DEPT. Of Computer Science Engineering

SRM IST, Kattankulathur – 603 203

Sub Code & Name: 18CSS201J - ANALOG AND DIGITAL ELECTRONICS

Experiment No	01
Title of Experiment	Design and Implementation of Half Wave and Full Wave Rectifiers using simulation package and demonstrate its working
Name of the candidate	Parth Katiyar
Register Number	RA2011026010124
Date of Experiment	30-09-2021

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Oral Viva / Online Quiz	5	
2	Execution	10	
3	Model Calculation / Result Analysis	5	
	Total	20	

Staff Signature with date

Aim

To construct a Half wave and Full wave rectifier using diode and to draw itsperformancecharacteristics.

Apparatus Required:

S.No	Particulars	Type	Range	Quantity
1	Diode	1N4001		4
2	Resistor		100 to 10000Ω	As per required
3	Capacitor		470µF	1
4	AC voltage source		4V, 50Hz	1
5	Voltage Measurement probe.			2

Software Required:

https://www.multisim.com/

1)a)Half wave rectifier

Theory

The process of converting an alternating current into direct current is known as rectification. The unidirectional conduction property of semiconductor diodes(junction diodes) is used for rectification. Rectifiers are of two types: (a) Half waverectifier and (b) Full wave rectifier.

In a half-wave rectifier circuit, during thepositive half-cycle of the input, the diode is forward biased and conducts. Currentflows through the load and a voltage is developed across it. During the negative halfcycle, it is reverse bias and does not conduct. Therefore, in the negative halfcycle of the supply, no current flows in the load resistor as no voltage appears across it. Thus the dc voltage across the load is sinusoidal for the first half cycle only and a pure a.c. input signal is converted into a unidirectional pulsating outputsignal.

Another type of circuit that produces the same output as a full-wave rectifieris that of the Bridge Rectifier. This type of single-phase rectifier uses 4 individualrectifying diodes connected in a "bridged" configuration to produce the desiredoutput but does not require a special center tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side. The 4 diodes labeled D arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in se D3 and D4 are reverse biased and the current flows through the load as shown below . During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch of as they are now reverse biased. The current flowing through the load is the same direction as before.

Formula:

Half wave rectifier without filter:

I. $V_{rms} = \frac{V_m}{2}$; V_m = Peak voltage magnitude

II. $V_{dc} = \frac{V_m}{\pi}$

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

IV. % Efficiency = ___ ×100%

Half wave rectifier with filter:

I. $V_{rms} = \frac{V_{rpp}}{(\sqrt{3} \times 2)}$; V_{rpp} = Peak to peak voltage magnitude

II. $V_{dc} = V_m - \frac{V_{rpp}}{2}$

III. Ripple factor = $\frac{V_{rms}}{V_{dc}}$

Procedure:

Without Filter

I. Give the connections as per the circuit diagram.

II. Give 6 V, 50Hz Input to the circuit.

III. Measure the rectifier output across the Load and input voltage.

IV. Plot its performance graph.

With Filter

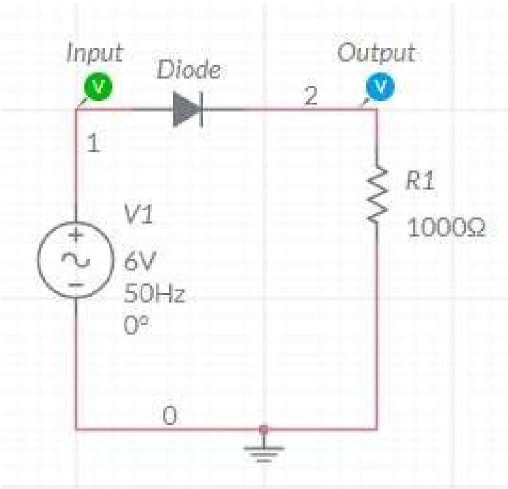
I. Give the connections as per the circuit diagram.

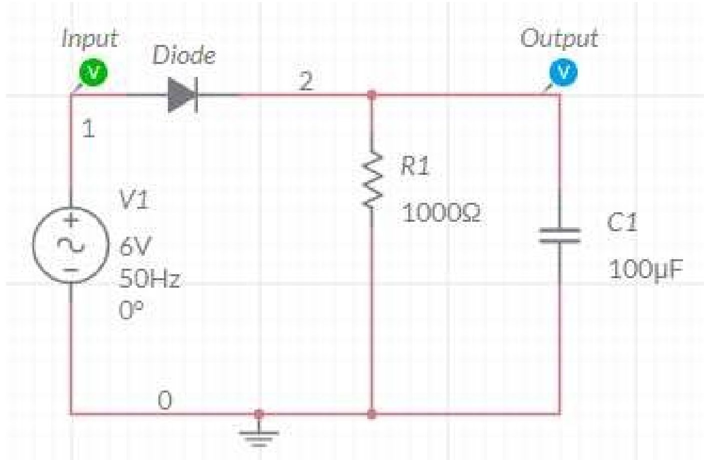
II. Give 6 V, 50Hz Input to the circuit.

