

# Islamic University of Technology (IUT)

## Organization of Islamic Cooperation (OIC)

Department of Electrical and Electronic Engineering

Date & Year: ..... Section: ..... Group: ..... Std. ID: .....

Course: EEE 4484 (Digital Electronics and Pulse Techniques Lab)

Experiment no.: 01

Name of the experiment: Study of Diode Characteristics and its Applications using PSIM

### OBJECTIVE

- To simulate the Voltage-Current (V-I) Characteristics of PN Junction Diode using PSIM.
- To simulate the circuit and observe the wave shapes of Half wave Diode Rectifier using PSIM.
- To simulate the Circuit and observe the wave shapes of Full-wave Diode Rectifiers using PSIM.

### Theory:

A PN junction diode conducts only in one direction. It is an example of a **unilateral element**. The V-I characteristics of the diode is a curve between the **voltage across the diode** ( $V_d$ ) and **current through the diode** ( $I_d$ ). When an external voltage is zero, the circuit is open and the potential barrier does not allow the current to flow. Therefore, the circuit current is zero.

When P-type (Anode) is connected to +ve terminal and N-type (cathode) is connected to -ve terminal of the supply voltage is known as **forward bias**. The potential barrier is reduced when the diode is in the forward biased condition. At some forward voltage, the potential barrier altogether eliminated and current starts flowing through the diode and also in the circuit. The diode is said to be in ON state. The current increases with increasing forward voltage.

When N-type (cathode) is connected to +ve terminal and P-type (Anode) is connected to the -ve terminal of the supply voltage is known as **reverse bias** and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. The diode is said to be in OFF state. The reverse bias current is due to minority charge carriers.

An ideal PN junction Diode is a two-terminal polarity sensitive device that has zero resistance (diode conducts) when it is forward biased and infinite resistance (diode doesn't conduct) when it is reverse biased.

Due to this characteristic, the diode finds some applications as 1. Rectifiers in DC power supply, 2. Switch in digital circuits, 3. Clamping, Clipping circuits network used in TV Receiver, 4. Demodulator (detector) circuits.

## Task 01: Simulation of the Voltage-Current Characteristics of PN Junction Diode using PSIM

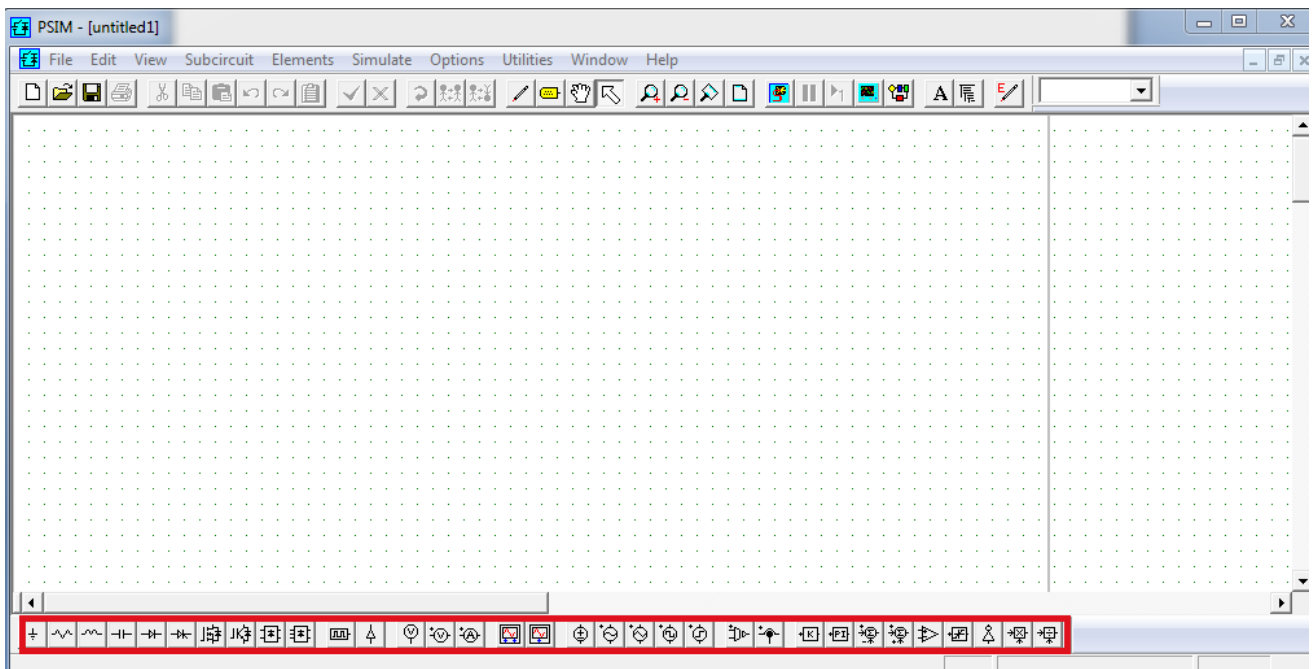
### Objective:

