AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

(AIUB)

Faculty of Engineering

Department of Electrical and Electronic Engineering

Semester: Spring 2021-22

Course: Electric device Lab

SEC: EE GROUP :07

LAB REPORT ON

Determination of Characteristic Curve of a Diode.

Supervised By

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Title: Study of Diode Rectifiers.

Abstract:

A diode rectifies an ac voltage, in order that it could be smoothed and transformed right into a dc voltage. A rectifier, however, can produce a regular or variable DC voltage. A diode rectifier can produce a set DC voltage while an SCR can produce a variable DC voltage.

Introduction:

The objectives of this lab are to:

1) study of half wave rectifiers,
2) study of full wave rectifiers.

Theory and Methodology:

Diode rectifiers are of the following types:

1. Half-wave rectifier.
2. Full-wave bridge rectifier.
3. Center tapped Full-wave rectifier.

A rectifier, however, can't produce a clean DC voltage. So the rectification block that makes the output DC voltage a clean one follows a clear out out circuit. In this case, the capacitor acts as a smoothing clear out out in order that the output is almost a dc voltage. A filtering isn't always perfect; there could be a last voltage fluctuation referred to as ripple, at the output voltage. The half- wave voltage sign is typically set up through a community with a unmarried diode has a median or equal DC voltage stage identical to 31.8% of the height voltage, while the full-wave rectified sign has two times the common or DC stage of the half-wave sign, or 63.6% of the height 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 fig

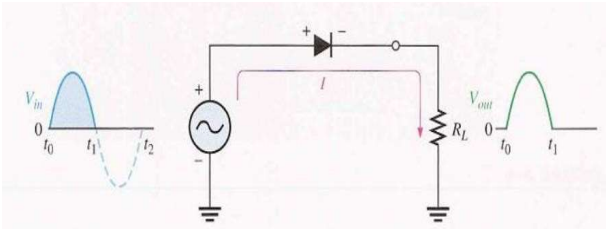


Figure: Half-Wave Rectification

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 is 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.

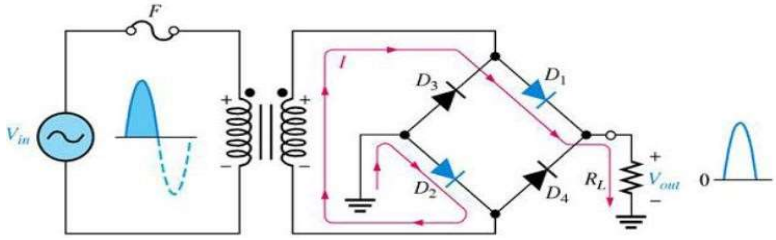


Figure: During positive half-cycle of the input, D_1 and D_2 areforward-biased and conduct current. D_3 and D_4 arereverse-biased

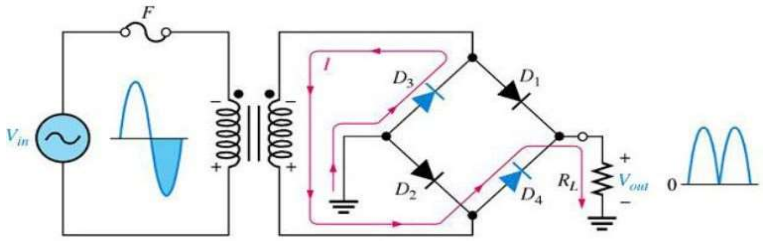


Figure: During negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased

Working Principle of Center Trapped Full-Wave rectifier:

A center tapped rectifier is a type of full wave rectifier that uses two diodes connected to the secondary of a center tapped transformer, as shown in below diagram. The input voltage is coupled through the transformer to the center-tapped secondary. Half of the total secondary voltage appears between the center tap and each end of the secondary winding as shown.

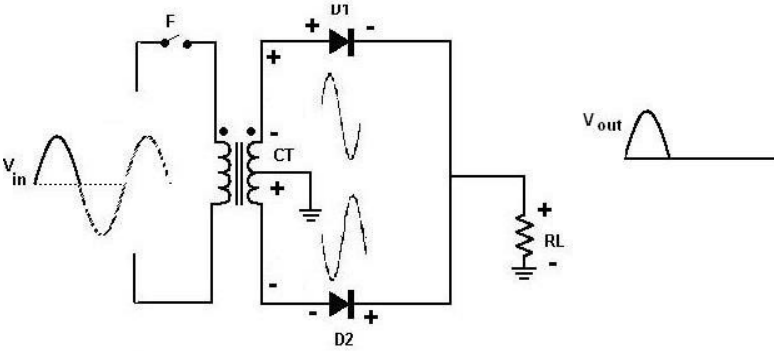


Figure: During positive half-cycle of the input, D_1 is forward-biased and D_2 is reverse-biased.

For a positive half cycle of the input voltage, the polarities of the secondary voltages are shown in figure. This condition forward biases diode D_1 and reverse biases diode D_2.The current path is through D_1 and the load resistor R_L.

For a negative half cycle of the input voltage, the voltage polarities on the secondary are shown. This condition reverse biases D_1 and forward biases D_2. The current path is through D_2 and R_L. Because the output current during both the positive and negative portions of the input cycle are in the same direction through the load the output voltage developed across the load resistor is a full wave rectified dc voltage.