III. Connect the Capacitor across the load.

IV. Measure the rectifier output across the different load and input voltage V. Plot its performance graph.

Circuit Diagram:

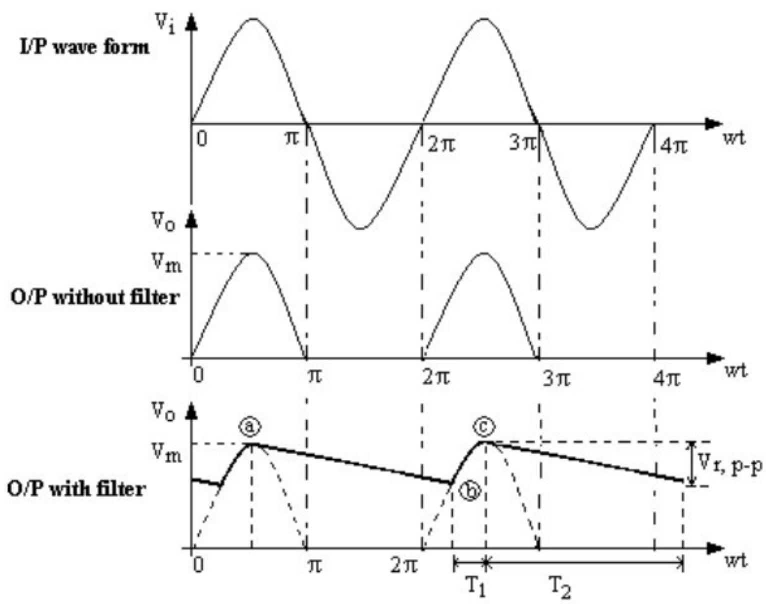




Half wave Rectifier – Without filter

Half wave Rectifier – With filter

Model graph for half wave rectifier



Tabulation Without Filter

V_m(V)	V_{rms}(V)	V_{dc}(V)	Ripple Factor	Efficiency (%)
5.2927	2.6463	1.6847	1.2113	40.52%

With filter

Load Resistor	V_{rpp}(V)	V_{rms}(V)	V_{dc}(V)	Ripple factor

1000Ω	0.1911	0.0551	5.1836	0.0106

Model Calculation

Without Filter:-

I $V_{rms} = \frac{V_m}{2}$; V_m = Peak voltage magnitude

$V_m = 5.2927\,V$

$V_{rms} = \frac{5.2927}{2}$

$= 2.643\,V$

a) $V_{dc} = V_m/\pi$

$= \frac{5.2927}{3.1415}$

$= 1.68475$

II) Ripple factor: $\sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$

$\sqrt{\left(\frac{2.6463}{1.6847}\right)^2 - 1}$

$\sqrt{\frac{7.0029}{2.8382} - 1}$

$= \sqrt{1.4673}$

$= 1.2113$

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

$= \left(\frac{1.6847}{2.6463}\right)^2 \times 100$

$= \frac{2.8382}{7.0029} \times 100$

$= 0.4052 \times 100 = 40.52\%$

With Filter

Page :
Date :

Model Calculation

I) $V_{rms} = \dfrac{V_{rpp}}{2 \times \sqrt{3}}$ – V_{rpp} = peak to peak voltage magnitude

$V_{rpp} = 5.2791 - 5.0880$
$= 0.1911\ V$

$V_{rms} = \dfrac{0.1911}{2 \times \sqrt{3}} = \dfrac{0.1911}{3.4641} = 0.0551\ V$