To observe the voltage-current characteristics of PN junction diode under forward and reverse bias condition and to determine cut-in voltage, reverse saturation current and forward dynamic resistance.

### Procedure:

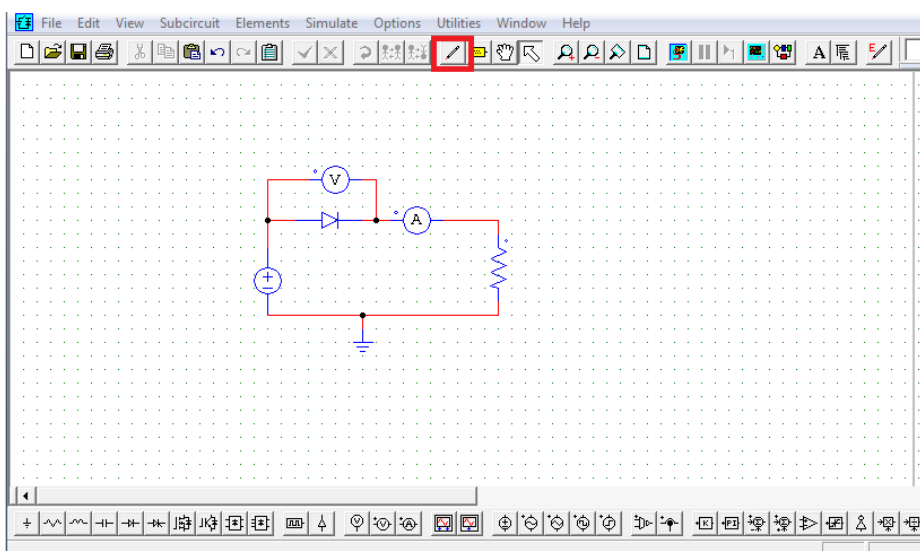
**Step 1:** Open PSIM. Go to File >> New.

**Step 2:** Select DC Voltage Source, diode, resistor, ammeter, voltmeter, etc from the bottom of the working window of PSIM. Most of the elements are found here.

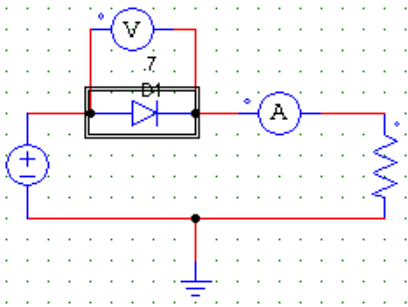


Another procedure to select any element is to go to “Elements” and select the desired group.

