Zener Diode-Voltage Regulator

Aim of the experiment

At the end of the experiment, the student will be able to

- Explain the function of a Zener diode
- Explain Zener Diode as Voltage Regulator

Theory

Zener Diode

A Zener Diode is a special kind of diode which permits current to flow in the forward direction as normal, but will also allow it to flow in the reverse direction when the voltage is above the breakdown voltage or 'zener' voltage. Zener diodes are designed so that their breakdown voltage is much lower - for example just 2.4 Volts.

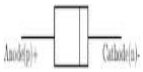


Figure 1

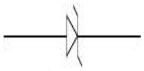


Figure 2

Function of Zener Diode

1. Zener diodes are a special kind of diode which permits current to flow in the forward direction.

2. Zener diodes will also allow current to flow in the reverse direction when the voltage is above a certain value. This breakdown voltage is known as the Zener voltage. In a standard diode, the Zener voltage is high, and the diode is permanently damaged if a reverse current above that value is allowed to pass through it.

3. In the reverse bias direction, there is practically no reverse current flow until the breakdown voltage is reached. When this occurs there is a sharp increase in reverse current. Varying amount of reverse current can pass through the diode without damaging it. The breakdown voltage or zener voltage (VZ) across the diode remains relatively constant.

Zener Diode As A Voltage Regulator

A voltage regulator is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations. A Zener diode of break down voltage V_Z is reverse connected to an input voltage source VI across a load resistance RL and a series resistor RS. The voltage across the zener will remain steady at its break down voltage VZ for all the values of zener current IZ as long as the current remains in the break down region. Hence a regulated DC output voltage V0=VZ is obtained across RL, whenever the input voltage remains within a minimum and maximum voltage. Basically there are two type of regulations such as: **Line Regulation:** In this type of regulation, series resistance and load resistance are fixed, only input voltage is changing. Output voltage remains the same as long as the input voltage is maintained above a minimum value. **Load Regulation:** In this type of regulation, input voltage is fixed and the load resistance is varying. Output volt remains same, as long as the load resistance is maintained above a minimum value.

Procedure

Zener Diode - Line Regulation

1. Set the Zener Voltage(V_Z)
2. Set the Series Resistance (R_S) value.
3. Set the Load Resistance (R_L) value.
4. Vary DC voltage.
5. Voltmeter is placed parallel to load resistor and ammeter series with the series resistor.

6. Choose appropriate DC voltage such that zener diode is 'on'.

7. Now note the Voltmeter and Ammeter reading for various DC voltage.

8. Note the Load current(I_L), zener current(I_Z), Output voltage(VO)

9. Calculate the voltage regulation.

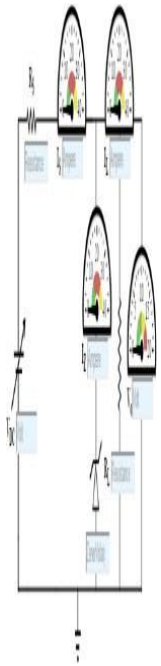


Figure:1

Zener Diode - Load Regulation

1. Set DC voltage.

2. Set the Series Resistance (R_S) value.

3. 1W D0-41 Glass Zener Diode 1N4740A, Zener voltage is 10 V.

4. Vary the Load Resistance (R_L).

5. Voltmeter is placed parallel to load resistor and ammeter series with the series resistor.

6. Choose Load Resistance in such a manner, such that the Zener diode is 'on'.

7. Now note the Voltmeter and Ammeter reading for various Load Resistance.

8. Increase the load resistance (R_L).

9. Note the Load current (I_L), zener current (I_Z), Output voltage(V_O)

10. Calculate the voltage regulation.

Figure: 2

Zener Characteristics

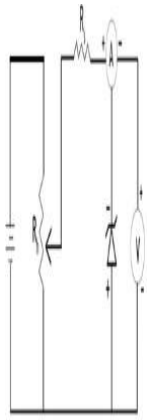
1. Select the diode

2. Set the rheostat Rh=1 Ω

3. By adjusting the rheostat, voltmeter reading is increased from 0 and in each time note the corresponding reading in milliammeter.

