2ndterm – Lec 1

Experiment No.1:

Diode Characteristics Experiment Using Multisim

1- Objective

The goal of this experiment is to simulate and analyze the I-V characteristics of a diode using Multisim. Students will observe how the diode behaves in:

- Forward bias, where it allows current to flow.
- Reverse bias, where it blocks current until breakdown.

2- Materials (Multisim Components)

The following virtual components will be used in Multisim:

- DC Power
- Ground
- Resistor (1 K Ohm)
- Diode (1N4007GP - Silicon or 1N34A - Germanium) (flip)
- Indicators > AMMETER >AMMETER-H
- Indicators > Voltmeter >Voltmeter-V

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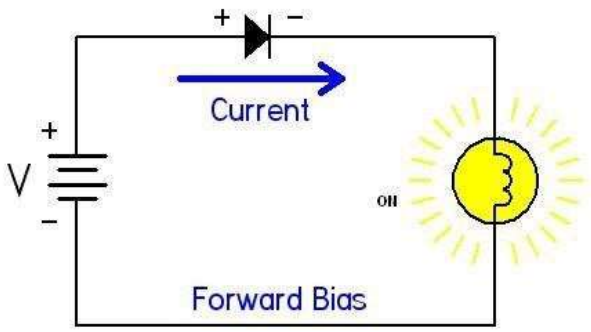
3- Theory

A diode is an electronic component that allows current to flow in one direction only.

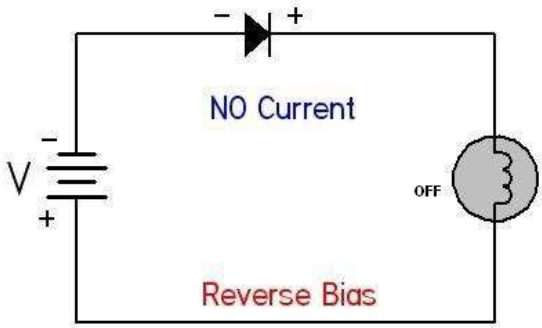
Forward Bias

- The anode is connected to the positive voltage, and the cathode to the negative.
- The diode starts conducting when the voltage exceeds the threshold:
- Silicon diodes: ~0.7V
- Germanium diodes: ~0.3V



Reverse Bias

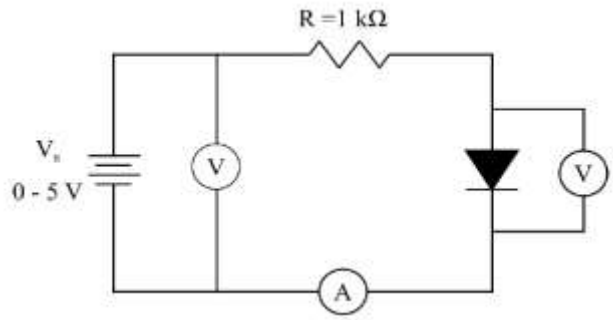
- The anode is connected to the negative voltage, and the cathode to the positive.
- The diode blocks current except for a small leakage current.
- If voltage exceeds the breakdown limit, the diode starts conducting heavily.



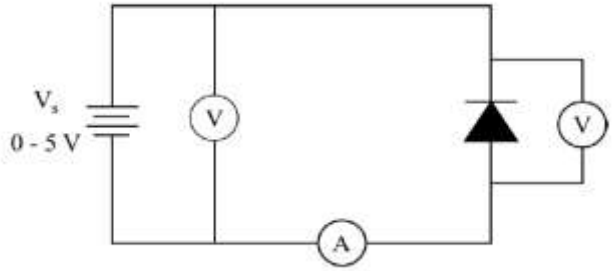
I-V Characteristics

- In forward bias, current increases exponentially after the threshold voltage.
- In reverse bias, current remains very low until breakdown.

The diode is a device made up of a junction of n-type and p-type semiconductor material. An ideal diode has two regions: a conduction region of zero resistance and a non-conduction region of infinite resistance. forward bias operation, the silicon diode will not conduct significant current until the voltage reaches the barrier potential about (0.3 - 0.7)V, called cut- in or knee voltage, based on its material. After the point of cut-in voltage (Knee voltage), a slight change in voltage causes a significant increase in current.



In reverse bias operation, the diode will not conduct significant current until a specific threshold voltage is called the breakdown voltage.



