Ahsanullah University of Science and Technology

Department of Electrical and Electronic Engineering

LABORATORY MANUAL

FOR

ELECTRICAL AND ELECTRONIC SESSIONAL COURSES

Student Name :

Student ID :

Course no : EEE - 2104

Course Title : Electronic Circuits - I Lab

For the students of

Department of Electrical and Electronic Engineering

2nd Year, 1st Semester

Price : Tk. 14.00

Experiment No: 1

Name of the Experiment : I-V Characteristics of diode.

Objective :

Study the I-V characteristic of diode.

Theory :

A diode is a bi-polar device that behaves as the short circuit when it is in forward bias and as an open circuit when it is in reverse bias condition.

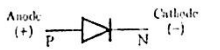

Figure 1.1 : Schematic Diagram of Diode.

Figure 1.2 : P - N Junction Diode .

There are two types of biasing condition for a diode :

1. When the diode is connected across a voltage source with positive polarity of source connected to p side of diode and negative polarity to n side, then the diode is in forward bias condition.

2. When the diode is connected across a voltage source with positive polarity of source connected to n side of diode and negative polarity to p side, then the diode is in reverse bias condition.

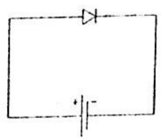

Figure 1.3 : Forward Bias connection.

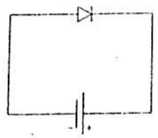

Figure 1.4 : Reverse Bias connection.

If the input voltage is varied and the current through the diode corresponds to each voltage are taken then the plot of diode current (I_d) vs diode voltage (V_D) will be follows :

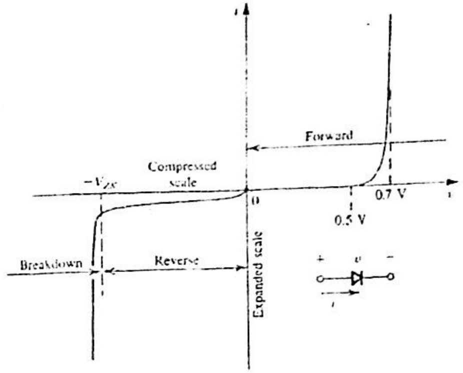

Figure 1.5 : I - V Characteristics of Diode.

At the reverse bias condition the amount of current flows through the diode is very small (at microampere range). But if the voltage continuously increases in reverse direction, at a certain value the diode will break down and huge amount of current will flow in reverse direction. This is called breakdown of diode. In laboratory the breakdown will not tested because it will damages the diode permanently.

From the characteristics curve it can be seen that, a particular forward bias voltage (V_T) is required to reach the region of upward swing. This voltage, V_T is called the cut-in voltage or threshold voltage of diode. For Si diode the typical value of threshold voltage is 0.7 volt and for Ge diode is 0.3 volt.

Equipments And Components :

Serial no.	Component Details	Specification	Quantity
1.	p-n junction diode	1N4007	1 piece
2.	Resistor	1 KΩ	1 piece
3.	DC power supply		1 unit
4.	Signal generator		1 unit
5.	Trainer Board		1 unit
6.	Oscilloscope		1 unit
7.	Digital Multimeter		1 unit
8.	Chords and wire		as required

Experimental Setup :

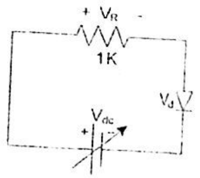

Figure 1.6 : Circuit Diagram for Obtaining Diode Diode Forward Characteristics.

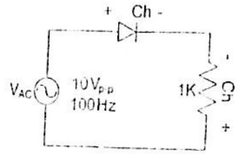

Figure 1.7 Circuit Diagram for Obtaining Characteristics From Oscilloscope.

