 Volts	0 A
15 Volts	15.18Volts	15.03 µA

Table 1.2

PROTEUS:

Reverse Bias:

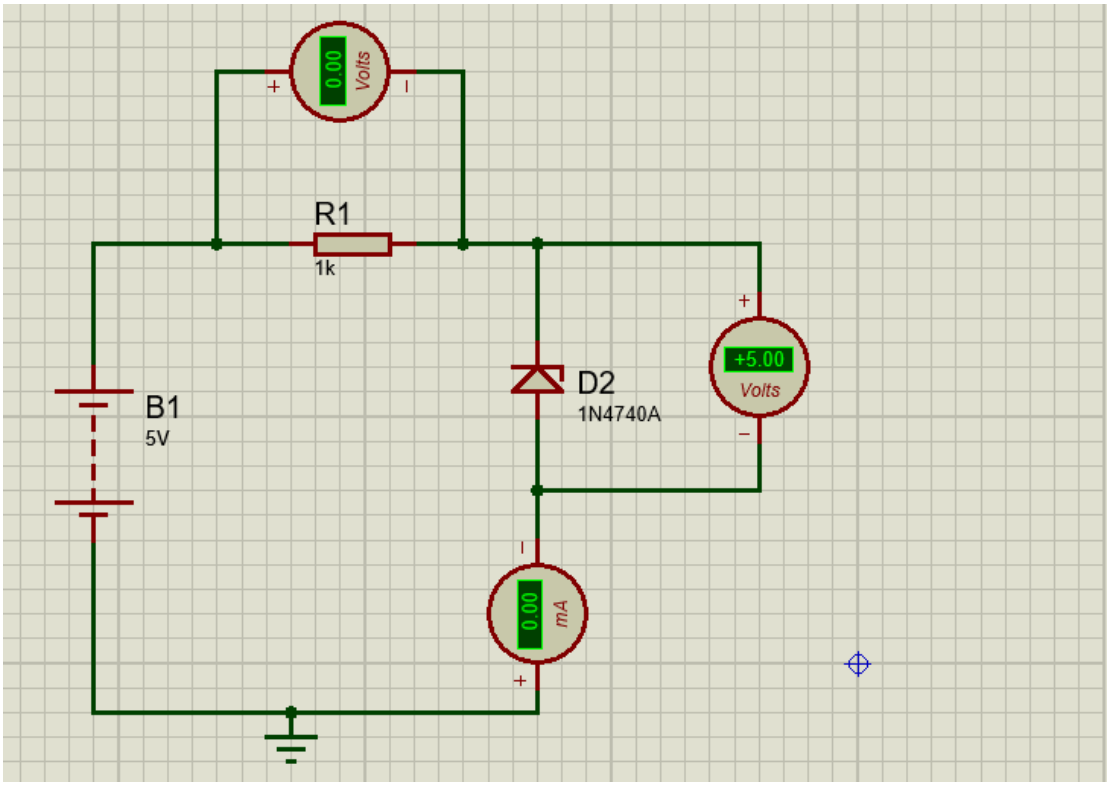

Figure 4, Proteus Circuit for Zener Diode Reverse Biased

Calculations:

Source Voltage	Voltage Across Diode (V_z)	Current Across Diode (I_z)
5 Volts	5 Volts	0 A
10 Volts	9.91 Volts	0.08 mA
15 Volts	10 Volts	4.97 mA
20 Volts	10 Volts	9.95 mA
50 Volts	10.1 Volts	14.9mA

Table 2

Forward Bias:

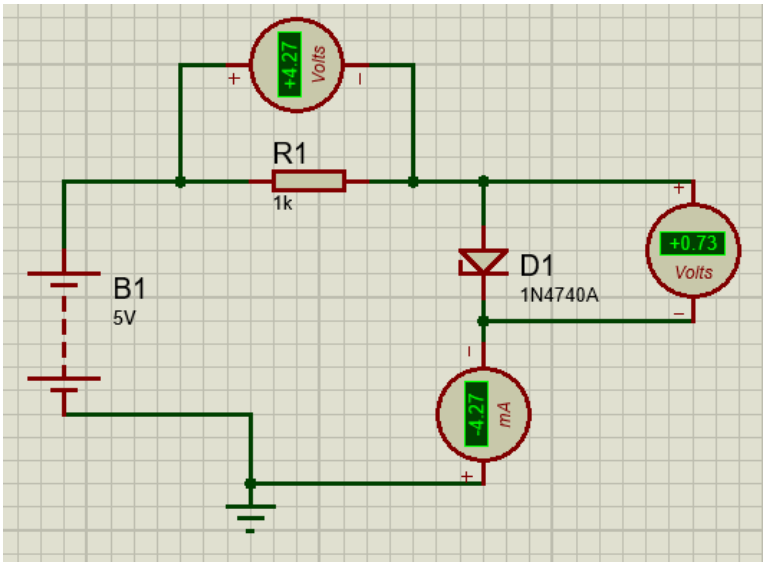

Figure 5, Proteus Circuit for Zener Diode Forward Biased

Calculations:

Source Voltage	Voltage Across Diode (VD)	Current Across Diode (ID)
5 Volts	0.73 Volts	4.27 mA
10 Volts	0.75 Volts	9.25 mA
15 Volts	0.76 Volts	14.2 mA
20 Volts	0.77 Volts	19.2 mA
50 Volts	0.80 Volts	49.2 mA

Table 3

As Voltage Regulator:

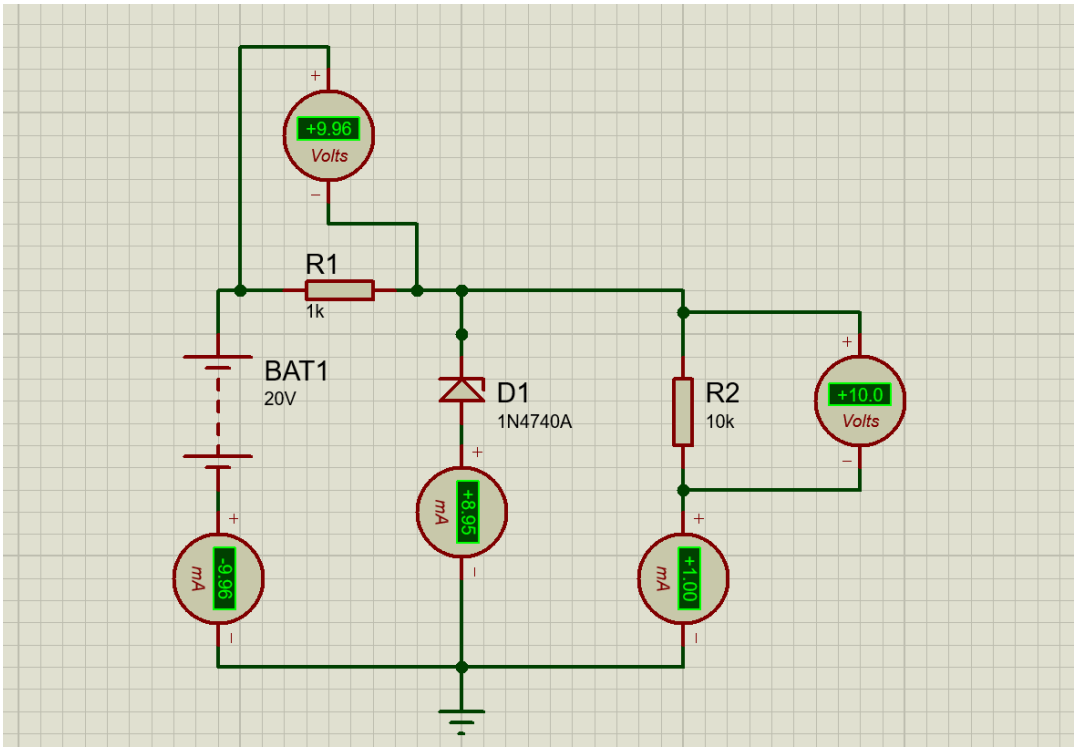

Figure 6, Voltage Regulator Circuit in Proteus

Calculations:

For R=1kΩ, R_L = 10kΩ,

V_{in}	V_R	V_L	I_z	I_L	I
5 Volts	0.45V	4.55V	0mA	0.45mA	0.45mA
10 Volts	0.91V	9.09V	0mA	0mA	0mA
20 Volts	9.96V	10V	8.95mA	1mA	9.95mA
30 Volts	19.9V	10.1V	18.9mA	1.01mA	19.9mA
50 Volts	39.9V	10.1V	38.9mA	1.01mA	39.9mA

Table 4

Conclusion:

We successfully performed experiments with Zener diode and learned about its properties. We also learned about its uses as voltage regulation.