II $V_{dc} = V_m - \dfrac{V_{rpp}}{2}$

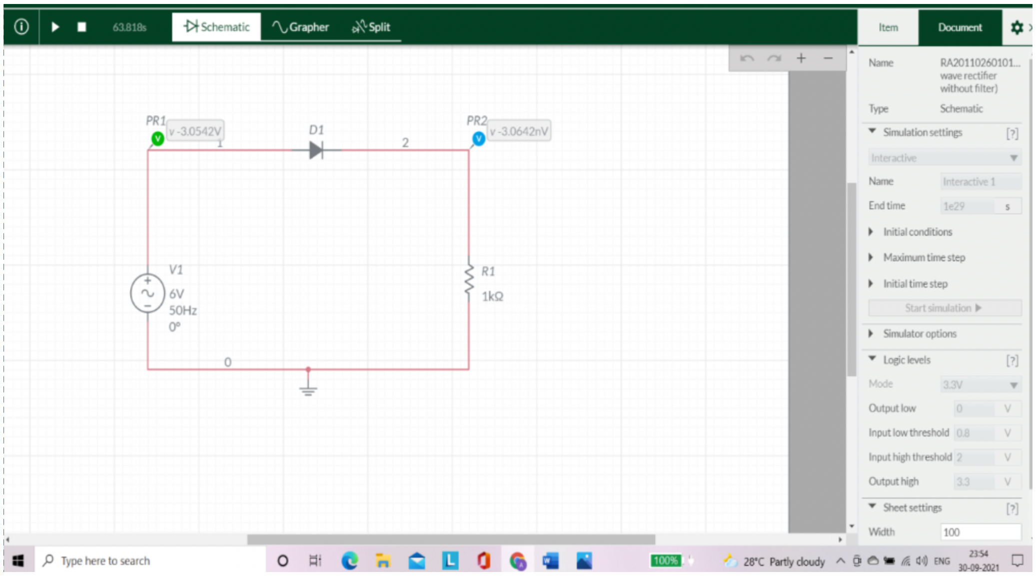
$5.2791 - \dfrac{0.1916}{2}$

$= 5.2798 - 0.0955 = 5.1836\ V$

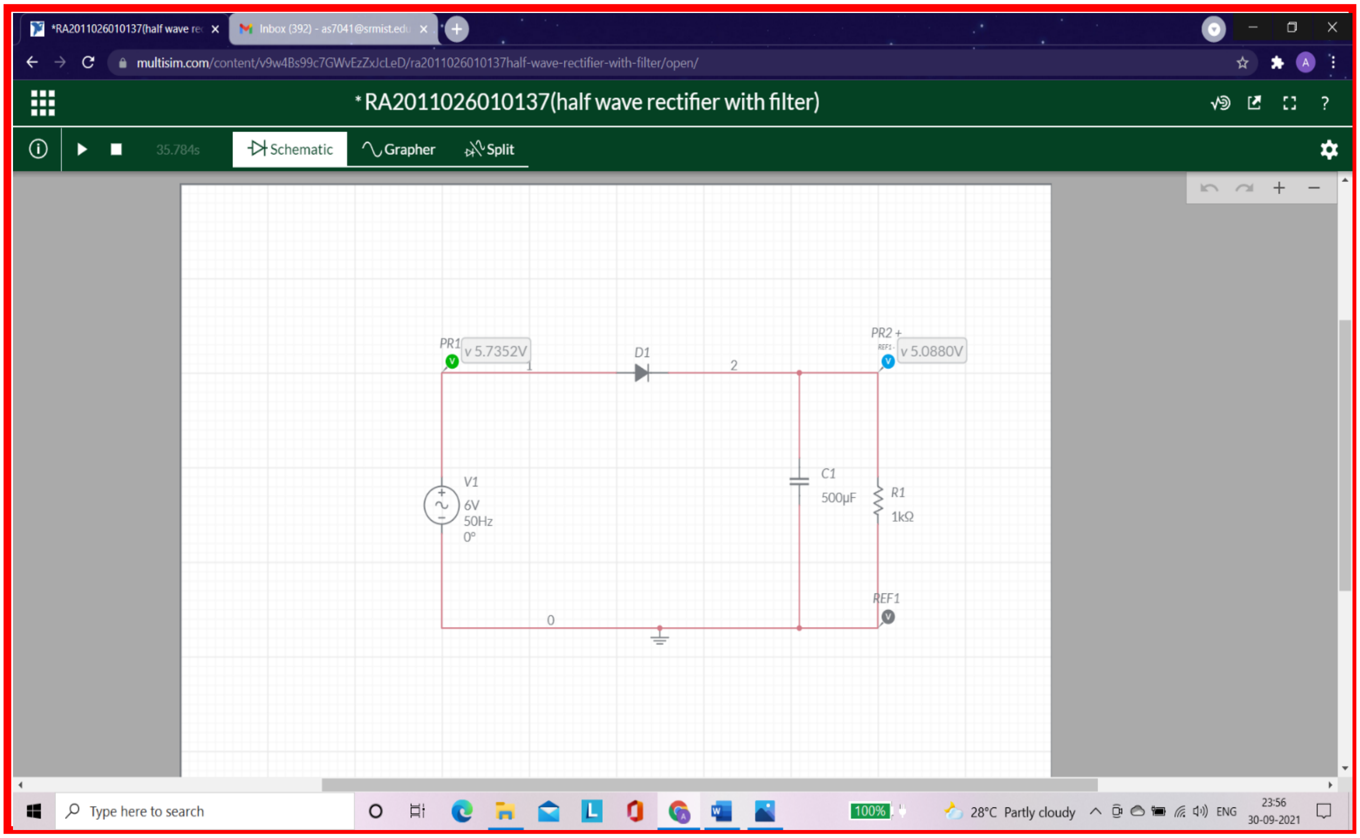
III Ripple factor $= \dfrac{V_{rms}}{V_{dc}}$

