DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment **Full**	:	**10. Wave shaping circuits (Half wave & Rectifiers, Clippers)**
Name of the candidate	:	Abdul Ahad
Register Number	:	RA2111028010094
Date of Experiment	:	08/12/2021
Date of submission	:	14/12/2021

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre-Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE-LAB QUESTIONS (Rectifiers)

1 What is the necessity of rectifier?

A rectifier in the power supply helps in converting AC to DC power supply. Rectifiers can take a wide variety of physical forms, from vacuum tube diodes and crystal radio receivers to modern silicon-based designs.

2 What is PIV of a diode in Full Wave Rectifier (FWR) and Half Wave Rectifier (HWR)?

The PIV value of a Full Wave Rectifier (FWR) is 2V and of Half wave Rectifier (HWR) is V.

3 What is ripple factor? Why it is required?

Ripple refers to the fluctuation occurs within the output of the rectifier. This factor is essential to measure the rate of fluctuation within the resolved output. The ripple within output voltage can be reduced by using filters like capacitive, etc.

4 Why are filters connected at the output of rectifiers?

A filter is a device which allows the passing of dc component of the load and blocks the ac component of the rectifier output. Thus, the output of the filter circuit will be a steady dc voltage. The filter circuit can be constructed by the combination of components like capacitors, resistors, and inductors.

5 What are the types of filters used in rectifier? And which is better and why?

For reducing the AC component different types of filters are used at the output of the rectifier. These filters consist of Inductors and capacitor. Inductor: It is connected in series in filter circuit because Inductors have inductive reactance which is against to any changes and hence it offers high impedance to AC and low to DC because DC is a constant signal whereas AC is not, Capacitor: capacitor is connected in parallel in the filter circuit as the capacitor blocks DC and allows AC. So, any AC component in the output will pass through the capacitor to the ground and we get less amount of ac in the output. Best filter is which have small inductor at input and large capacitor at the output.

Experiment No. 10 a) **Date:** 08/12/2021	**SINGLE PHASE HALF WAVE RECTIFIER**

Aim

To construct a half wave rectifier using diode and to draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P. S	(0-30) V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	1
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	-	1

Formulae

Without Filter

(i) $V_{rms} = V_m / 2$

(ii) $V_{dc} = V_m / \prod$

(iii) Ripple Factor $= \sqrt{((V_{rms} / V_{dc})^2 - 1)}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

With Filter

(i) $V_{rms} = \sqrt{(V_{rms}^2 + V_{dc}^2)}$

(ii) $V_{rms} = V_{rpp} / (\sqrt{3} \times 2)$

(iii) $V_{dc} = V_{m-} V_{rpp} / 2$

(iv) Ripple Factor $= V_{rms} / V_{dc}$

Procedure

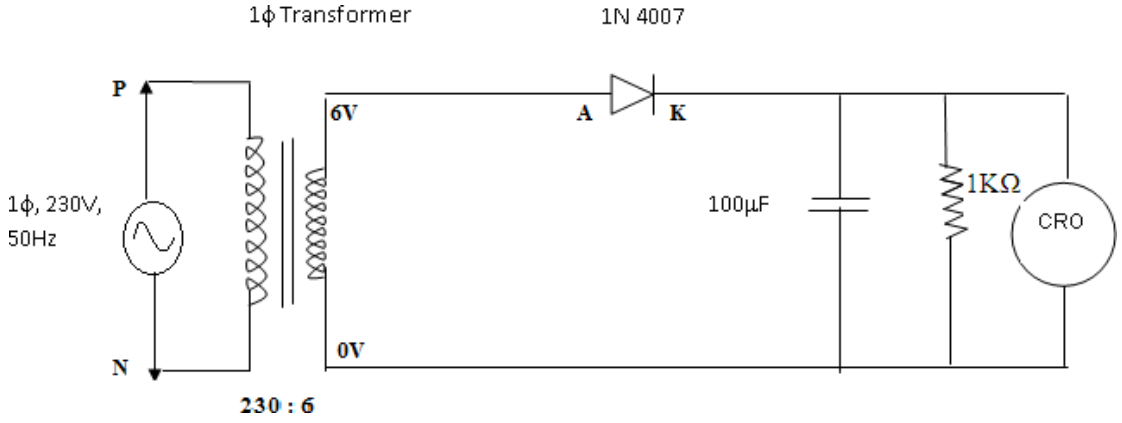
Without Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load.
4. Plot its performance graph.

With Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

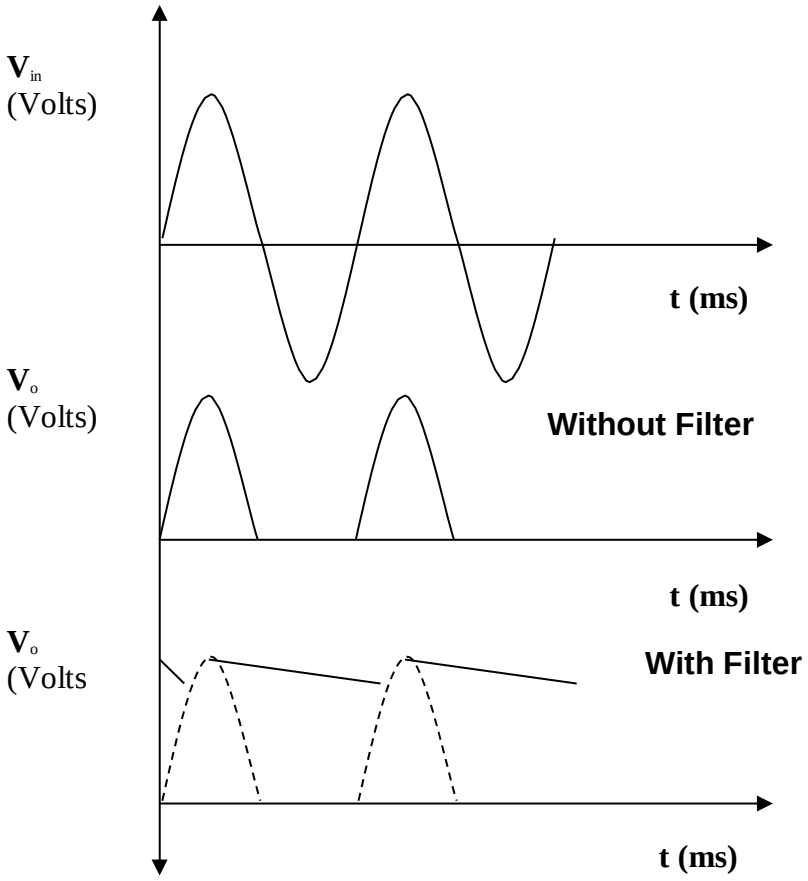
Without Filter

$V_{m\,(V)}$	$V_{rms\,(V)}$	$V_{dc\,(V)}$	Ripple factor	Efficiency
5.3	2.65	1.687	1.219	41.1