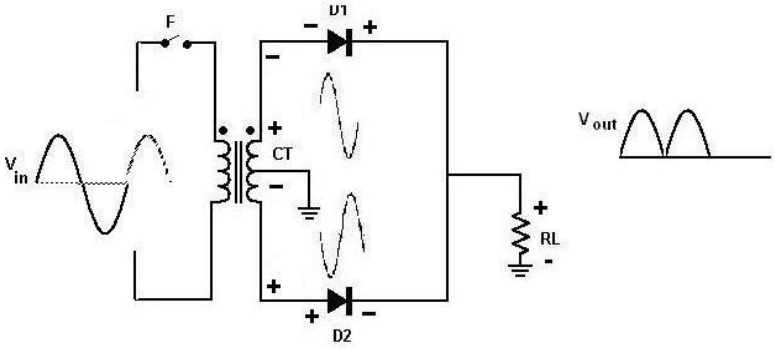
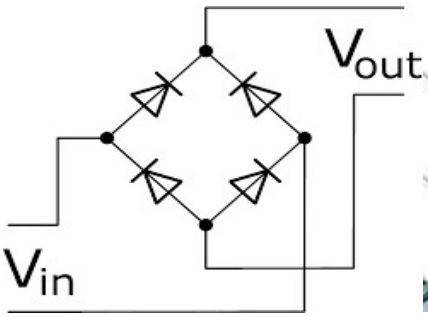


Figure: During negative half-cycle of the input, D_2 is forward-biased and D_1 is reverse-biased.

Apparatus:

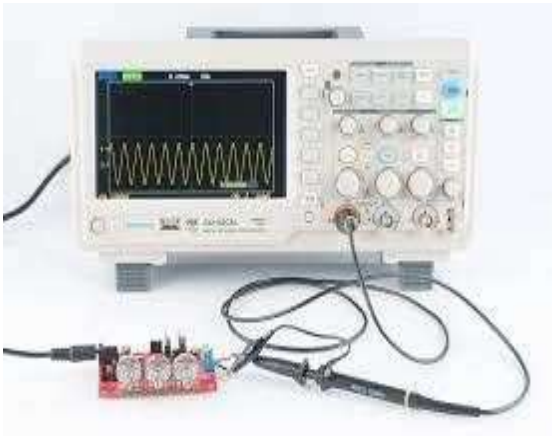
No.	Apparatus	Quantity
1	Diode	4
2	10k Resistance	1
3	Project Board	1
4	Oscilloscope	1
5	Multimeter	1
6	Transformer 220V/12V/9V/6V	1
7	47µF Capacitor	1
8	100µF Capacitor	1
9	Chord	2



Diode

10k Resistance

Project Board



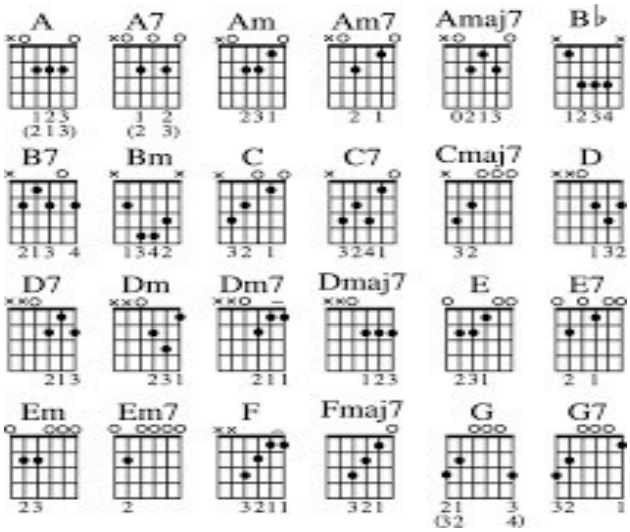
Oscilloscope

Multimeter

Transformer 220V/12V/9V/6V

47µF Capacitor

100µF Capacitor



Chord

Circuit Diagram:

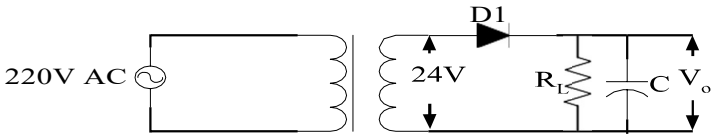


Figure 1: Half wave rectifier.

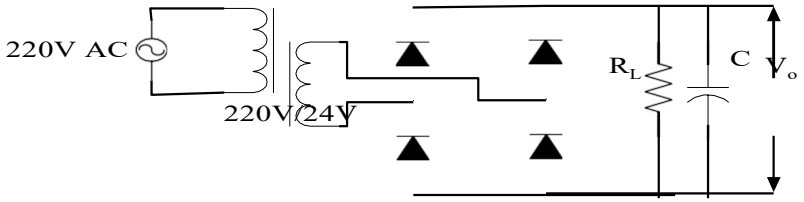


Figure 2: Full wave Bridge rectifier.