**Step 3:** Now construct the following circuit:



**Step 4:** Now select each of the elements and set “Diode Threshold Voltage” to 0.7V and resistance to 1K.



**Diode**

Parameters | Other Info | Color

Diode

Help

Display

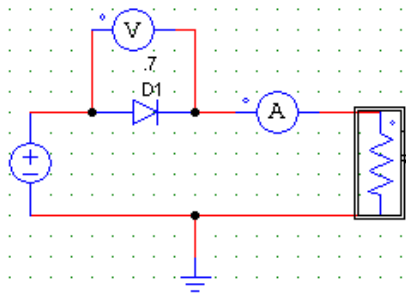
Name: D1 ☒

Diode Threshold Voltage: .7 ☒

Diode Resistance: 0 ☐

Initial Position: 0 ☐

Current Flag: 0 ☒



**Resistor**

Parameters | Other Info | Color

Resistor

Help

Display

Name: R1 ☒

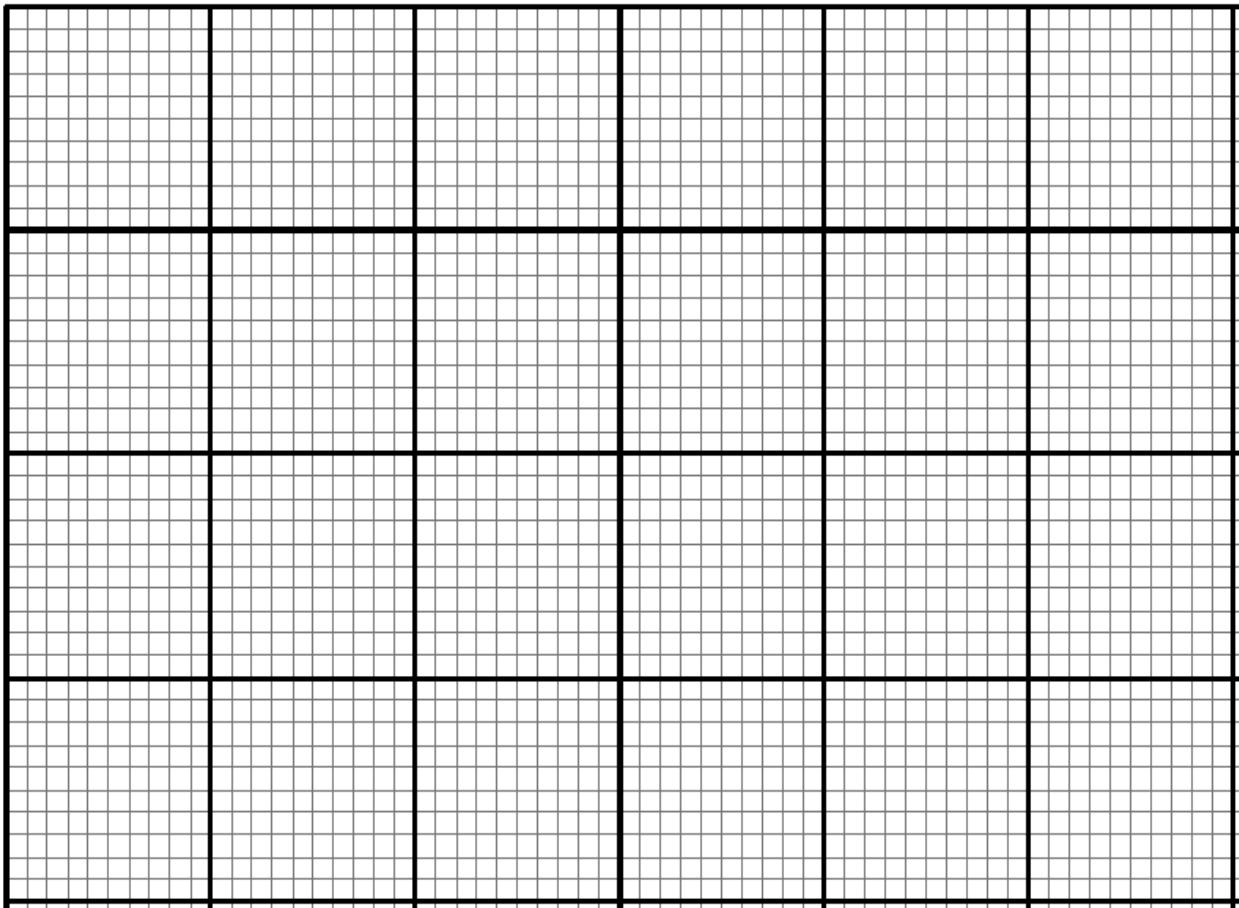
Resistance: 1k ☒

Current Flag: 0 ☒

**Step 5:** Go to “Simulate >> Simulation control” and set the parameters.

**Step 6:** Now vary the value of the DC source and take the readings each time to plot the V-I characteristics of the diode.