4. Take the readings and note Voltmeter reading across Zener diode and Ammeter reading.

5. Plot the V-I graph and observe the change.



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Zener Diode - LINE Regulator

INSTRUCTION

EXPERIMENTAL TABLE

Zener Voltage(V_Z): 5 V

Series Resistance(R_S): 1 KΩ

Load Resistance (R_L): 2 KΩ

Serial No.	Unregulated supply voltage(V_S) V	Load Current(I_L) mAmp	Zener Current(I_Z) mAmp	Regulated Output Voltage(V_O) V	% Voltage Regulation
1	0	2.50	0	0	NaN
2	5.2	2.50	-2.300	5.00	100
3	8.4	2.50	0.900	5.00	62.5
4	11	2.50	3.500	5.00	45.5
5	14	2.50	6.500	5.00	35.7
6	20	2.50	12.500	5.00	25.0

CONTROLS

DC volt : Volt

Zener Diode(V_Z) : Volt

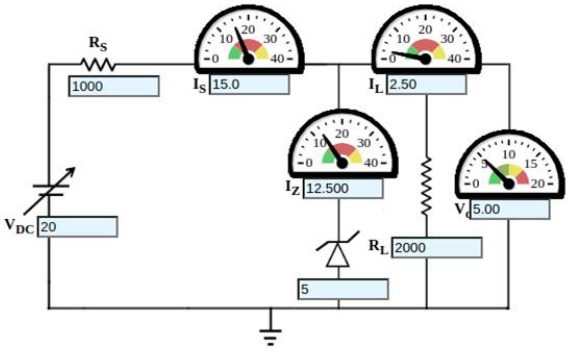
Resistance(R_S) : Ohms

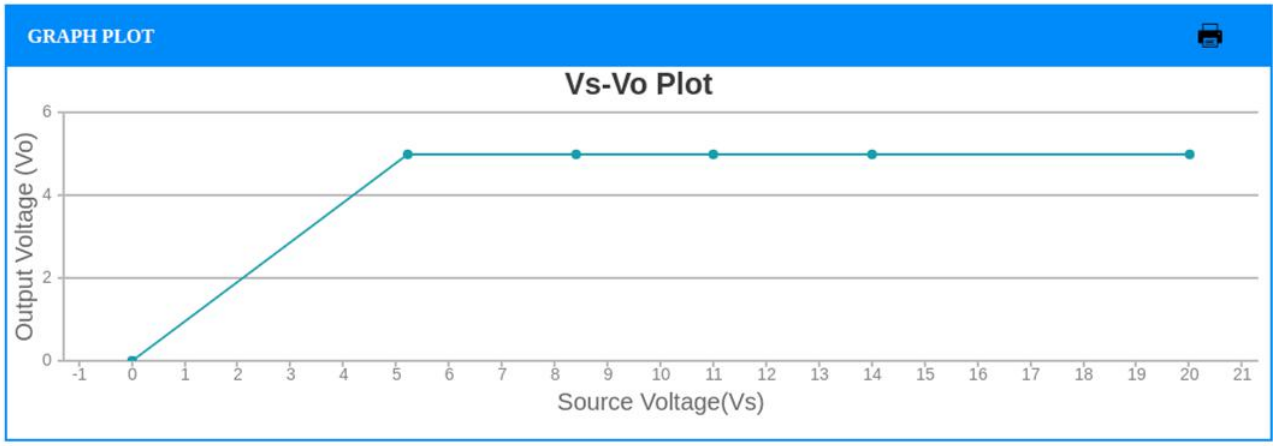
Resistance(R_L) : Ohms

Print It

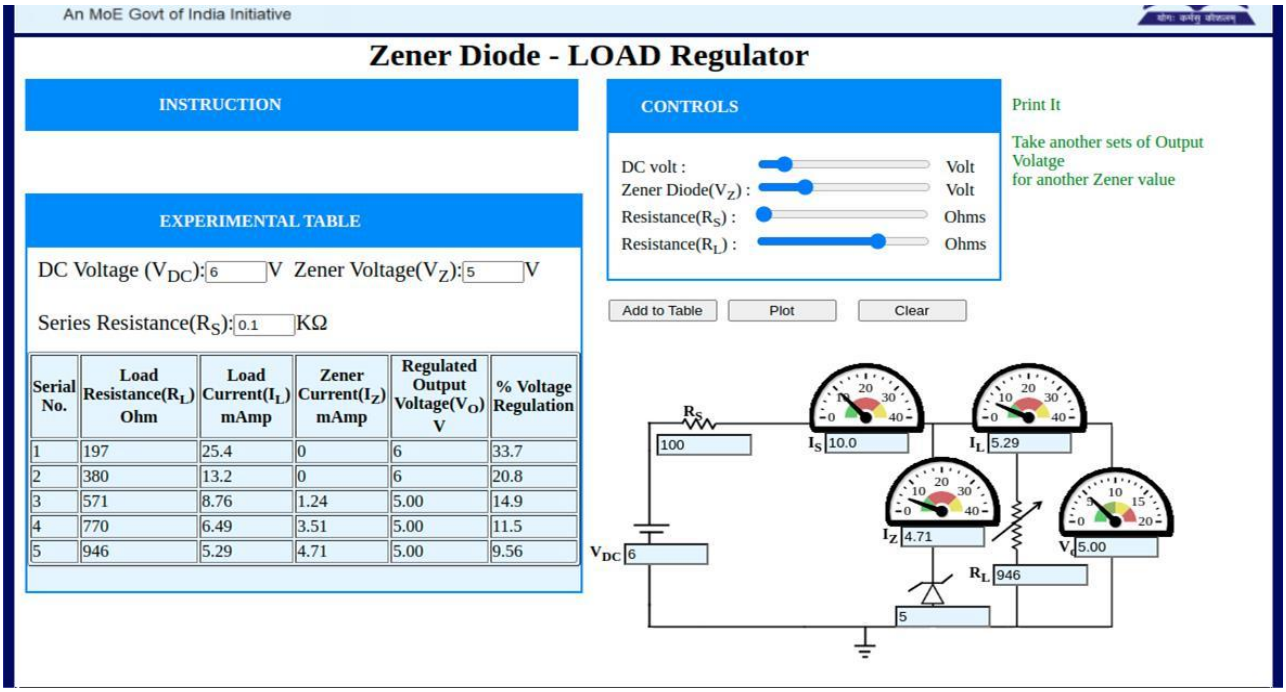
Take another sets of Output Volatge for another Zener value

Add to Table | Plot | Clear

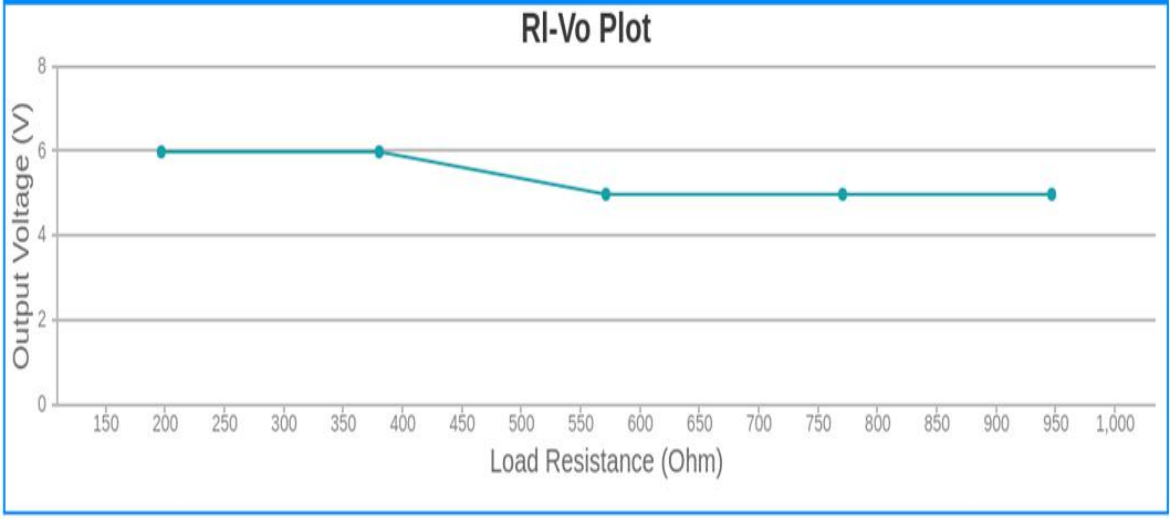




LOAD REGULATOR



GRAPH PLOT


Rl-Vo Plot
Output Voltage (V)
0
2
4
6
8
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1,000
Load Resistance (Ohm)