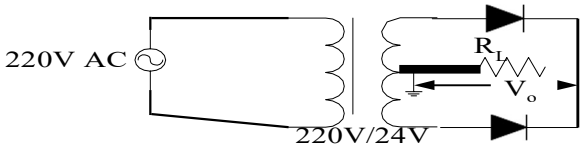
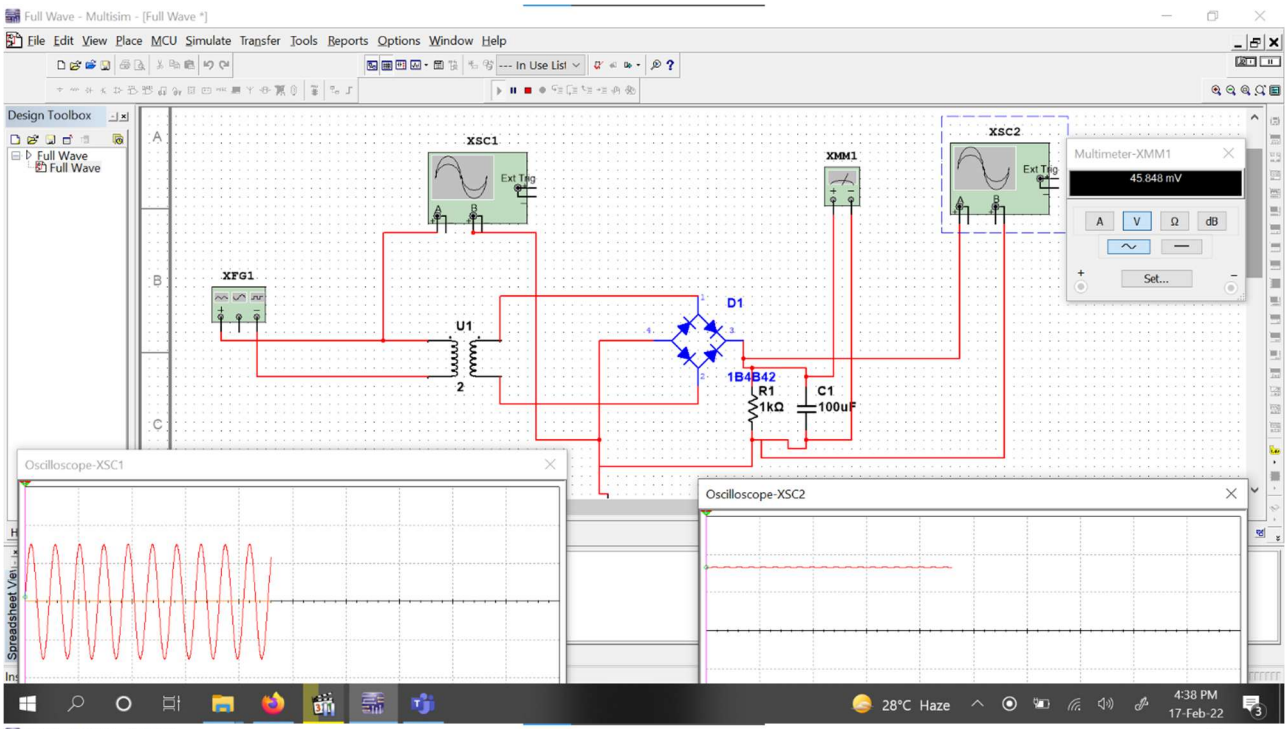
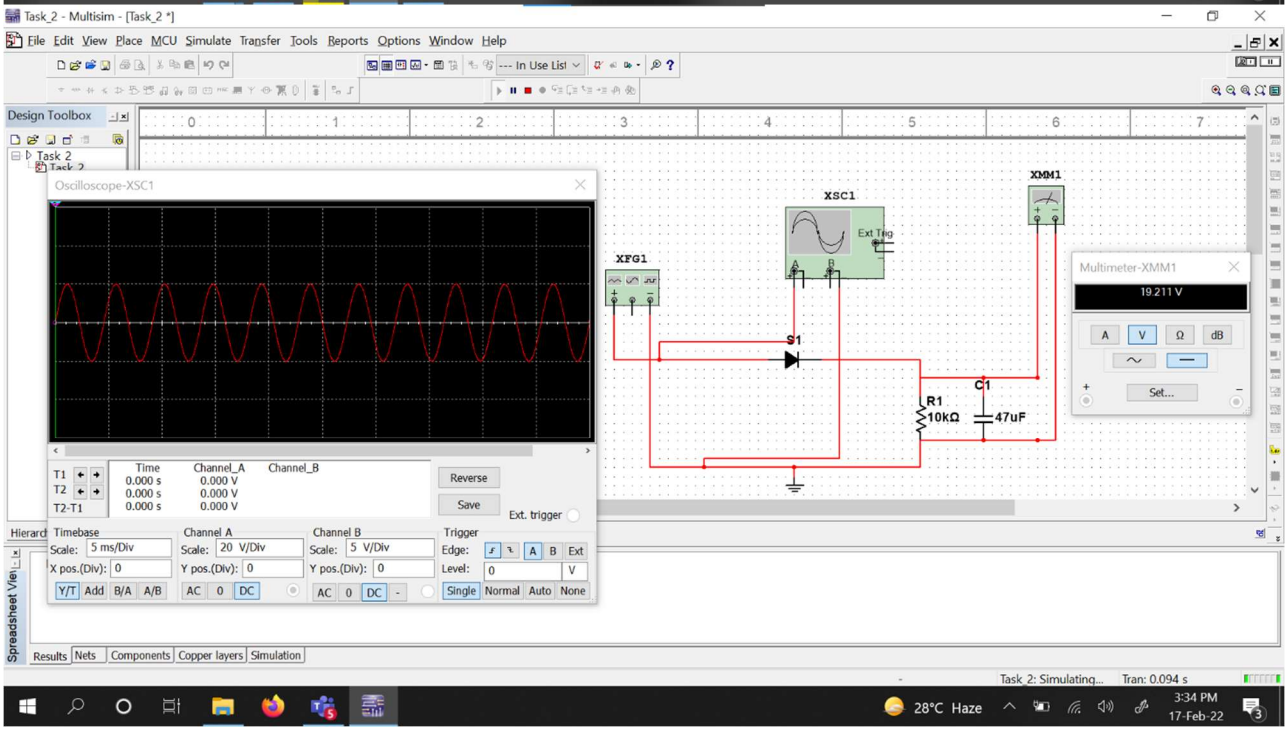
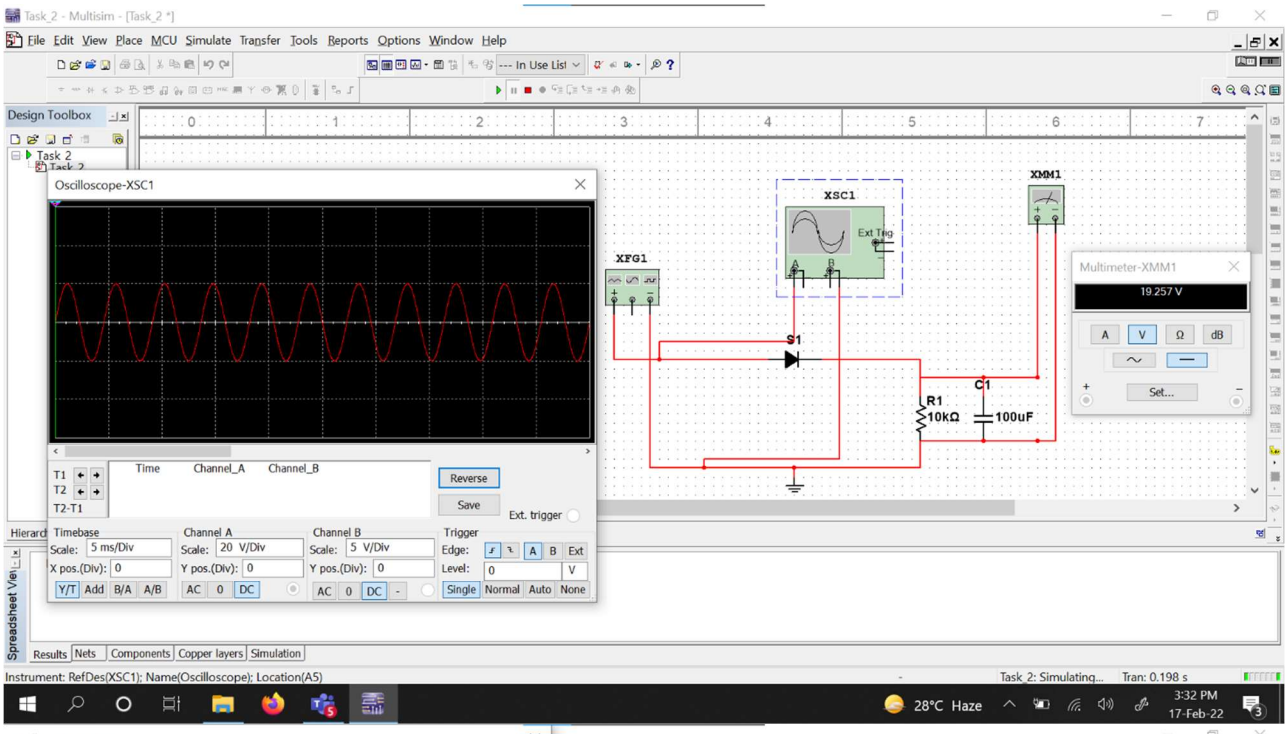