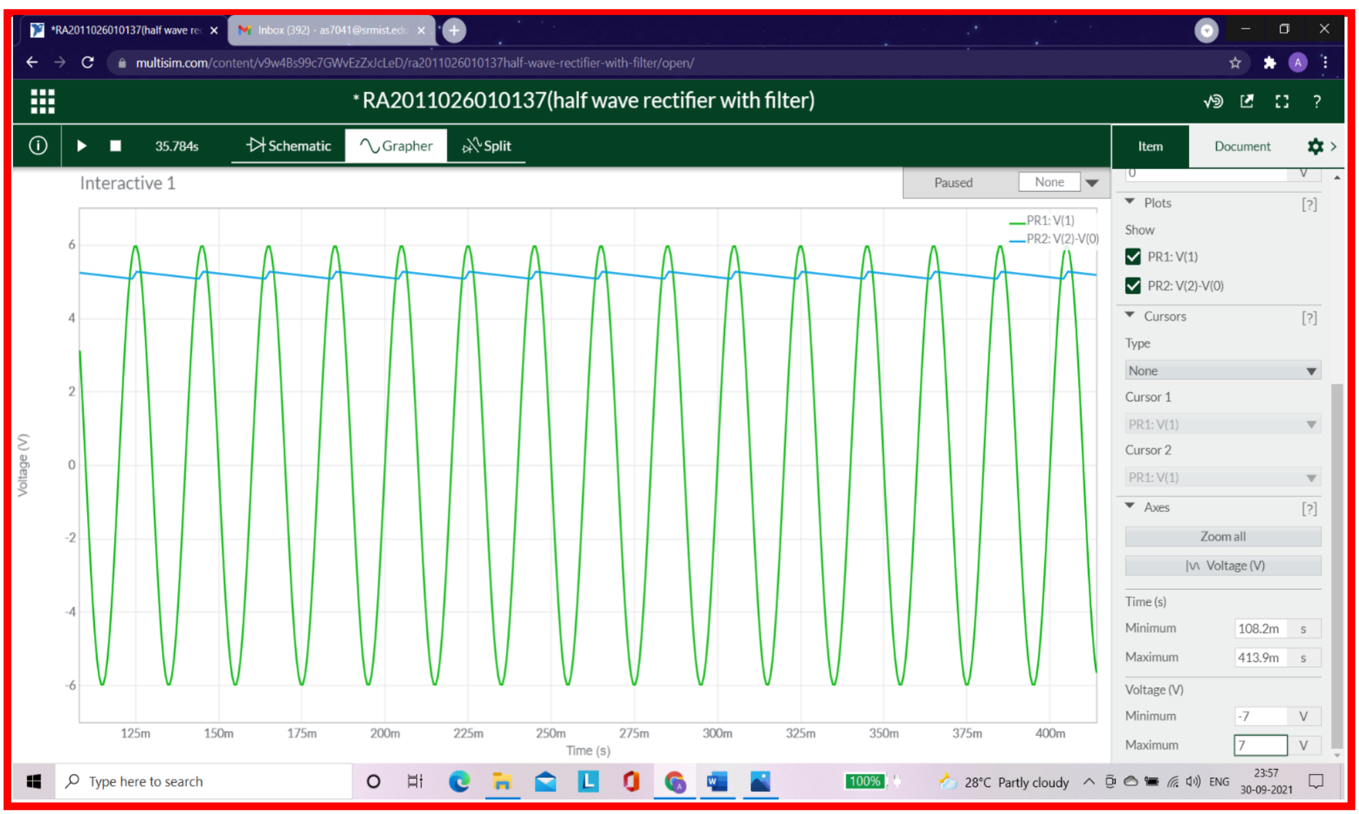
$= \dfrac{0.0550}{5.1836} = 0.0106$

Simulation waveform for without filter:



Simulation waveform for with filter:



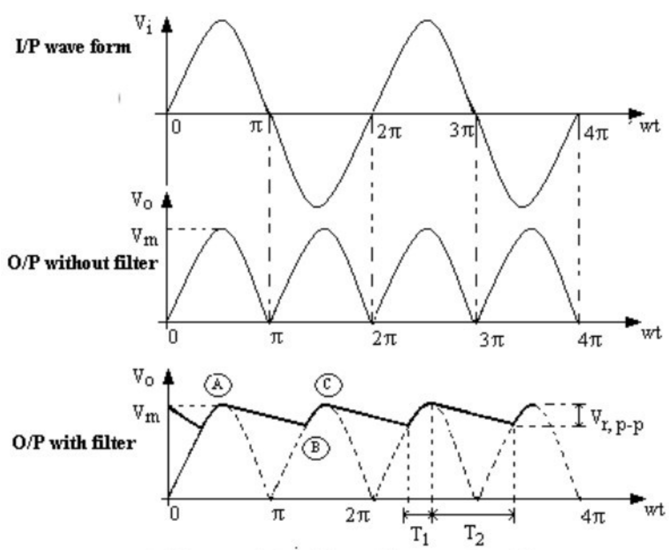


Full wave rectifier

Theory

Another type of circuit that produces the same output as a full-wave rectifier is that of the Bridge Rectifier. This type of single-phase rectifier uses 4 individualrectifying diodes connected in a "bridged" configuration to produce the desiredoutput but does not require a special center tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side. The 4 diodes labeled D arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in se D3 and D4 are reverse biased and the current flows through the load as shown below . During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch of as they are now reverse biased. The current flowing through the load is the same direction as before.

Model Graph:



FORMULA:

Full wave rectifier without filter:

I. $V_{rms} = \frac{V_m}{\sqrt{2}}$; V_m = Peak voltage magnitude

II. $V_{dc} = \frac{2V_m}{\pi}$

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

IV. % Efficiency = ___ ×100%

Full wave rectifier with filter:

I. $V_{rms}=\frac{V_{rpp}}{(\sqrt{3}\times 2)}$ V_{rpp} = Peak to peak voltage magnitude

II. $V_{dc}=\square - V_{rpp}$

III. Ripple factor = $\frac{V_{rms}}{V_{dc}}$

Procedure:

Without Filter

I. Give the connections as per the circuit diagram.

II. Give 6 V, 50Hz Input to the circuit.

III. Measure the rectifier output across the Load and input voltage.

IV. Plot its performance graph.

With Filter

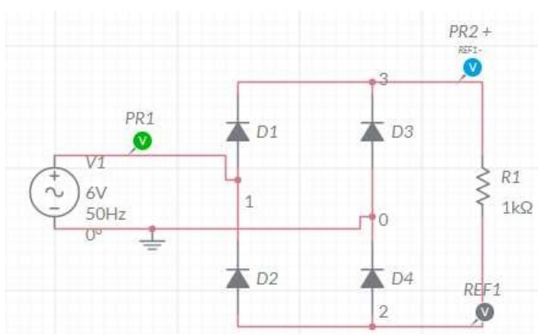
I. Give the connections as per the circuit diagram.

II. Give 6 V, 50Hz Input to the circuit.

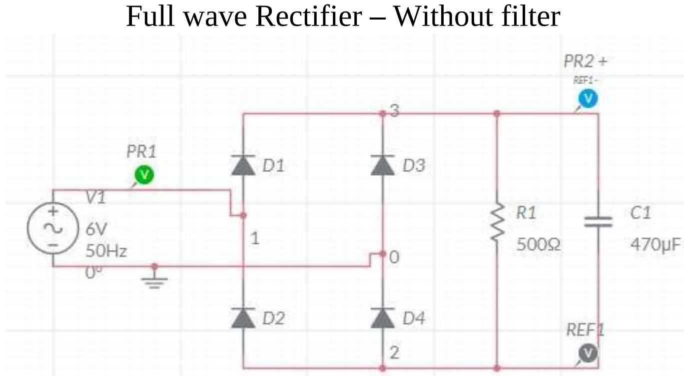
III. Connect the Capacitor across the load.