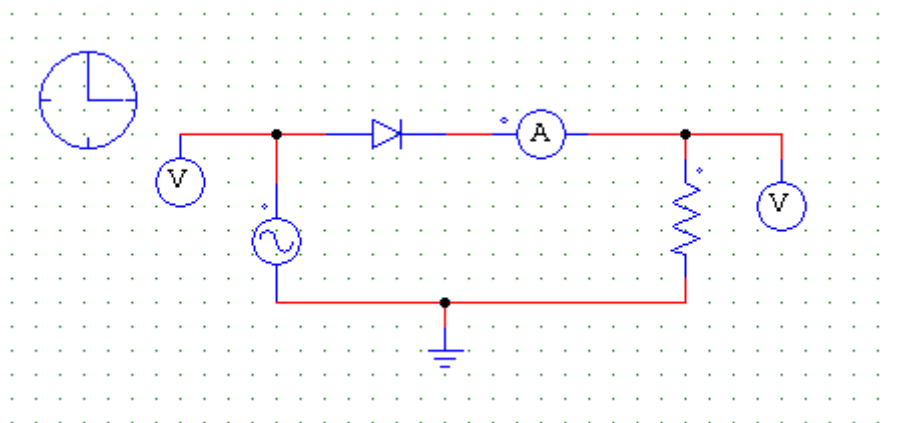
DC Voltage Source (V)	Diode Voltage (V)	Diode Current (mA)
0.1	0.099	$1 \times 10^{-5}$
0.3	0.299	$3 \times 10^{-5}$
0.5	0.499	$5 \times 10^{-5}$
0.6	0.599	$6 \times 10^{-5}$
0.7	0.699	$7 \times 10^{-5}$
1	0.7	0.3
3	0.7	2.3
5	0.7	4.3