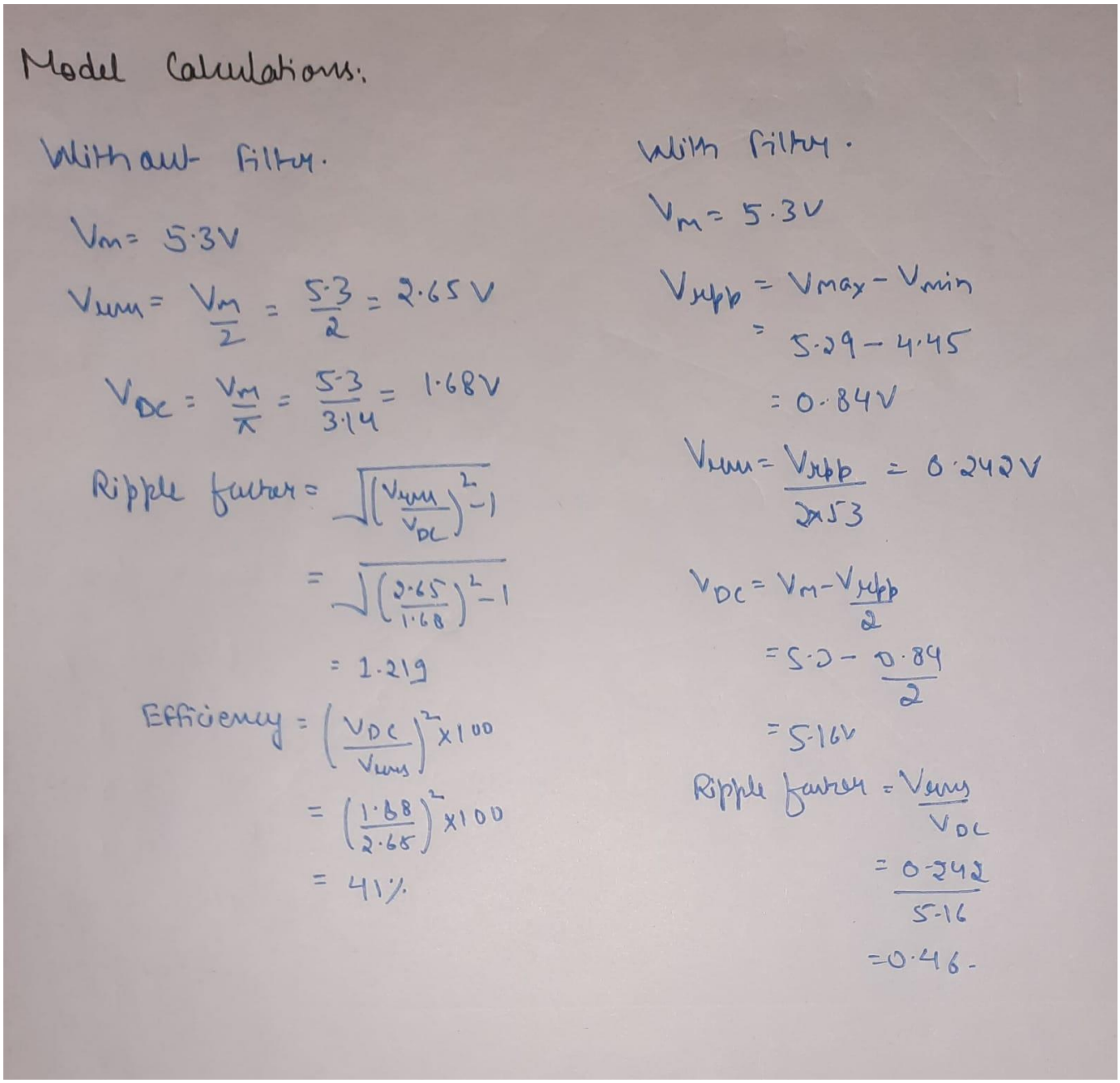
With Filter

$V_{rpp\,(V)}$	$V_{rms\,(V)}$	$V_{dc\,(V)}$	Ripple factor
0.84	0.242	5.16	0.46

Model Graph



Model calculations:



Model Calculations:

Without filter.

$V_m = 5.3V$

$V_{rms} = \frac{V_m}{2} = \frac{5.3}{2} = 2.65V$

$V_{DC} = \frac{V_m}{\pi} = \frac{5.3}{3.14} = 1.68V$

Ripple factor $= \sqrt{\left(\frac{V_{rms}}{V_{DC}}\right)^2 - 1}$

$= \sqrt{\left(\frac{2.65}{1.68}\right)^2 - 1}$

$= 1.219$

Efficiency $= \left(\frac{V_{DC}}{V_{rms}}\right)^2 \times 100$

$= \left(\frac{1.68}{2.65}\right)^2 \times 100$

$= 41\%$

With filter.

$V_m = 5.3V$

$V_{rpp} = V_{max} - V_{min}$

$= 5.29 - 4.45$

$= 0.84V$

$V_{rms} = \frac{V_{rpp}}{2\sqrt{3}} = 0.242V$

$V_{DC} = V_m - \frac{V_{rpp}}{2}$

$= 5.3 - \frac{0.84}{2}$

$= 5.16V$

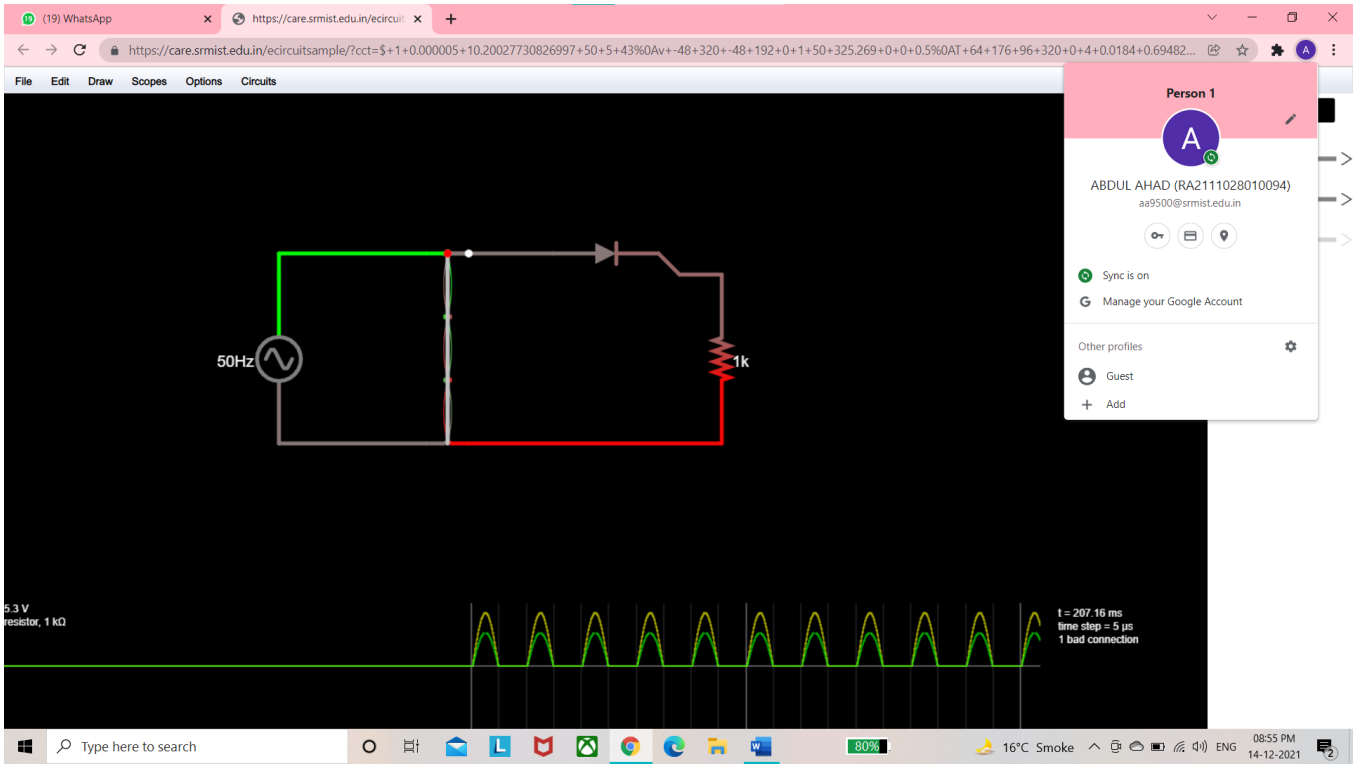
Ripple factor $= \frac{V_{rms}}{V_{DC}}$