IV. Measure the rectifier output across the different Load and input voltage. V. Plot its performance graph.

Circuit Diagram:



Full wave Rectifier – Without filter



Full wave Rectifier – With filter

Tabulation Without Filter

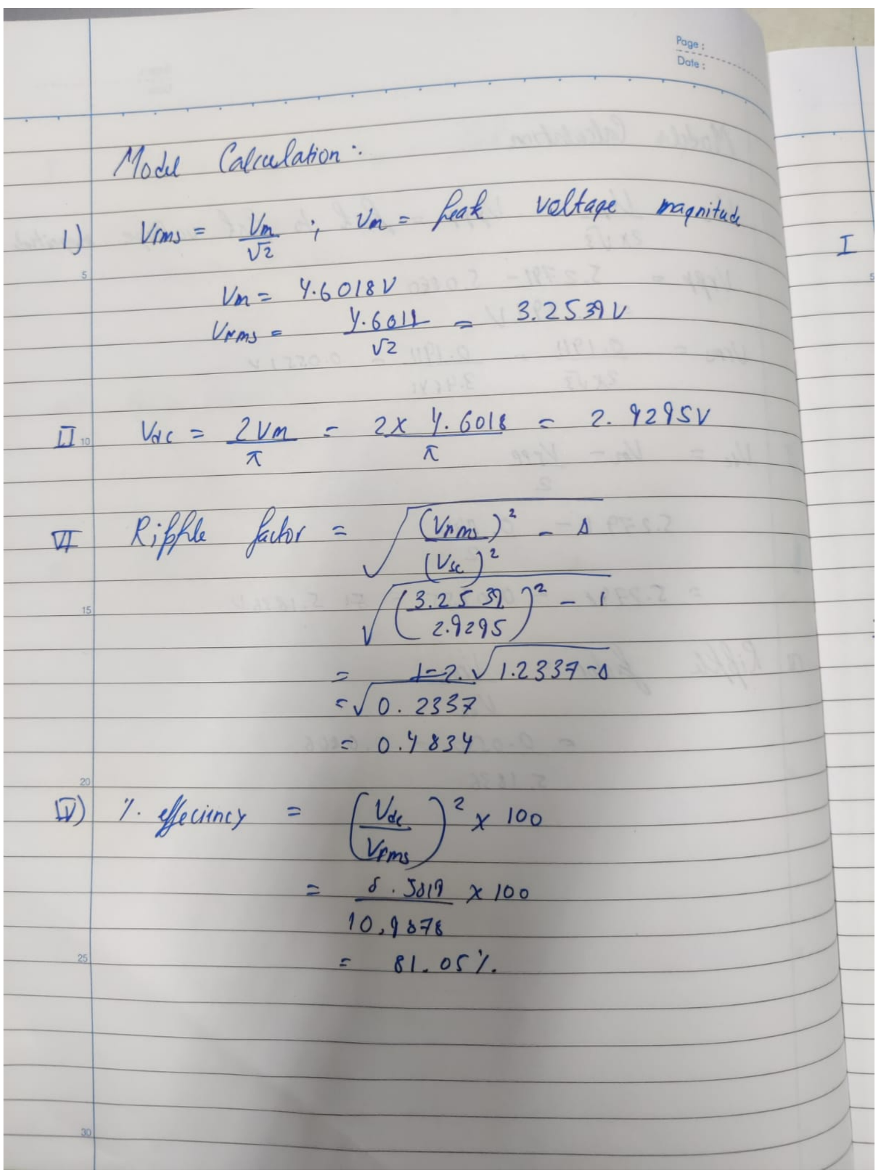
V_m(V)	V_{rms}(V)	V_{dc}(V)	Ripple Factor	Efficiency (%)
4.6018	3.2539	2.9295	0.4834	81.05%

With filter

Load Resistance	V_{rpp}(V)	V_{rms}(V)	V_{dc}(V)	Ripple factor
1000Ω	0.0701	0.0202	4.4773	0.0045

Model Calculation:

Without Filter



Model Calculation:

1) $V_{rms} = \frac{V_m}{\sqrt{2}}$; V_m = Peak voltage magnitude

$V_m = 4.6018V$

$V_{rms} = \frac{4.6018}{\sqrt{2}} = 3.2539V$

II $V_{dc} = \frac{2V_m}{\pi} = \frac{2\times 4.6018}{\pi} = 2.9295V$

III Ripple factor $= \sqrt{\frac{(V_{rms})^2}{(V_{dc})^2} - 1}$

$= \sqrt{\left(\frac{3.2539}{2.9295}\right)^2 - 1}$

$= \sqrt{1.2337 - 1}$

$= \sqrt{0.2337}$

$= 0.4834$

IV) % efficiency $= \left(\frac{V_{dc}}{V_{rms}}\right)^2 \times 100$

$= \frac{8.5819}{10.5878} \times 100$

$= 81.05\%$

With Filter

Model calculation

I $\quad V_{rms} = \dfrac{V_{rpp}}{(\sqrt{3} \times 2)}$ – V_{rpp} = peak to peak voltage magnitude

