Offset Voltage Model: This is used when a more accurate determination of load current or voltage is required.

Complete Diode Model: This is used during the actual design of circuits using diodes.

Procedure

Forward Bias-Si Diode

1. Set DC voltage to 0.2 V .
2. Select the diode.
3. Set the resistor.
4. Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
5. The positive side of battery to the P side(anode) and the negative of battery to the N side(cathode) of the diode.
6. Now vary the voltage upto 5V and note the Voltmeter and Ammeter reading for particular DC voltage .
7. Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
8. Plot the V-I graph and observe the change.
9. Calculate the dynamic resistance of the diode. $r_d=\Delta V/\Delta I$
10. Therefore from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

Reverse Bias-Si Diode

1. Set DC voltage to 0.2 V .
2. Select the diode.
3. Set the resistor.
4. Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
5. The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode.
6. Now vary the voltage upto 30V and note the Voltmeter and Ammeter reading for DC voltage .
7. Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
8. Plot the V-I graph and observe the change.

EXPERIMENT-2

Objective: To verify the V-I characteristics of the Zener diode.

Apparatus required

Power supply

Lab trainer kit

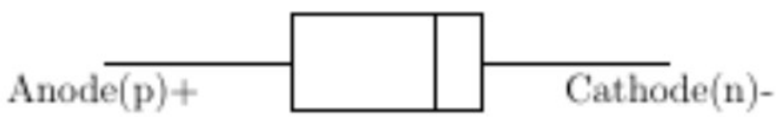
Jumper wires

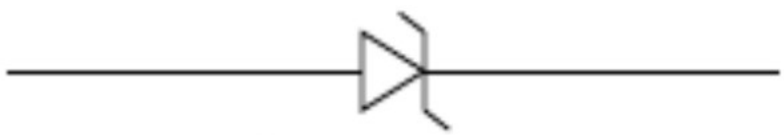
Multimeter

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.





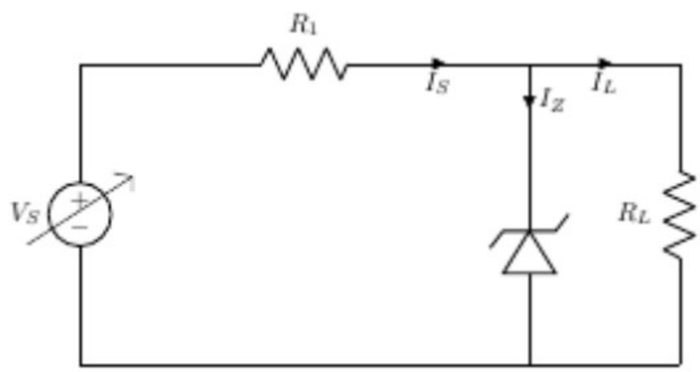
Function of Zener Diode

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 VZ is reverse connected to an input voltage source V_I across a load resistance R_L and a series resistor R_S. The voltage across the zener will remain steady at its break down voltage V_Z for all the values of zener current I_Z as long as the current remains in the break down region. Hence a regulated DC output voltage $V_0=V_Z$ is obtained across R_L, 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.

Line Regulation



In Line Regulation, Load resistance is constant and input voltage varies. V_I must be sufficiently large to turn the Zener Diode ON.

$$V_L = V_Z = \frac{V_{Imin} \times R_L}{(R_S + R_L)}$$

So, the minimum turn-on voltage $V_{Imin}$is :

$$V_{Imin} = \frac{V_Z \times (R_S + R_L)}{R_L}$$

The maximum value of V_I is limited by the maximum zener current I_{Zmax}

$$I_{Rmax} = I_{Zmax} + I_L$$

I_L is fixed at :

$$\frac{V_Z}{R_L}$$

Since, V_L=V_Z, So maximum V_I is

$$V_{Imax} = V_{Rmax} + V_Z$$
$$V_{Imax} = I_{Rmax} \times R + V_Z$$

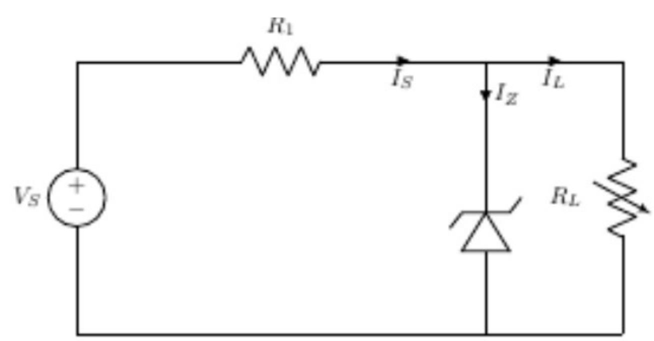
For V_I< V_Z

$$V_O = V_I$$

For V_I>V_Z

$$V_O = V_I - I_S \times R_S$$

<u>Load Regulation</u>



In Load Regulation , input voltage is constant and Load resistance varies. Too small a Load Resistance R_L,will result in V_{Th}< V_Z and Zener Diode will be OFF.

$$V_L = V_Z = \frac{V_{Imin} \times R_L}{(R_S + R_L)}$$

So the minimum load resistance R_L

$$R_{Lmin} = \frac{V_Z \times R_S}{V_I - V_Z}$$

Any load resistance greater than R_{Lmin} will make Zener Diode ON

$$I_S = I_L + I_Z$$

R_{Lmin} will establish maximum I_L as