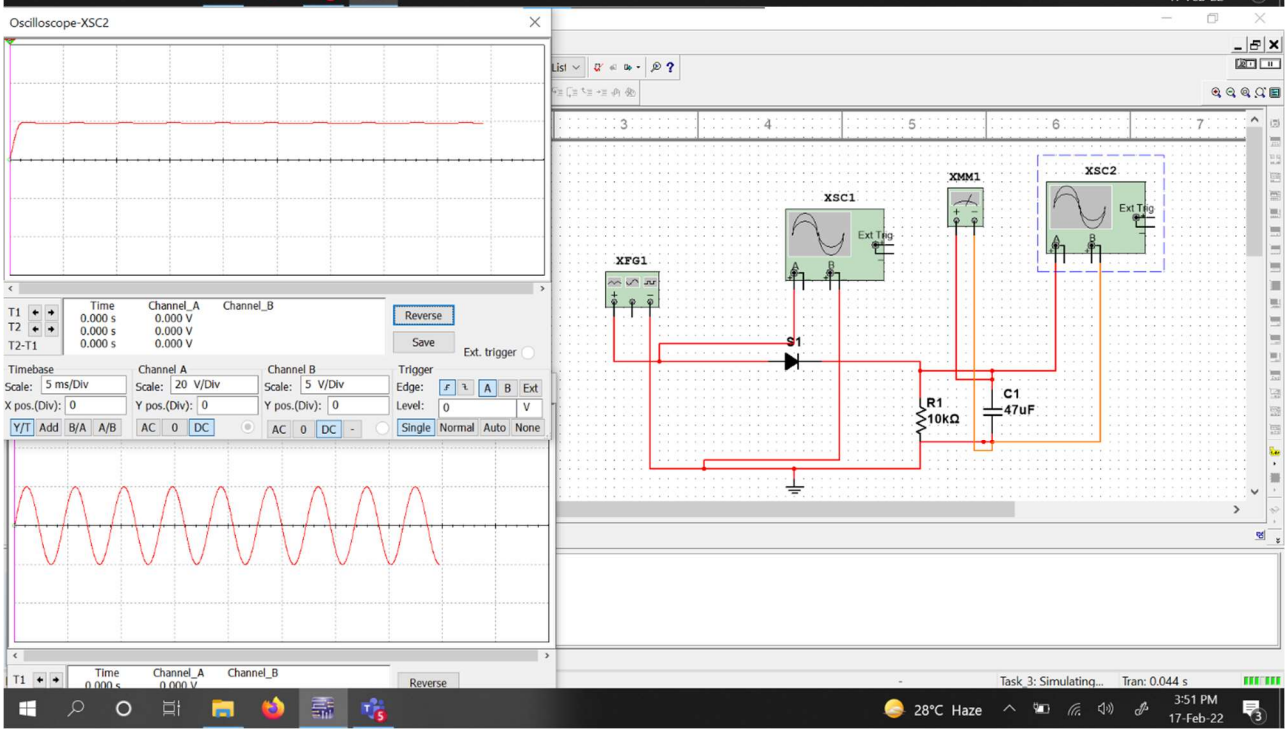
Figure 3: Full wave Center Tapped rectifier.