$$V_{rpp} = 4.5123 - 4.4422$$
$$= 0.0701\ V$$

$$V_{rms} = \frac{0.0701}{\sqrt{3} \times 2} = 0.0202\ V$$

II $\quad V_{dc} = V_m - \dfrac{V_{rpp}}{2}$

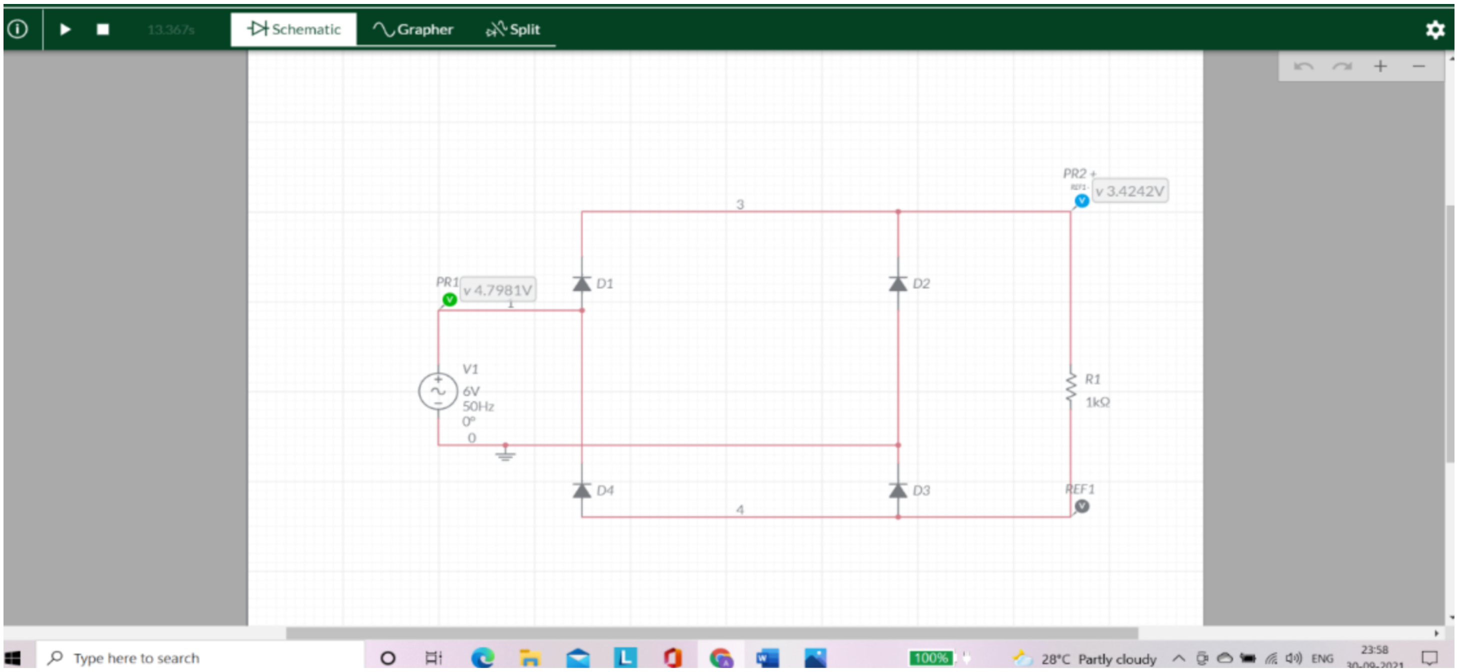
$$4.5123 - \frac{0.0701}{2} = 4.4773\ V$$