$= \frac{0.242}{5.16}$

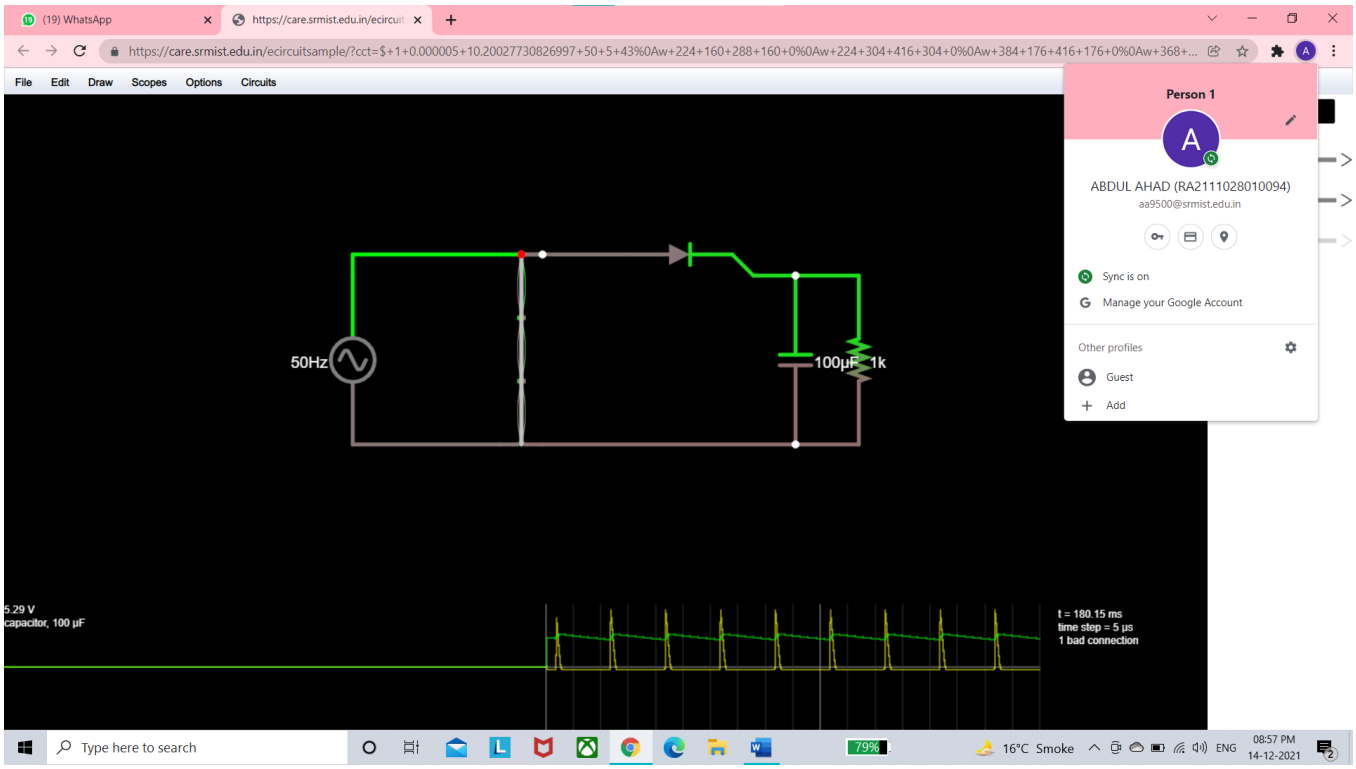
$= 0.46$

Result:

1. Without filter



2. With filter



Experiment No. 10 b) Date: 08/12/2021	SINGLE PHASE FULL WAVE RECTIFIER

Aim

To construct a single phase full-wave rectifier using diode and to draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P.S	(0-30)V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	2
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	1Hz-20MHz	1
6	Connecting wires	-	Req

Formulae

Without Filter

(i) $V_{rms} = V_m / \sqrt{2}$

(ii) $V_{dc} = 2V_m / \prod$

(iii) Ripple Factor $= \sqrt{((V_{rms} / V_{dc})^2 - 1)}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

With Filter

(i) $V_{rms} = V_{rpp}/(2*\sqrt{3})$

(ii) $V_{dc} = V_m - V_{rpp}$

(iv) Ripple Factor $= V_{rms'} / V_{dc}$

Procedure

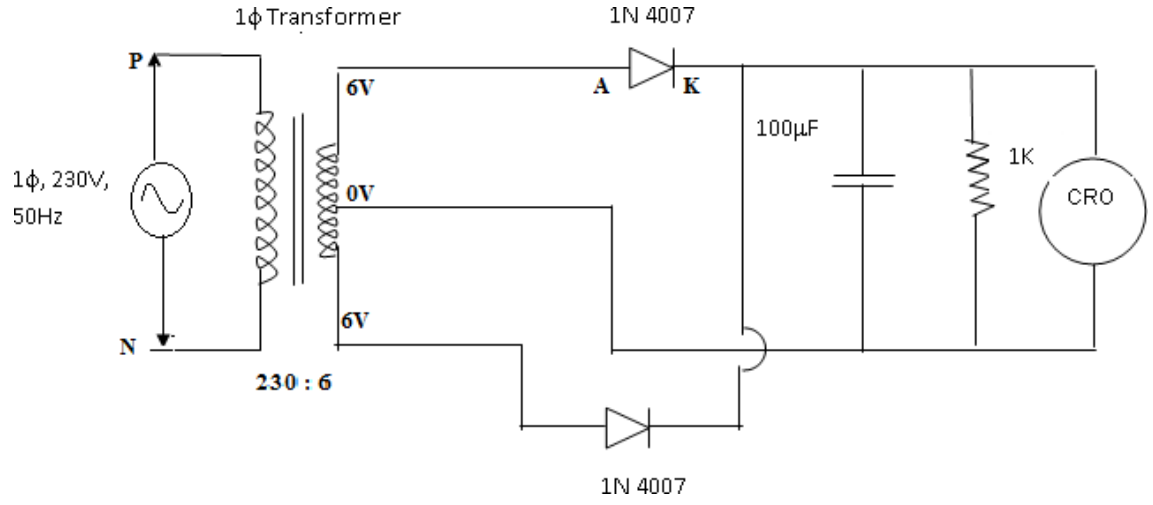
Without Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load.
4. Plot its performance graph.

With Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

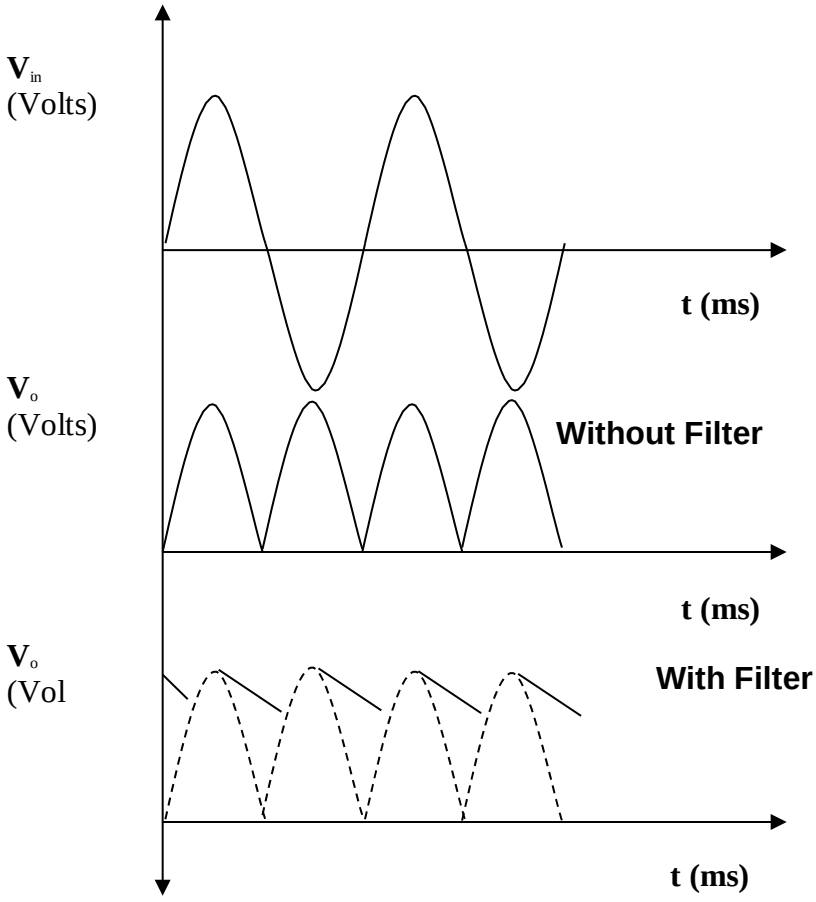
Without Filter

V_m	V_{rms}	V_{dc}	Ripple factor	Efficiency
3.67	2.59	2.33	0.44	80.93

With Filter

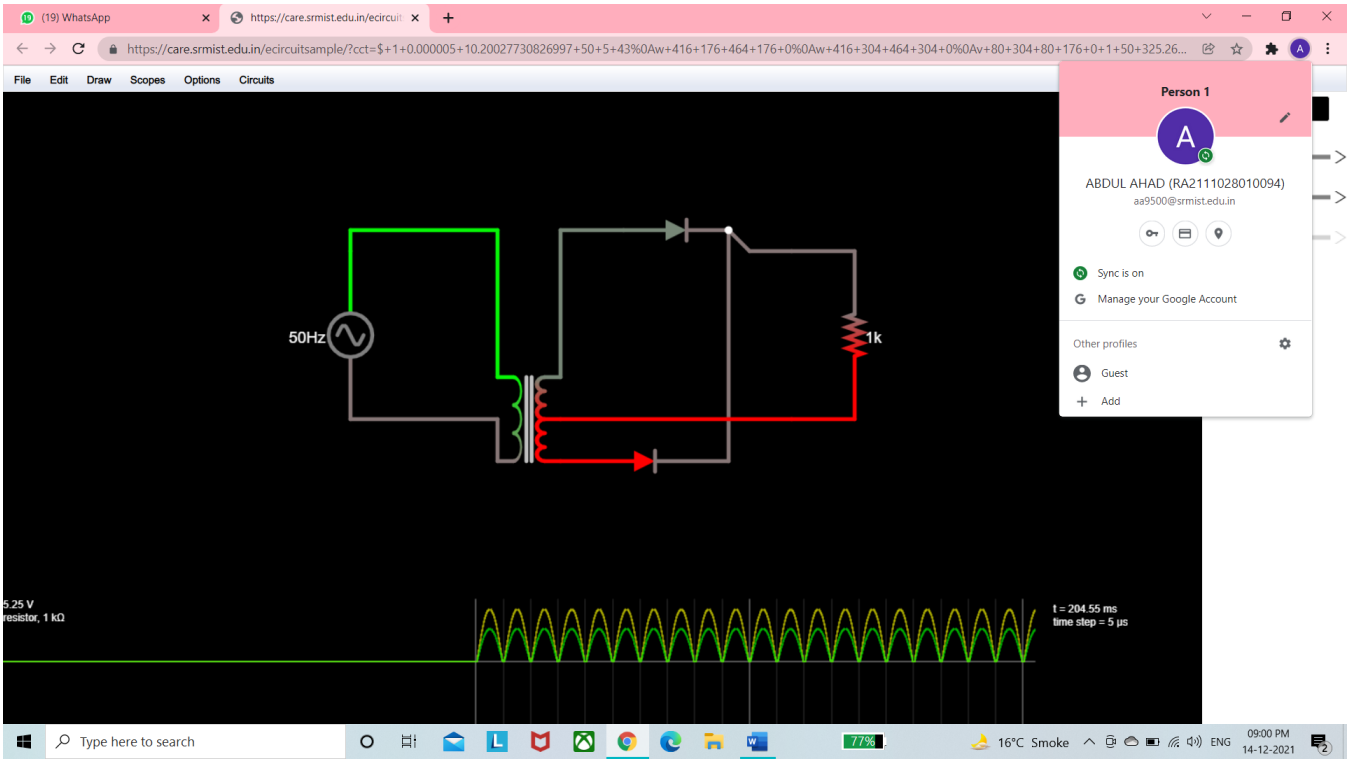
V_{rms}	V_{rpp}	V_{dc}	Ripple factor
0.092	0.32	3.31	0.027