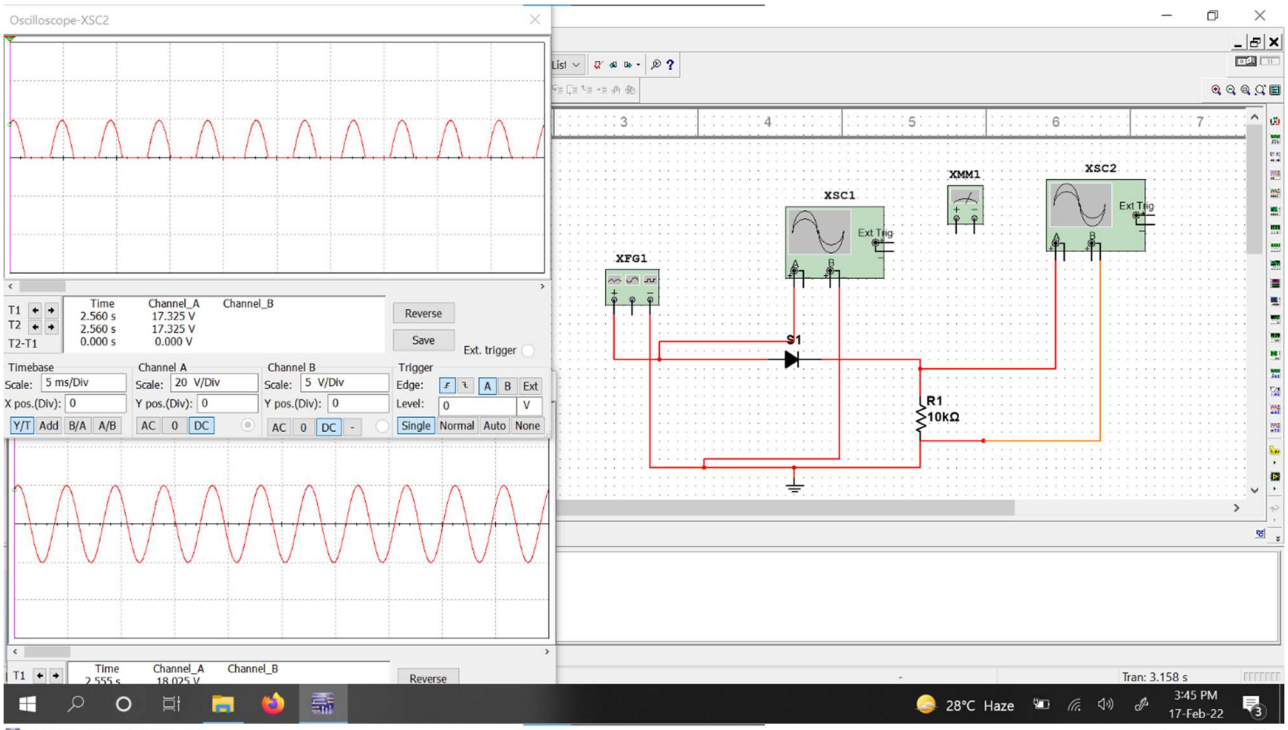
Simulations:

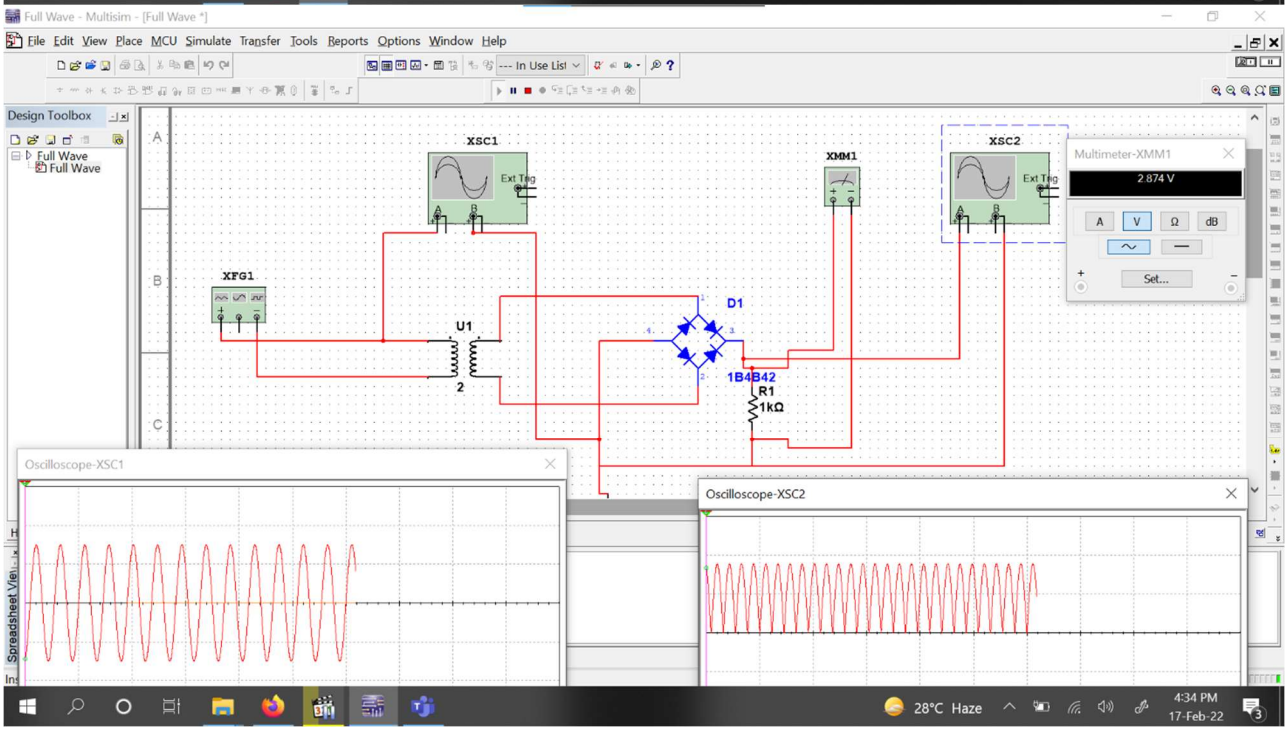


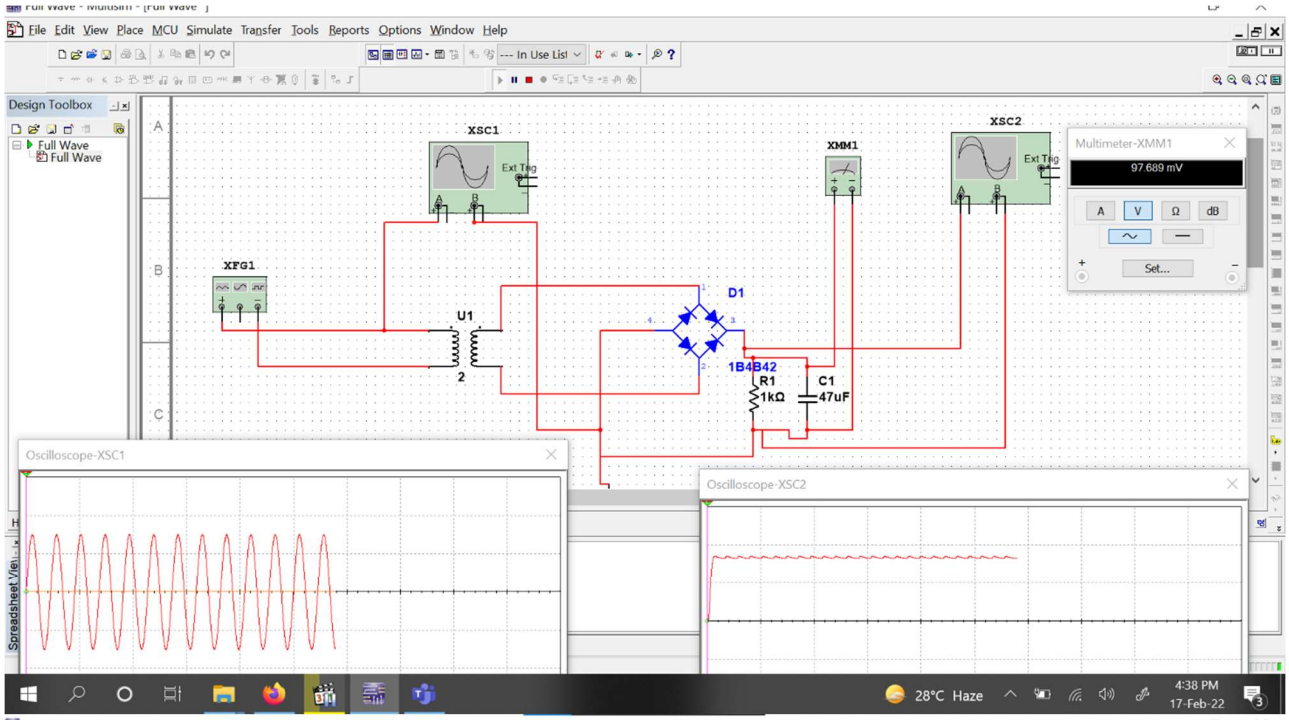


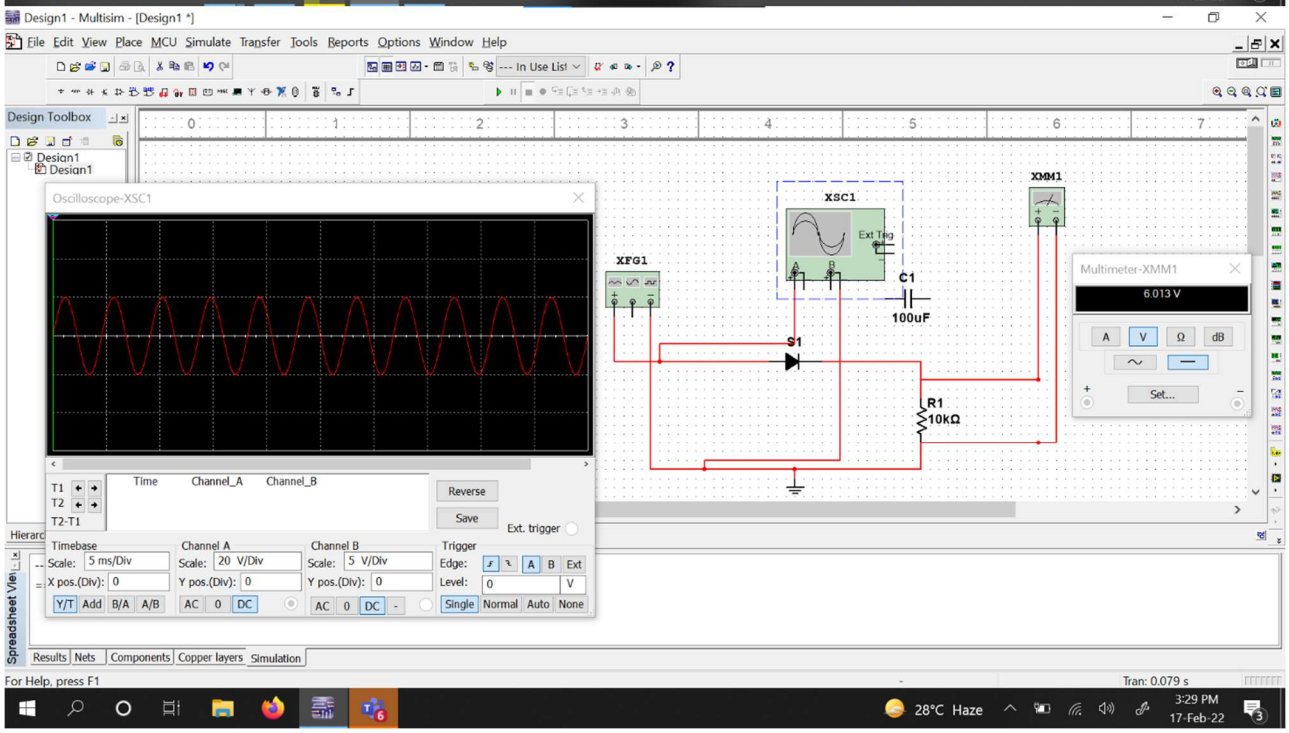

Task_2 - Multisim - [Task_2 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Design Toolbox
Oscilloscope-XSC1
XSC1
XMM1
XFG1
S1
R1
10kΩ
C1
100uF
Multimeter-XMM1
19.257 V
Reverse
Save
Ext. trigger
Timebase
Channel A
Channel B
Trigger
Results Nets Components Copper layers Simulation
Instrument: RefDes(XSC1); Name(Oscilloscope); Location(A5)
Task_2: Simulating... Tran: 0.198 s
28°C Haze
3:32 PM
17-Feb-22