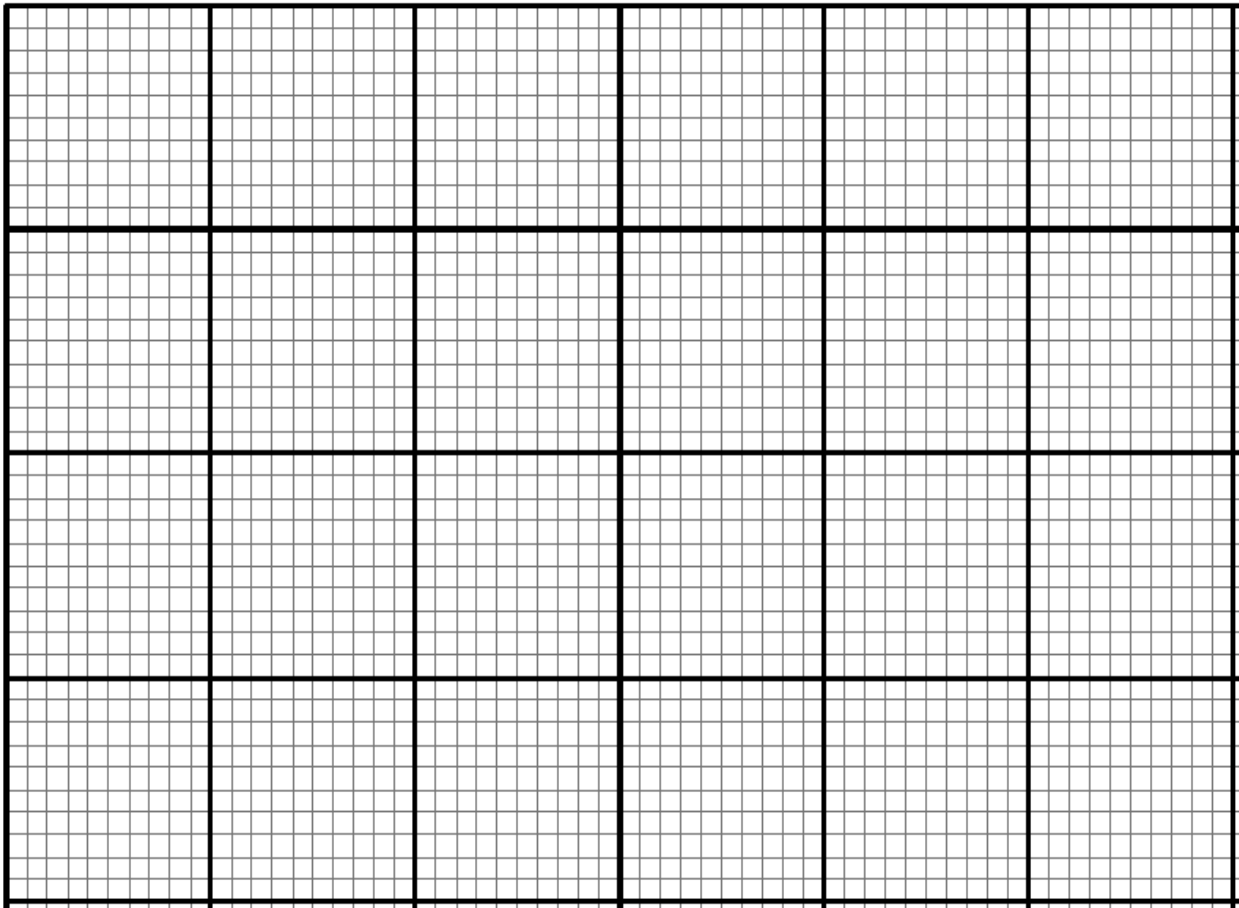


**Graph 1: V-I Characteristics of PN Junction Diode**

**Task 2: To simulate the Circuit and observe the wave shapes of Half wave Diode Rectifier using PSIM.**

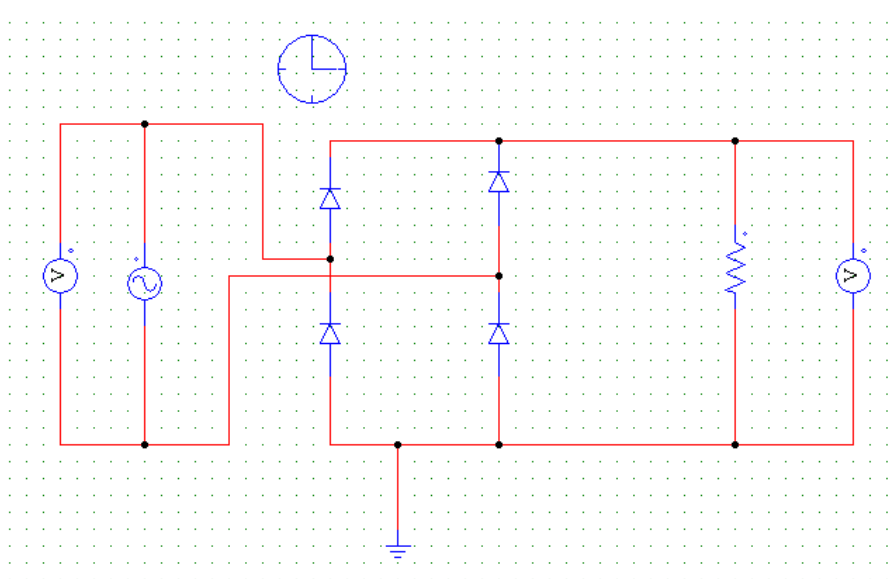
Construct the following circuit and observe the input and output wave shapes.