Model Graph

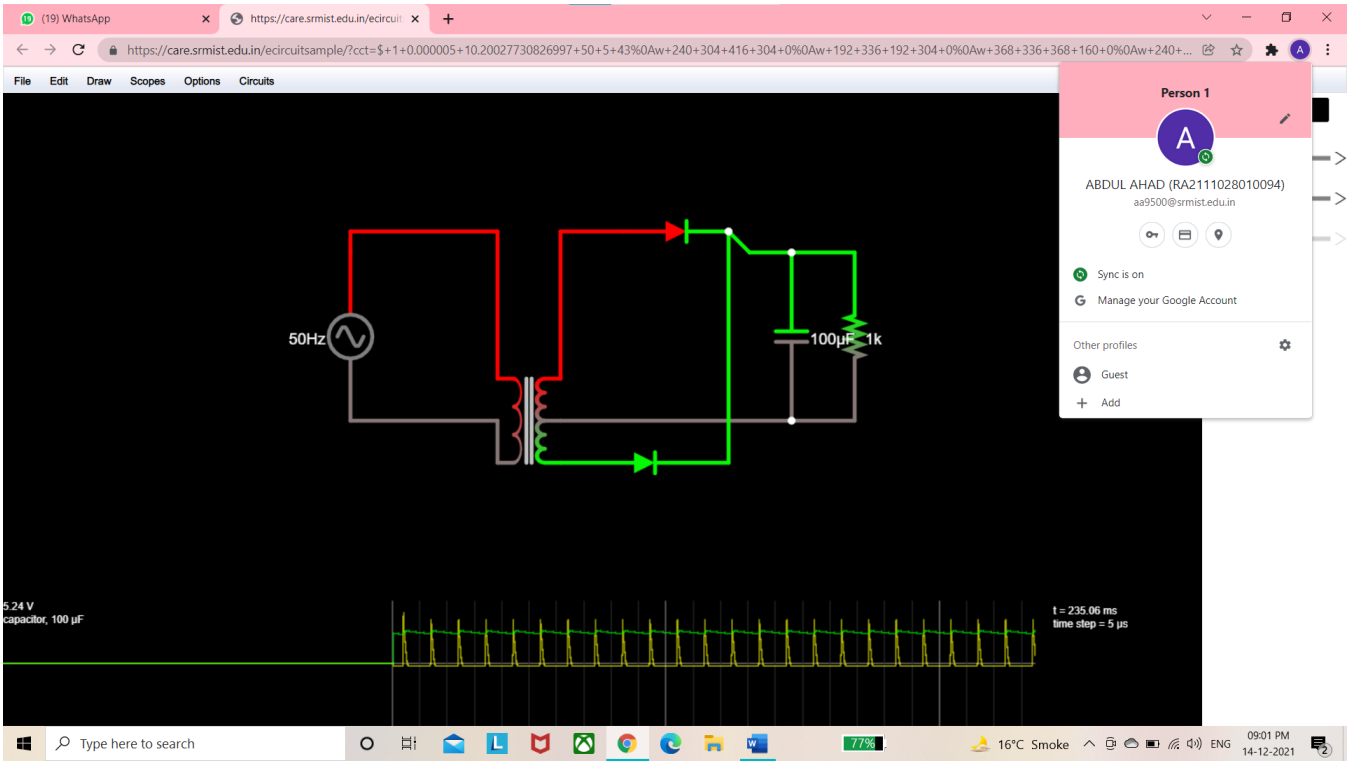


Result

1. Without filter



2. With filter

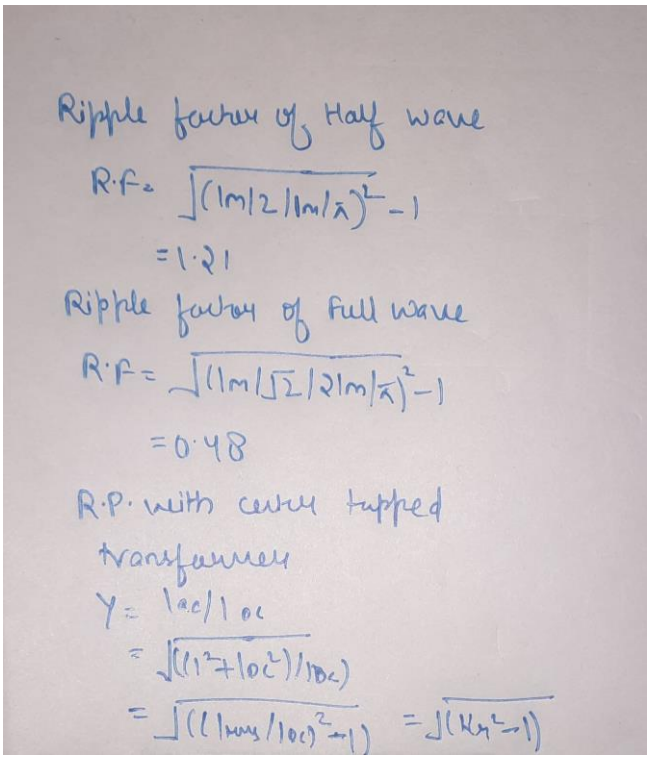


POST LAB QUESTIONS

1. **What is Transformer Utilization Factor (TUF)?**

Transformer Utilization Factor (TUF) is defined as the ratio of DC power output of a rectifier to the effective Transformer VA rating used in the same rectifier. Effective VA Rating of transformer is the average of primary and secondary VA rating of transformer.

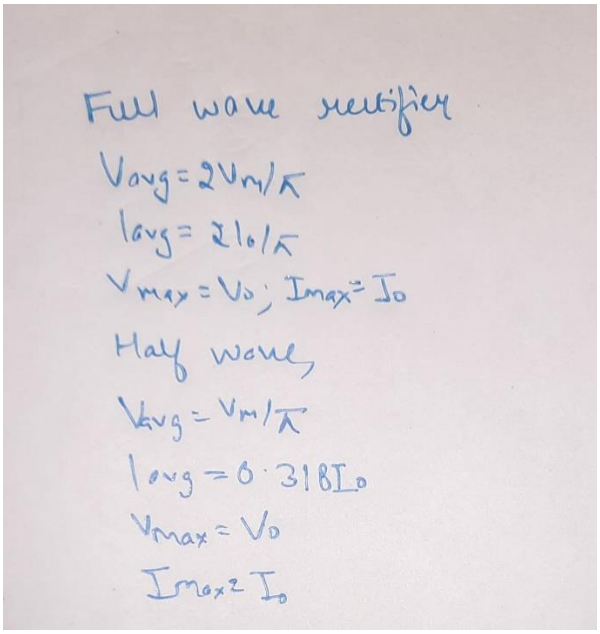
2. **Mention the value of ripple factor for HWR, FWR & rectifier with centre tapped transformer.**



3. **What is the difference between uncontrolled rectifier and controlled rectifier? Which is advantageous and why?**

An uncontrolled rectifier is a simple diode which conducts for half cycle or 180degree of sinewave and remains cut-off for remaining 180 degrees. In a controlled rectifier, the conduction can start at any angle in positive half cycle - namely 0 to 180 degrees. A controlled rectifier is advantageous over an uncontrolled one because it can compensate the DC line voltage variations caused by voltage variations on the medium voltage power network and keep voltage constant even in case of load variations and also control the fault current on faults far from the electrical substation and consequently, help increase line protection settings.

4. State the average and peak value of output voltage and current for full wave rectifier and half wave rectifier.



5. What is PIV of a diode in half wave and full wave rectifier?

Peak Inverse Voltage (PIV) is the maximum voltage that the diode can withstand during reverse bias condition. If a voltage is applied more than the PIV, the diode will be destroyed. Peak Inverse Voltage of single-phase center-tap full wave rectifier is the maximum possible voltage across a diode when it is reversed biased.

Clippers
PRE-LAB QUESTIONS

1. **What are the differences between linear and nonlinear wave shaping circuit?**

In the non-linear circuit, the non-linear elements are an electrical element and it will not have any linear relationship between the current & Voltage.

In the linear circuits, the linear element is also an electrical element and there will be a linear relationship between the voltage and current.

2. **What are the applications of wave shaping circuit?**

The wave shaping is used to perform any one of the following functions, To hold the waveform to a particular D.C. level, to limit the voltage level of the waveform of some presenting value and suppressing all other voltage levels in excess of the present level.

3. **What is wave shaping?**

In electronic music wave shaping is a type of distortion synthesis in which complex spectra are produced from simple tones by altering the shape of the waveforms.

4. **What is the necessity of wave shaping?**

To generate one wave from the other. To limit the voltage level of the waveform to some preset value and suppressing all other voltage levels in excess of the preset level.

5. **Mention the application of clipper and clamper.**

Clippers and clampers can be defined as clippers that are used to protect the electronic circuits by applying the AC input signals to the described voltage range.

Experiment No. 10c) Date : 08/12/2021	CLIPPERS

Aim

To study the clipping circuits for different reference voltages and to verify the responses.

Apparatus Required

S.No.	Name	Range	Qty
1	CRO	1Hz-20MHz	1
2	RPS	(0–30) V	1
3	Bread Board	-	1
4	Connecting Wires	-	Req
5	Function Generator	1Hz-1MHz	1

Components Required

S.No.	Name	Range	Qty
1	Resistor	10KΩ	1
2	Diode	IN4007	1

Theory

The non-linear semiconductor diode in combination with resistor can function as clipper circuit. Energy storage circuit components are not required in the basic process of clipping. These circuits will select part of an arbitrary waveform which lies above or below some particular reference voltage level and that selected part of the waveform is used for transmission. So they are referred as voltage limiters, current limiters, amplitude selectors or slicers. There are three different types of clipping circuits.

1) Positive Clipping circuit.

2) Negative Clipping.