Procedure :

1. Measure the resistance accurately using multimeter.
2. Construct the circuit as shown in figure - 1.6.
3. Vary input voltage V_{dc}. Measure V_{dc}, V_d, V_R for the given values of V_d and record data on data table. Obtain maximum value of V_d without increasing V_{dc} beyond 25 volt.
4. Calculate the values of I_d using the formula, $I_d = V_R / R$.
5. Construct the circuit as shown in figure - 1.7.
6. Ste the oscilloscope in X-Y mode. Identify zero record on oscilloscope display. Make proper connection and observe the output.
7. Repeat the step 5 and 6 by increasing the input supply frequency 5 KHz.

Data Table :

V_{dc} (volt)	V_d (volt)	V_R (volt)	$I_d = V_R / R$ (mA)

Report :

1. Draw the I - V characteristics curve of diode from the reading obtain in this experiment.
2. Calculate static resistance for I_d = 5 mA and I_d = 10 mA.
3. Determine the Q- point for the circuit in figure - 6, when V_{dc} = 8 volt.

Experiment No: 02

Name of the Experiment: Diode rectifier circuits.

Objective:

Study of different diode rectifier circuits.

Theory:

A rectifier converts an AC signal into a DC signal. From the characteristic curve of a diode we observe that if allows the current to flow when it is in the forward bias only. In the reverse bias it remains open. So, when an alternating voltage (signal) is applied across a diode it allows only the half cycle (positive half cycle depending on the orientation of diode in the circuit) during its forward bias condition, other half cycle will be clipped off. In the output the load will get DC signal.

Diode rectifier can be categorized in two major types. They are -

1. Half-wave rectifier.
2. Full-wave rectifier.

Half - Wave Rectifier: Half-wave rectifier can be built by using a single diode. The circuit diagram and the wave shapes of the input and output voltage of half wave rectifier are shown bellow (figure 2.1) -

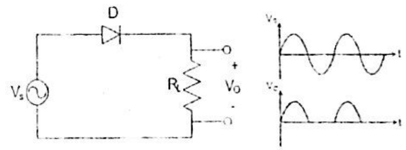

Figure 2.1: Half Wave Rectifier.

The major disadvantages of half wave rectifier are -

- In this circuit the load receives approximately half of input power.
- Average DC voltage is low.
- Due to the presence of ripple output voltage is not smooth one.

Full Wave Rectifier: in the full-wave rectifier both the half cycle is present in the output. Two circuits are used as full-wave rectifier are shown bellow -

a) Full-wave rectifier using center-tapped transformer.
b) Full-wave bridge rectifier.

Full-wave rectifier using center-tapped transformer: two diodes will be connected to the ends of the transformer and the load will be between the diode and center tap. The circuit diagram and the wave shapes are shown in bellow (figure 2.2) -

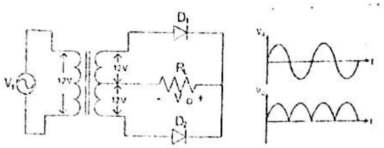

Figure 2.2: Full Wave Rectifier Using Center Tapped Transformer.

Full-wave rectifier using center-tapped transformer circuit has some advantages over full-wave rectifier. Those are -

- Wastage of power is less.
- Average DC output increase significantly.
- Wave shape becomes smoother.

The disadvantages of full-wave rectifier using center-tapped transformer are -

- Require more space and becomes bulky because of the transformer.
- Not cost effective (for using transformer).

Full-wave bridge rectifier: a bridge rectifier overcomes all the disadvantages of described above. Here four diodes will be connected as bridge connection. The circuit diagram and the wave shapes are shown in bellow (figure 2.3) -

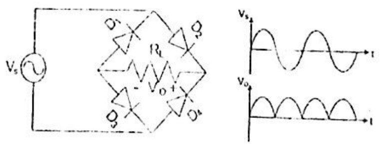

Figure 2.3: Full Wave Bridge Rectifier.

This rectifier however cannot produce a smooth DC voltage. It produces some ripple in the output. This ripple can be reducing by using filter capacitor across the load.