Diode Characteristic Curve

Fig. is a graph of diode voltage versus current, known as a V-I characteristic curve. The upper right quadrant of the graph represents the forward-biased condition. As you can see, there is very little forward current (I_F)for forward voltages (V_F) below the barrier potential. As the forward voltage approaches the value of the barrier potential, the current begins to increase. Once the forward voltage reaches the barrier potential, the current increases drastically and must be limited by a series resistor. The voltage across the forward-biased diode remains approximately equal to the barrier potential.

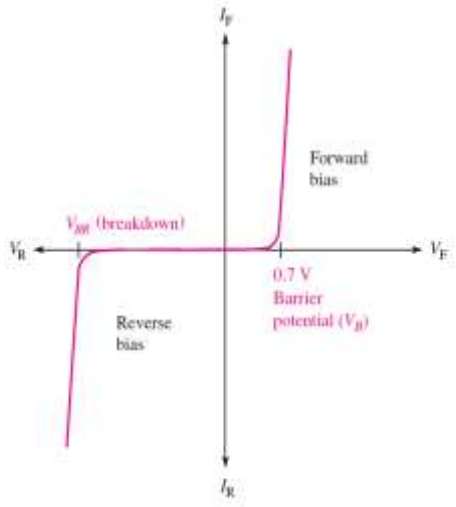


Figure: General diode V-I characteristic curve

The lower left quadrant of the graph represents the reverse-biased condition. As the reverse voltage (V_R)increases to the left, the current remains near zero until the breakdown voltage (V_{BR}) is reached. When breakdown occurs, there is a large reverse current which, if not limited,can destroy the diode.

4- Procedure (Steps in Multisim)

Step 1: Circuit Design in Multisim

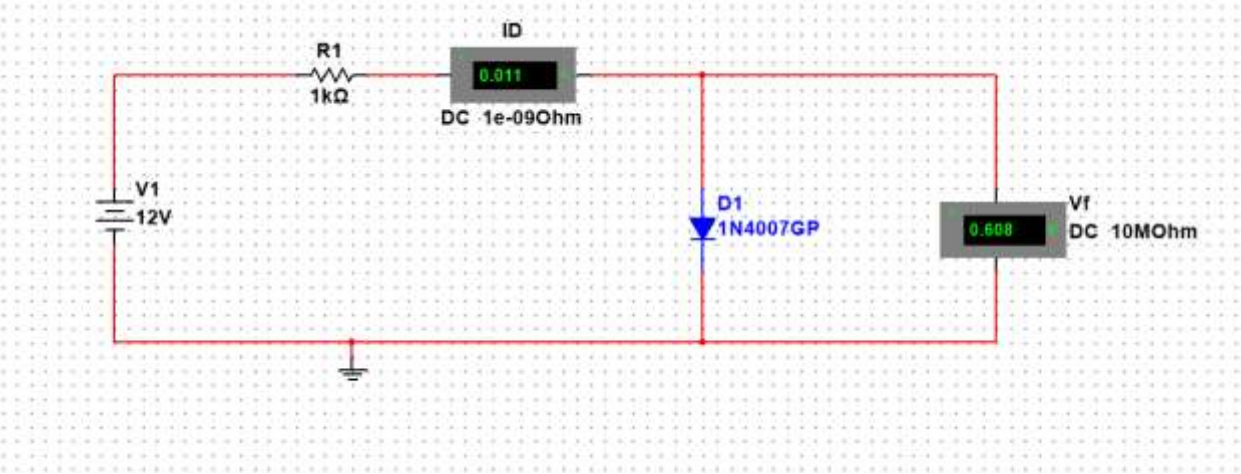
1. Open Multisim and create a new circuit.

2. Add the following components:

- Diode
- DC Power Supply
- Ammeter (series with the diode)
- Voltmeter (parallel with the diode)
- Variable Resistor
- Ground (GND)

Step 2: Forward Bias Simulation

- Connect the anode to positive and cathode to negative.
- Gradually increase voltage from 0V to 1.5V.
- Record voltage and current values at each step.
- Identify the threshold voltage.



Diode Characteristics FORWARD BIAS			
NO.	Supply Voltage	Voltage drop across Diode (V)	Diode Current (mA)

Questions

1 On a graphic paper, draw the V-I characteristic curve from the experimental resulet you recorded

2. What would happen to the reverse current if the diode was heated to 50°C? Explain your reasoning.

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3. what is the difference between this Zener diode and the normal diode you measured previously?

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