3) Positive and Negative Clipping (slicer).

In positive clipping circuit positive cycle of Sinusoidal signal is clipped and negative portion of sinusoidal signal is obtained in the output of reference voltage is added, instead of complete positive cycle that portion of the positive cycle which is above the reference voltage value is clipped. In negative clipping circuit instead of positive portion of sinusoidal signal,

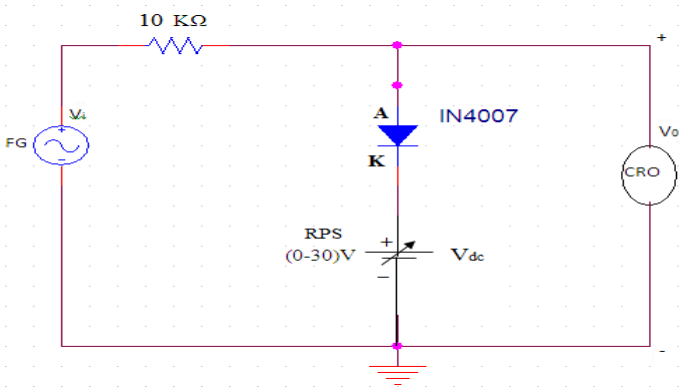
negative portion is clipped. In slicer both positive and negative portions of the sinusoidal signal are clipped.

Procedure

1. Connect the circuit as shown in the circuit diagram.
2. Connect the function generator at the input terminals and CRO at the output terminals of the circuit.
3. Apply a sine wave signal of frequency 1 KHz, Amplitude greater than the reference voltage at the input and observe the output waveforms of the circuits.

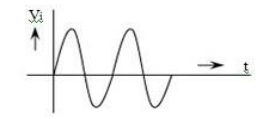
Circuit Diagram

Positive Clipper

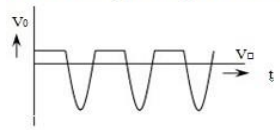


Model Graph:

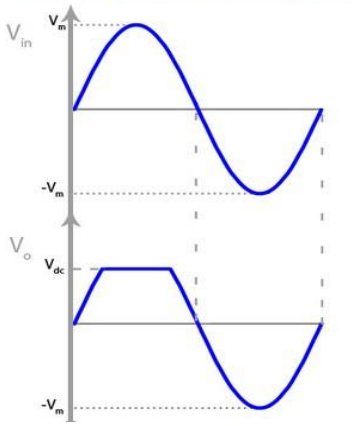
Input waveform



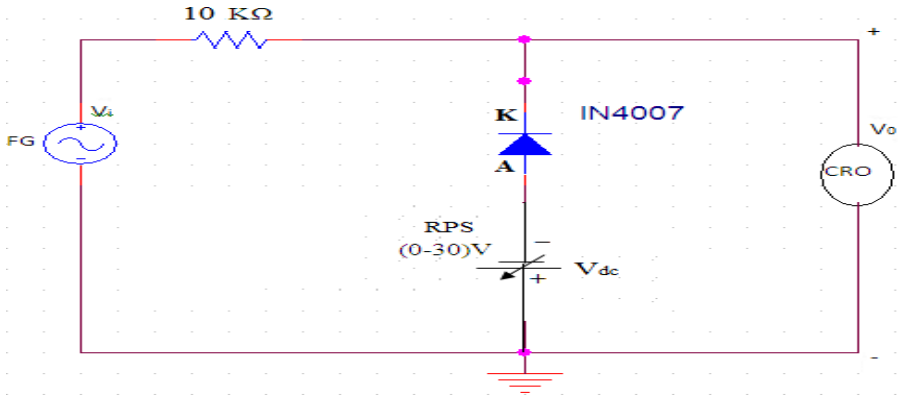
Unbiased Clipper Output Waveform



Biased Clipper Input Output Waveform

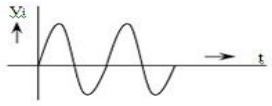


Negative Clipper



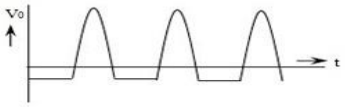
Model Graph:

Input waveform

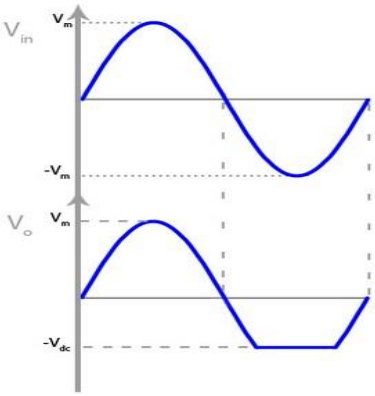


Unbiased Clipper

Output Waveform



Biased Clipper Input/Output Waveform

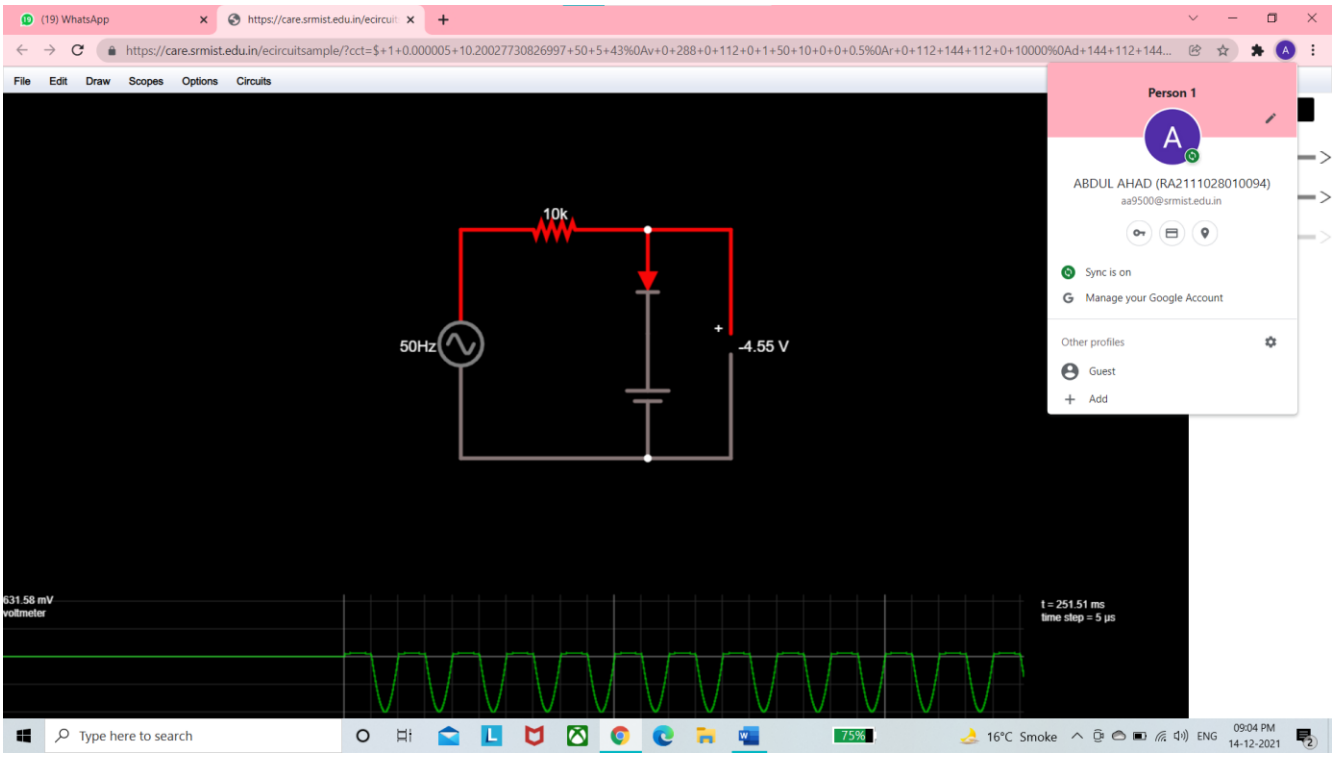


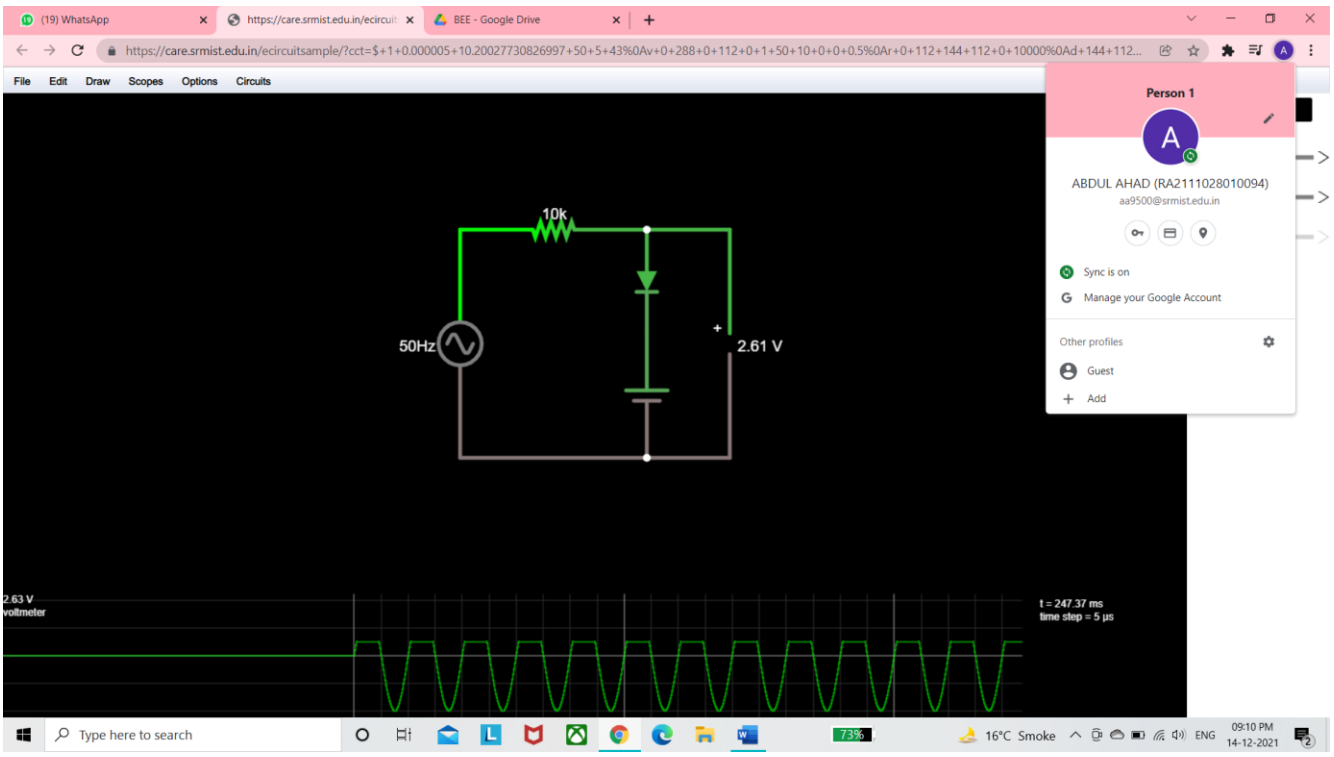
Tabulation:

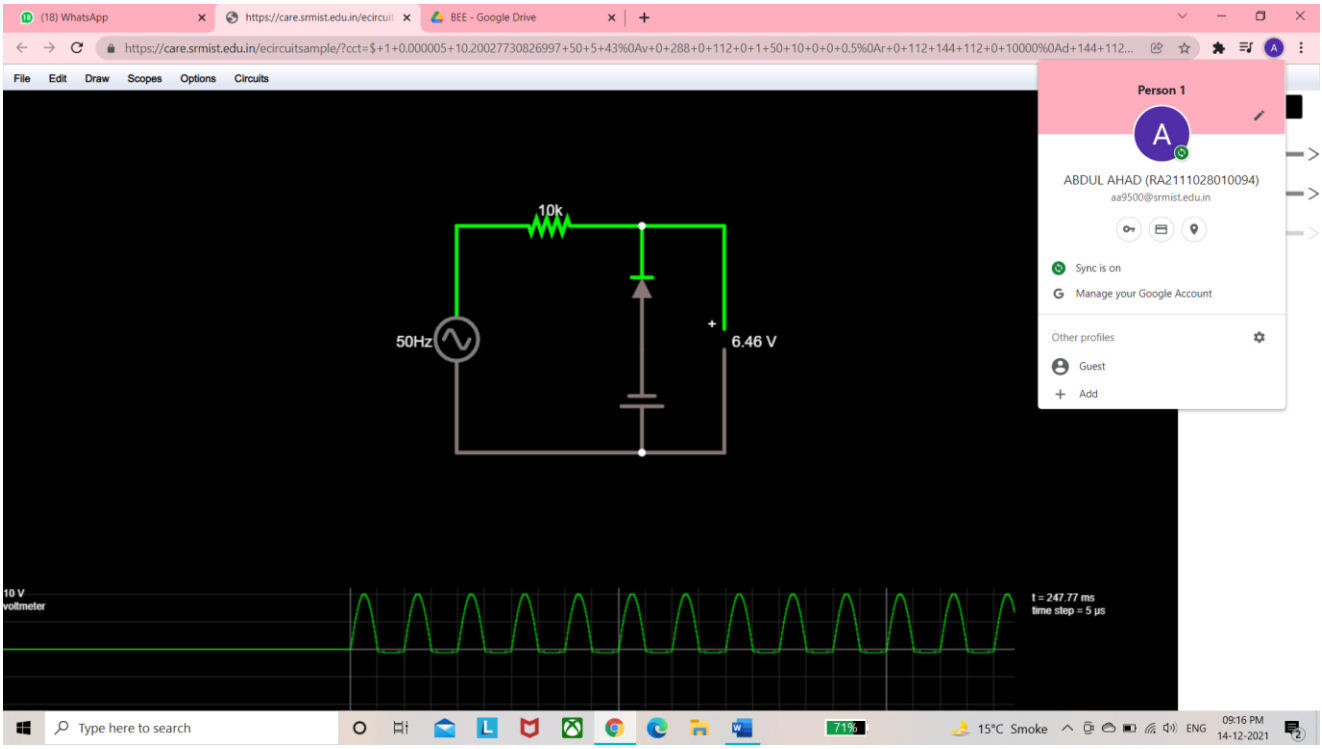
Positive Clipper **Negative Clipper**

Unbiased Clipper			
V_{ref} = 0V		**V_{ref} = 0V**	
Output voltage (V)	**Time Period (ms)**	**Output voltage (V)**	**Time Period (ms)**
5	20	5	20
Biased Clipper			
V_{ref} = 2V		**V_{ref} = 2 V**	
Output voltage (V)	**Time Period (ms)**	**Output voltage (V)**	**Time Period (ms)**
2.6	20	-2.6	20