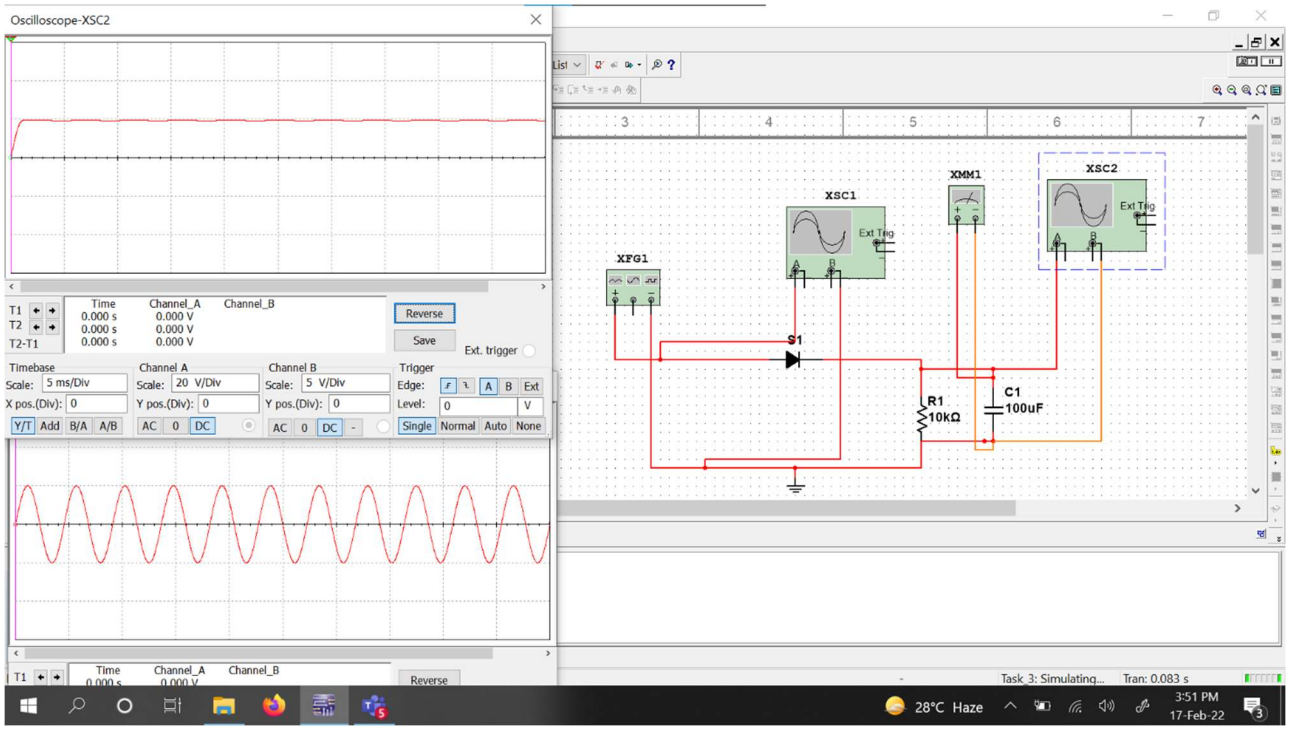

Oscilloscope-XSC2
XSC1
XSC2
XMM1
XFG1
S1
R1
10kΩ
C1
47uF
Reverse
Save
Ext. trigger
Timebase
Channel A
Channel B
Trigger
Task_3: Simulating... Tran: 0.044 s
28°C Haze
3:51 PM
17-Feb-22


Oscilloscope-XSC2
Time
Channel_A
Channel_B
T1
2.560 s
17.325 V
T2
2.560 s
17.325 V
T2-T1
0.000 s
0.000 V
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Y/T Add B/A A/B
Channel A
Scale: 20 V/Div
Y pos.(Div): 0
AC 0 DC
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
AC 0 DC
Trigger
Edge:
Level: 0 V
Single Normal Auto None
XSC1
XSC2
XMM1
XFG1
S1
R1
10kΩ
Ext Trig
Tran: 3.158 s
28°C Haze
3:45 PM
17-Feb-22


Full Wave - Multisim - [Full Wave *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Design Toolbox
Full Wave
Full Wave
XSC1
XSC2
XMM1
XFG1
U1
D1
1B4B42
R1
1kΩ
Multimeter-XMM1
2.874 V
Set...
Oscilloscope-XSC1
Oscilloscope-XSC2
28°C Haze
4:34 PM
17-Feb-22


File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Design Toolbox
Full Wave
Full Wave
XSC1
Ext Trig
XMM1
XSC2
Multimeter-XMM1
97.689 mV
A V Ω dB
Set...
XFG1
U1
D1
1B4B42
R1
1kΩ
C1
47uF
Oscilloscope-XSC1
Oscilloscope-XSC2
Spreadsheet View
28°C Haze
4:38 PM
17-Feb-22


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Design Toolbox
Design1
Design1
Oscilloscope-XSC1
XSC1
Ext Trig
XMM1
XFG1
C1
100uF
S1
R1
10kΩ
Multimeter-XMM1
6.013 V
A V Ω dB
Set...
Time Channel_A Channel_B
T1
T2
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Y/T Add B/A A/B
Channel A
Scale: 20 V/Div
Y pos.(Div): 0
AC 0 DC
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
AC 0 DC
Trigger
Edge:
Level: 0 V
Single Normal Auto None
Results Nets Components Copper layers Simulation
For Help, press F1
Tran: 0.079 s
28°C Haze
3:29 PM
17-Feb-22


Oscilloscope-XSC2
Time
Channel_A
Channel_B
T1
T2
T2-T1
0.000 s
0.000 V
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Y/T Add B/A A/B
Channel A
Scale: 20 V/Div
Y pos.(Div): 0
AC 0 DC
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Single Normal Auto None
XFG1
XSC1
XMM1
XSC2
Ext Trig
S1
R1
10kΩ
C1
100uF
Task_3: Simulating...
Tran: 0.083 s
28°C Haze
3:51 PM
17-Feb-22

Experimental Data:

Table 1: Data Table for circuit of Figure – 1

	V_o (Oscilloscope)	V_o (Multimeter)
No Capacitance		6.013 v
47μF		19.25 v
100 μF		19.211 v

Table 2: Data Table for circuit of Figure – 2

	V_o (Oscilloscope)	V_o (Multimeter)
No Capacitance		2.874 v
47μF		45.848 mv
100 μF		97.689 mv

Result Analysis:

Half wave rectifier :

For half wave rectifier we have observed that the value of terminal voltage was lower without any capacitance and it was 6.015v. However, when we add capacitance with resistor then the terminal voltage value increases it was 19.294v and 19.299v respectively for 47uF and for 100uF.

Full wave bridge rectifier:

For full wave bridge rectifier, we have seen that the value of terminal voltage was lower without any capacitance and it was 5.402v. However, when we add capacitance with resistor then the terminal voltage value increases it was 8.757v and 8.732v respectively for 47uF and for 100uF. In both the cases terminal voltage increases with addition of capacitor. We also shown the rectification of the ac signal to dc signal through Oscilloscope.

Discussion:

In this experiment our aim was to get familiar with the diode rectifier. We have studied about half wave rectifier and full wave bridge rectifier. Based on our theoretical knowledge we done simulation in mutism and observed how the diode rectifier works. We observed that the terminal voltage goes up if we add capacitor with the resistor. These phenomena seen in both half and full wave rectifier.

Reference(s):

[1] Adel S. Sedra, Kennth C. Smith, "Microelectronic Circuits", Saunders College 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.

Video link:

https://www.youtube.com/watch?v=Ll0IOk_Ltfc
https://www.youtube.com/watch?v=0qwuRF6SaVY