Equipments And Components:

Serial no	Component Details	Specification	Quantity
1.	p-n junction diode	1N4007	4 piece
2.	Resistor	10KΩ	1 piece
3.	Capacitor	0.22μF, 10μF	1 piece each
4.	Signal generator		1 unit
5.	Trainer Board		1 unit
6.	Oscilloscope		1 unit
7.	Digital Multimeter		1 unit
8.	Chords and wire		as required

Experimental Setup:

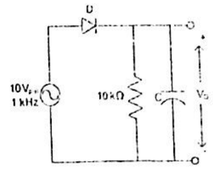

Figure 2.4 : Experimental Circuit 1.

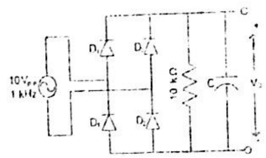

Figure 2.5 : Experimental Circuit 2.

Procedure:

1. Connect the circuit in breadboard as shown in figure 2.4 without capacitor.
2. Observe the output and input voltages in the oscilloscope and draw them.
3. Connect the 0.22μF capacitor and repeat step 2.
4. Connect the 10μF capacitor and repeat step 2. How does the output wave-shape differ from that in step 3?
5. Vary the frequency from 10 KHz to 100 Hz. What effects do you observe when frequency is changed?
6. Connect the circuit breadboard as shown in figure 2.5 without capacitor.
7. Observe the output and input voltages in the oscilloscope and draw them.
8. Connect the 0.22μF capacitor and repeat step 7.
9. Connect the 10μF capacitor and repeat step 7. How does the output wave-shape differ from that in step 8?
10. Vary the frequency from 10 KHz to 100 Hz. What effects do you observe when frequency is changed?

Report:

1. Write the answers that were asked during the working procedure.
2. Draw the input wave, output wave (without and with capacitor) for both the circuits.
3. What is the effect in output for changing input signal frequency for both the circuits (without and with capacitor)?
4. What is the function of capacitor in the both circuits? Why a capacitor of higher value is preferable?

Experiment No: 03

Name of the Experiment: Clipper and Clamper circuits.

Objective:

Study of Clipper and Clamper circuits.

Theory:

Clipper: Clippers remove signal voltage above and below a specified level. In the experiment no. 2, half wave rectifier can also be called as a clipper circuit. Because it clipped off the negative half cycle of the input signal.

A diode connected in series with the load can clipped off any half cycle of input depending on the orientation of the diode. (figure 3.1) -

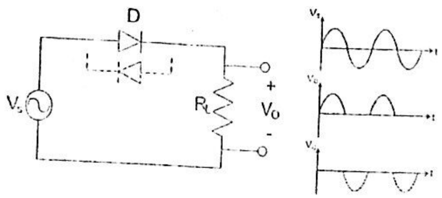

Figure 3.1: Simple Diode Clipper.

It is also possible to clip off a certain part of the input signal bellow a specified signal level by using a voltage source in reverse bias condition with the diode. If a battery of V volts is added to it, then for V_s above (V+0.7) volts the diode becomes forward bias and turns ON. The load receives above this voltage level.

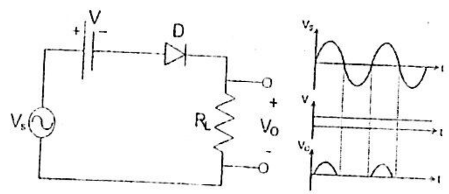

Figure 3.2: Clipper Circuit Using Bias Diode.

A diode connected in parallel with the load can clip off the input signal above 0.7 volts of one half cycle depending on the connection of the diode. Using two diodes in parallel in opposite direction both the half cycle can be limited to 0.7 volts.

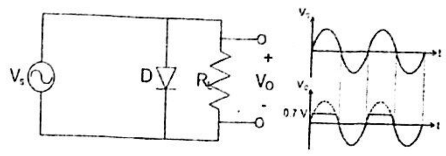

Figure 3.3: Parallel Clipper Circuit.