Result


10k
50Hz
-4.55 V
631.58 mV
voltmeter
t = 251.51 ms
time step = 5 µs
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is on
Manage your Google Account
Other profiles
Guest
Add


10k
50Hz
2.61 V
2.63 V
voltmeter
t = 247.37 ms
time step = 5 µs
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is on
Manage your Google Account
Other profiles
Guest
Add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File
Edit
Draw
Scopes
Options
Circuits
10k
50Hz
6.46 V
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is on
Manage your Google Account
Other profiles
Guest
Add
10 V
voltmeter
t = 247.77 ms
time step = 5 µs
Type here to search
71%
15°C Smoke
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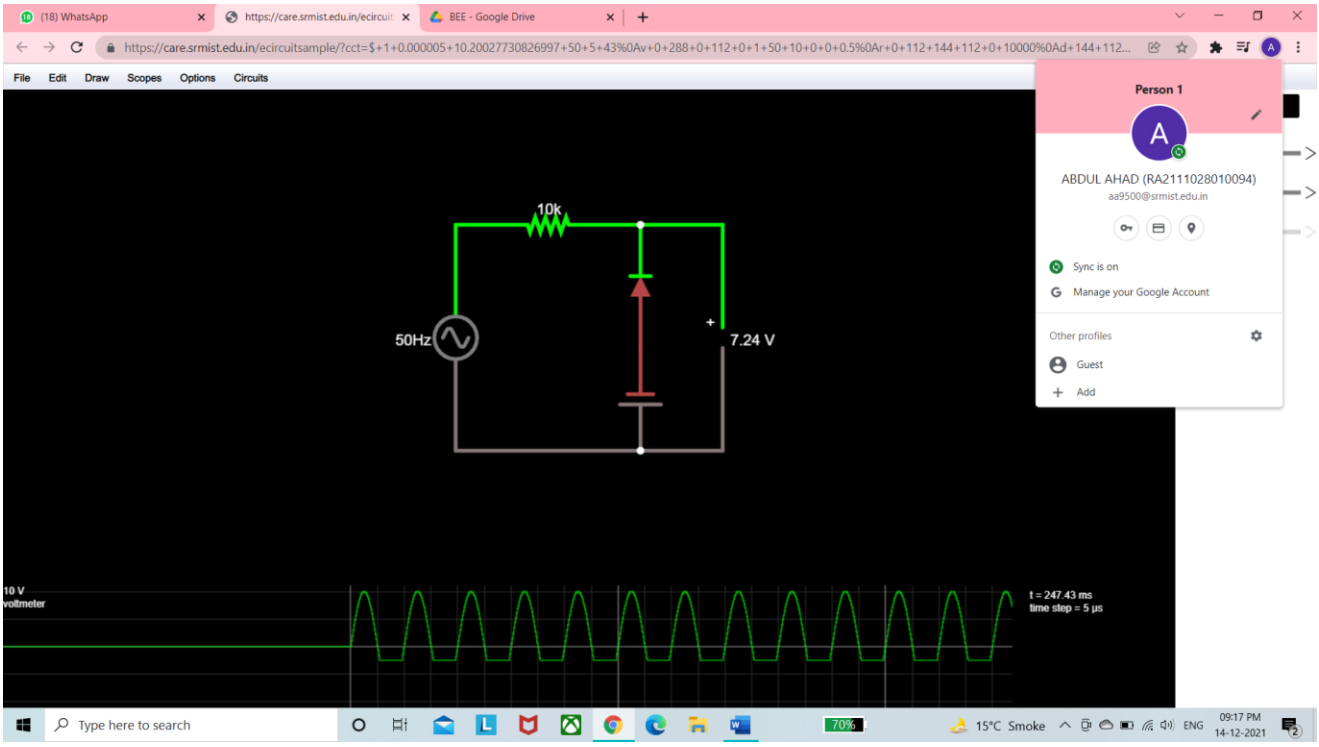
14-12-2021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File
Edit
Draw
Scopes
Options
Circuits
10k
50Hz
7.24 V
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is on
Manage your Google Account
Other profiles
Guest
Add
10 V
voltmeter
t = 247.43 ms
time step = 5 µs
Type here to search
70%
15°C Smoke
ENG
09:17 PM
14-12-2021

POST LAB QUESTIONS

1. Differentiate +ve and -ve Clippers.

Positive clipper-the clipper which removes the positive half cycles of the input voltage, while the negative clipper the clipper which removes the negative half cycles of the input voltage.

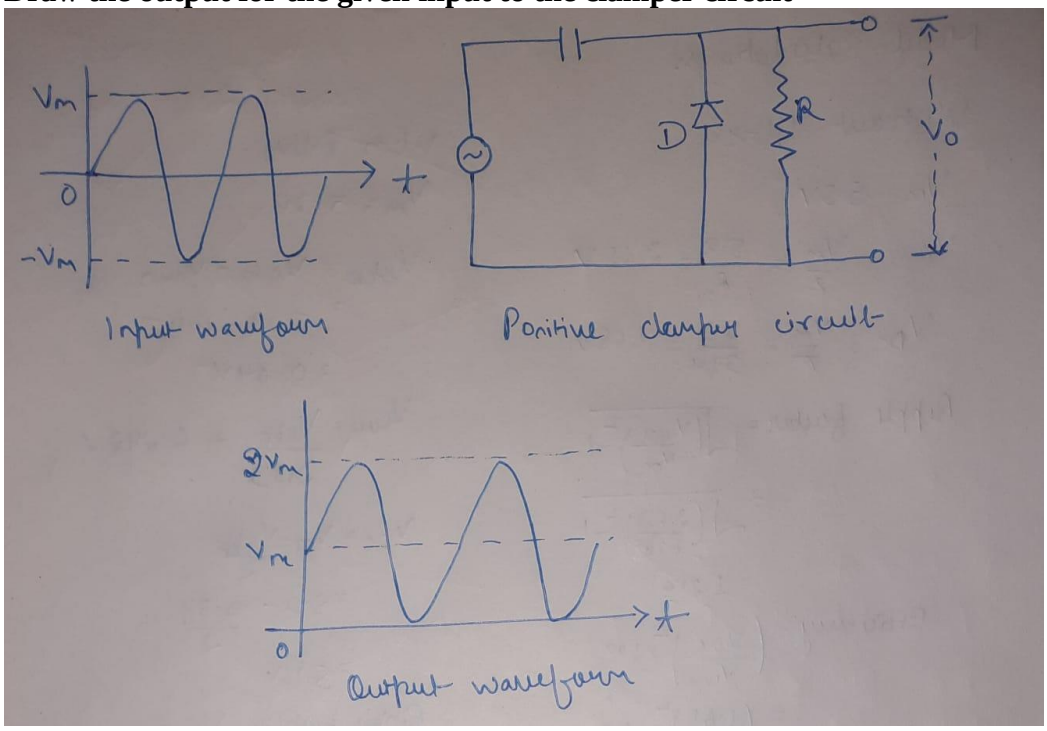
2. What is the function of Clampers?

A clamper is an electronic circuit that fixes either the positive or the negative peak excursions of a signal to a defined value by shifting its DC value. The clamper does not restrict the peak-to-peak excursion of the signal, it moves the whole signal up or down so as to place the peaks at the reference level.

3. Write the classifications of clippers and clampers.

They can be classified into two types. They are:
Positive Clampers., Negative Clampers and Positive clippers, Negative clippers.

4. Draw the output for the given input to the clamper circuit



5. What is the need of wave shaping circuit?

To generate one wave from the other. To limit the voltage level of the waveform to some preset value and suppressing all other voltage levels in excess of the preset level.