Title: Study of Diode Rectifiers.

Abstract:

A diode rectifies an ac voltage, so that it can be smoothed and converted into a dc voltage. A rectifier, however, can produce a constant or variable DC voltage. A diode rectifier can produce a fixed DC voltage whereas an SCR can produce a variable DC voltage.

Introduction:

The objectives of this lab are to:

1) study Half wave rectifiers,
2) study Full wave rectifiers.

Theory and Methodology:

Diode rectifiers are of the following types:

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

A rectifier, however, cannot produce a smooth DC voltage. So, the rectification block that makes the output DC voltage a smooth one follows a filter circuit. In this case, the capacitor acts as a smoothing filter so that the output is nearly a dc voltage. A filtering is not perfect; there will be a remaining voltage fluctuation known as ripple, on the output voltage.

The half-wave voltage signal is normally established by a network with a single diode has an average or equivalent DC voltage level equal to 31.8% of the peak voltage, whereas the full-wave rectified signal has twice the average or DC level of the half-wave signal, or 63.6% of the peak value.

Working Principle of Half-wave rectifier:

In half wave rectifier only half cycle of applied AC voltage is used. Another half cycle of AC voltage (negative cycle) is not used. Only one diode is used which conducts during positive cycle. The circuit diagram of half wave rectifier without capacitor is shown in the following figure.

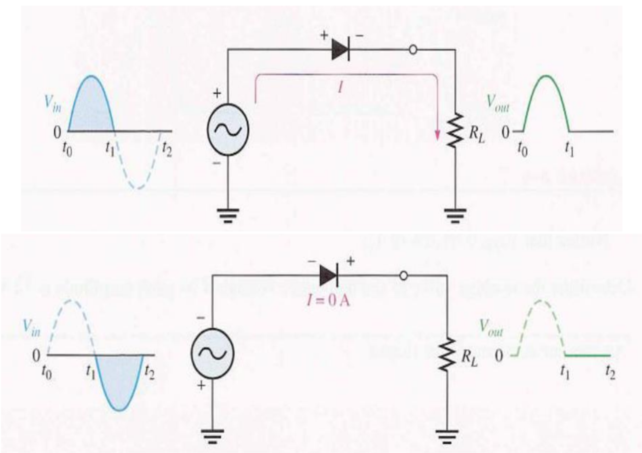

Figure: Half-Wave Rectification

During positive half cycle of the input voltage anode of the diode is positive compared with the cathode. Diode is in forward bias and current passes through the diode and positive cycle develops across the load resistance R_L. During negative half cycle of input voltage, anode is negative with respected to cathode and diode is in reverse bias. No current passes through the diode hence output voltage are zero.

Working Principle of Full-Wave rectifier:

The Bridge rectifier is a circuit, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the following figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge. For the positive half cycle of the input ac voltage, diodes D_1 and D_2 conduct, whereas diodes D_3 and D_4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L. For the negative half cycle of the input ac voltage, diodes D_3 and D_4 conduct whereas, D_1 and D_2 remain OFF. The conducting diodes D_3 and D_4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half cycle. Thus, a bi-directional wave is converted into a unidirectional wave.

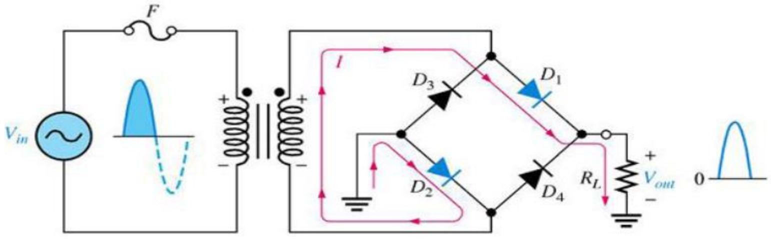

Figure: During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased

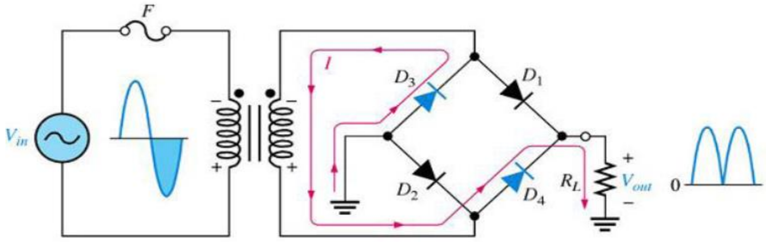

Figure: During negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased

Apparatus:

No.	Apparatus	Quantity
1	Diode	4
2	10k Resistance	1
3	Project Board	1
4	Oscilloscope	1
5	Multimeter	1
6	Transformer 220V/12V/9V/6V	1
7	47µF Capacitor	1
8	100µF Capacitor	1
9	Chord	2

Circuit Diagram:

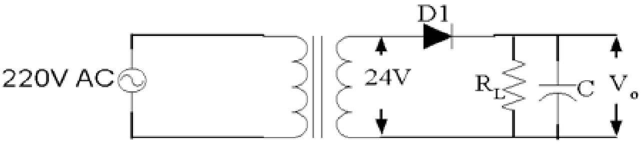

Figure 1: Half wave rectifier.

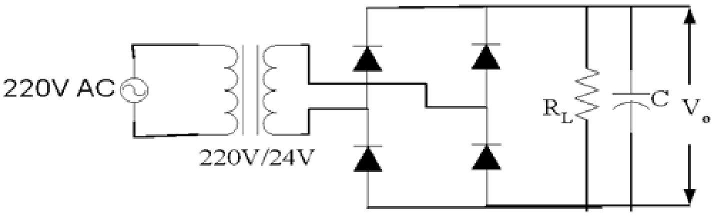

Figure 2: Full wave Bridge rectifier.

Experimental Procedure:

1. Connect the circuit shown in the figure – 1 but without the capacitor.
2. Connect the oscilloscope to observe the wave shapes of the input and output voltages. Measure the peak DC voltage from the oscilloscope.
3. Measure the output voltage by Multimeter and compare it with that obtained from the oscilloscope.
4. Turn off the power supply and connect a 47µF capacitor across the load. Observe the output voltage and measure with the oscilloscope.
5. Measure the output voltage with a Multimeter and compare it with that obtained from the oscilloscope.
6. Turn of the power supply and change the capacitor with the 100µF capacitor.
7. Repeat procedures 4 & 5 to obtain necessary measurements.
8. Repeat procedures 1 through 7 for circuits in figure 2.

Experimental Data:

Table 1: Data Table for circuit of Figure – 1

	V_o (Oscilloscope)	V_o(Multimeter)
No Capacitance	2.51v	2.51v
47µF	13.75v	13.75v
100 µF	13.91v	13.91v

Table 2: Data Table for circuit of Figure – 2

	V_o (Oscilloscope)	V_o(Multimeter)
No Capacitance	4.15v	4.15v
47µF	13.31v	13.31v
100 µF	13.38v	13.38v

Discussion & Conclusion:

In this experiment we found that half wave rectifier only we get the output when the diode is forward biased, we get zero voltage at output when the diode is reversed biased it means we are throwing away the negative or blocked cycle of the waves. It means half wave is not so much effective in Ac to Dc conversion Vout=Vm-Vd. Vdc/ Average of the output voltage will be 0.318(Vm-Vd). Vm is input voltage amplitude and Vd is voltage drop across diode. Also we found that full wave rectifier we use bridge rectifier which consist of four diodes. For a positive cycle two diode operate and for the negative cycle the other two diode operate. These diodes help in converting the AC to pulsating DC. Full wave rectifier is efficient because we are using both the cycle of input and get a positive cycle output for both positive and negative cycle. Vout=Vm-2Vd. Vdc/ Average of the output voltage will be 0.636(Vm-2Vd). 2Vd because two diodes are used.

Reference(s):

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Publishing, 3rd ed., ISBN: 0-03-051648-X, 1991.

[2] David J. Comer, Donald T. Comer, Fundamentals of Electronic Circuit Design, John
Wiley & Sons Canada, Ltd.; ISBN: 0471410160, 2002.

[3] American International University–Bangladesh (AIUB) Electronic Devices Lab Manual.