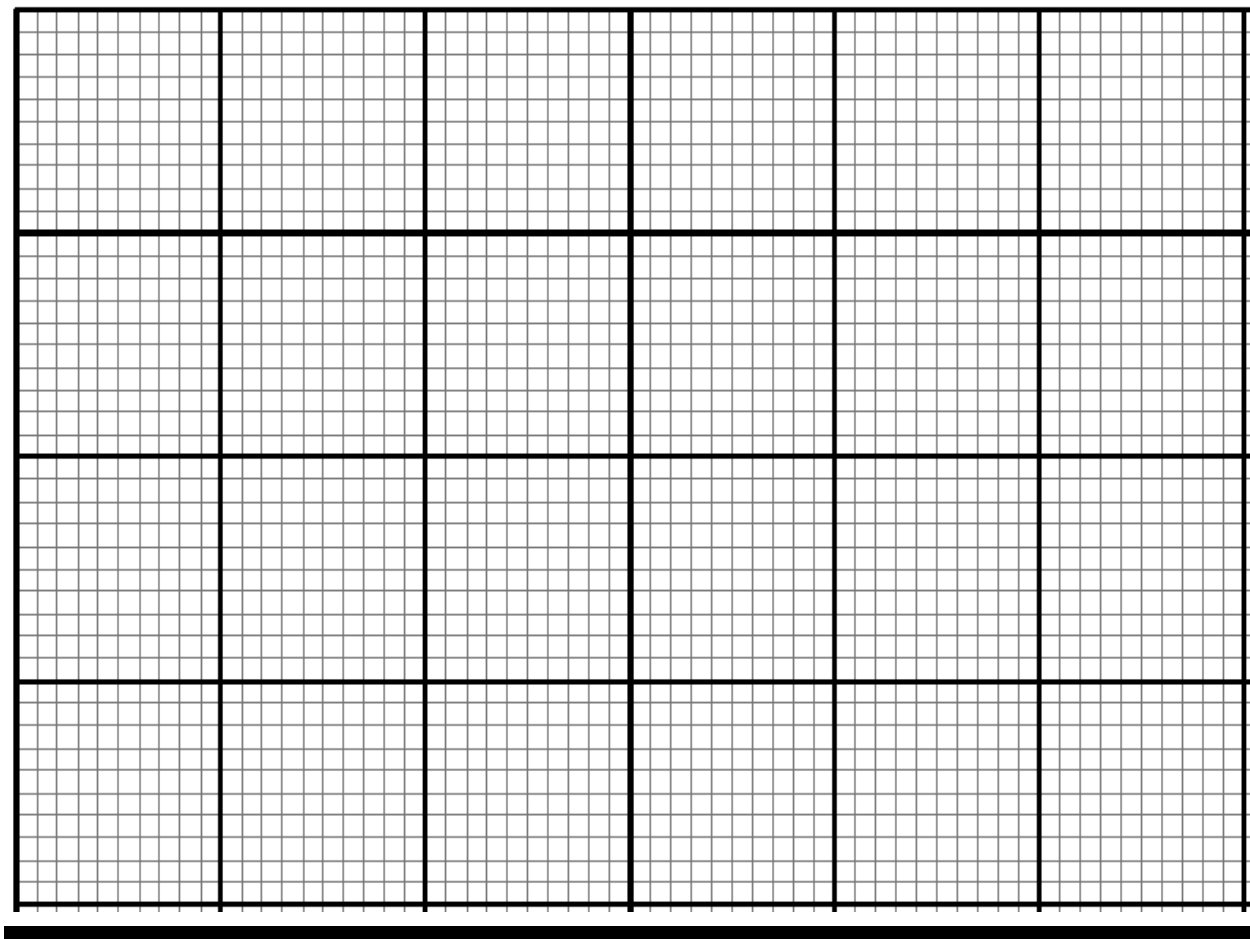


**Task #03: Simulate the Circuit and observe the wave shapes of Full wave Diode Rectifiers using PSIM.**

Simulate the circuit :

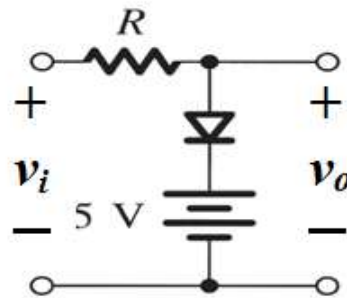


Draw the waveshapes :

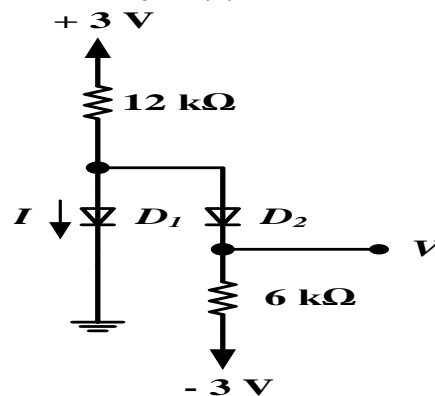


## Assignment:

01. Complete the all the tasks of the lab sheet.
02. Simulate the circuit below in PSIM. Insert necessary wave shapes in your assignment. Assume suitable values for the unknown parameters ( $v_i$  is an AC source).



03. Using PSIM, find out the values of  $I$  and  $V$  and justify your answer.



04. Simulate the circuit below and draw all the possible wave shapes.  $v_s$  is a sinusoid with a peak of 24 V.