Using a biased diode it is possible to limit the output voltage to a specified level depending on the attached battery voltage. Either the half cycles or both of them can be clipped off above a specified level.

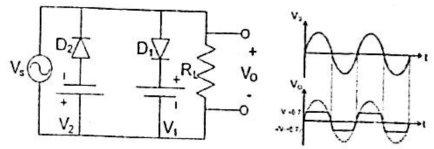

Figure 3.4: Biased Parallel Clipper Circuit.

In practical case for both the series and parallel clippers voltage source is not added. Required voltage levels are maintained by adding more semiconductor diode.

Clamper: A DC clamper circuit adds a DC voltage to the input signal. For instance, if the incoming signal varies from -10 volts to +10 volts, a positive DC clamper will produce an output that ideally swing from 0 volts to 20 volts and a negative clamper would produce an output between 0 volts to -20 volts.

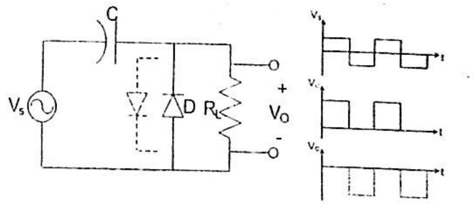

Figure 3.5: Clamper Circuit.

Equipments And Components :

Serial no.	Component Details	Specification	Quantity
1.	p-n junction diode	1N4007	1 piece
2.	Resistor	100KΩ	1 piece
3.	Capacitor	0.1μF	1 piece
4.	Signal generator		1 unit
5.	Trainer Board		1 unit
6.	DC power Supply		1 unit
7.	Oscilloscope		1 unit
8.	Digital Multimeter		1 unit
9.	Chords and wire		as required

Experimental Setup:

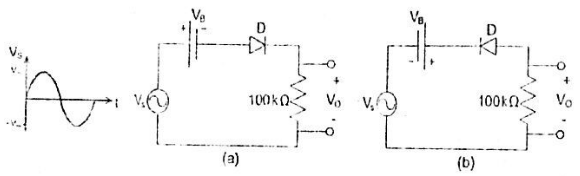

Figure 3.6: Experimental Circuit 1.

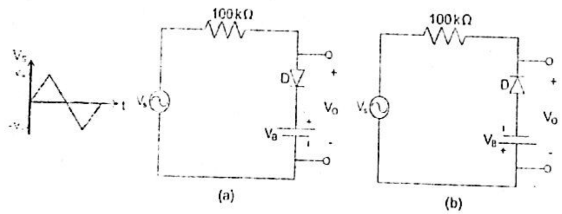

Figure 3.7: Experimental Circuit 2.

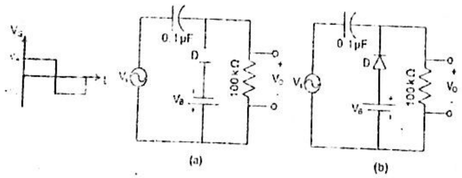

Figure 3.8: Experimental Circuit 3.

Procedure :

1. Connect the circuit as shown in the figure 3.6. Using a sinusoidal voltage source with 5 volts peak (V_m).
2. Observe the output wave shapes for various values of V_B and draw V_B = 2.5 volts for each circuit..
3. Do the same as in step 1 and 2 for the circuits in figure 3.7 with V_s wave shapes as drawn beside each figure having V_m = 5 volts. Parallel Branch 1 of circuit of figure 3.7(a) and Branch 2 of circuit of figure 3.7(b) and observe output.
4. For the clamper circuits of figure 3.8 do the same steps as step 1 and 2 with V_s wave shapes as drawn beside each figure having V_m = 5 volts.

Report :

1. Sketch all the waveforms observed on the oscilloscope.
2. What role dose the value of capacitor used in the clamping circuit play in order to obtain proper clamping?
3. Add the SPICE simulation waveforms of all the experimental circuits.