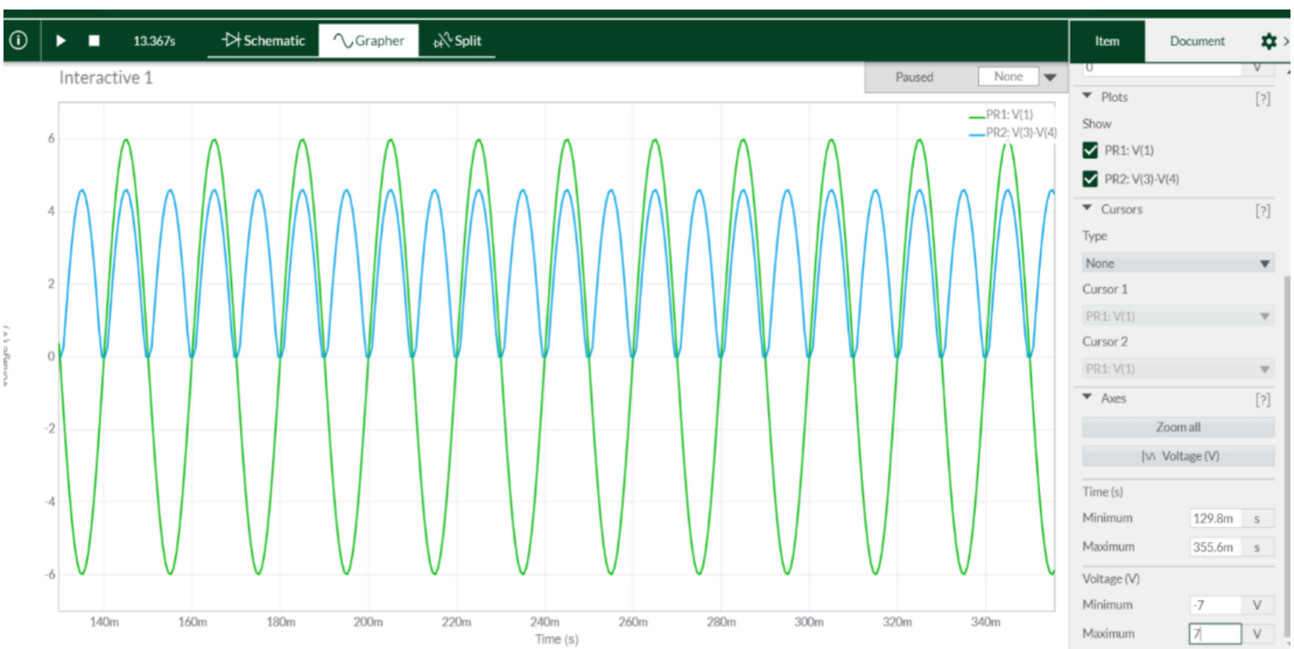
III Ripple factor : $\dfrac{V_{rms}}{V_{dc}}$

$$= \frac{0.0202}{4.4773}$$

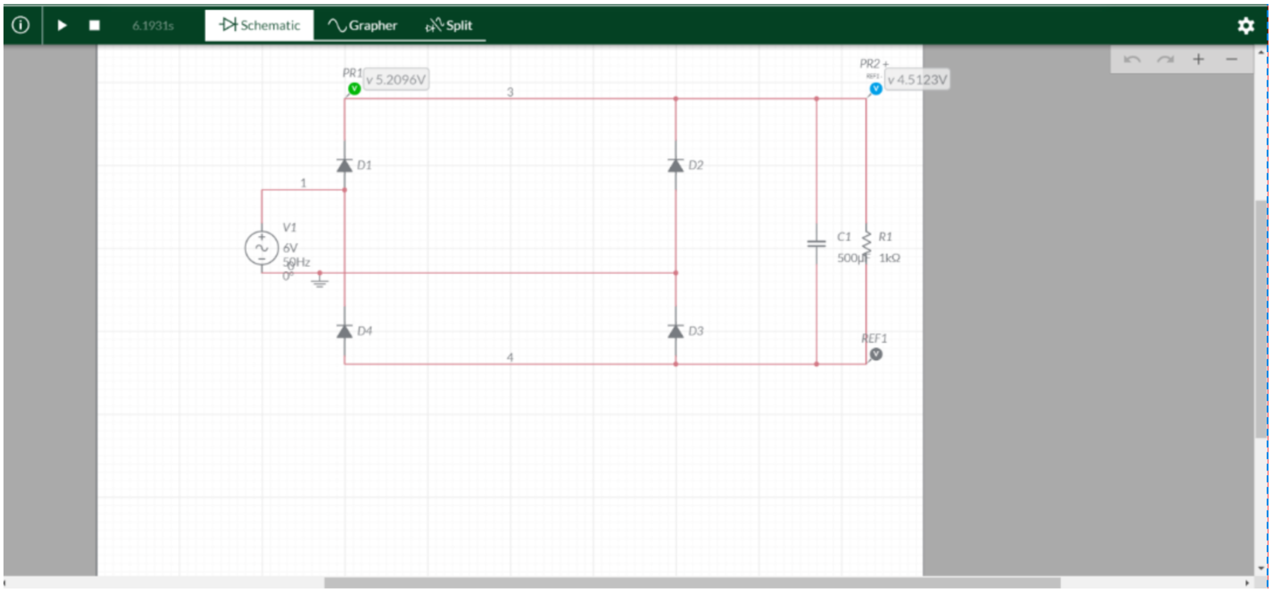
$$= 0.0045$$

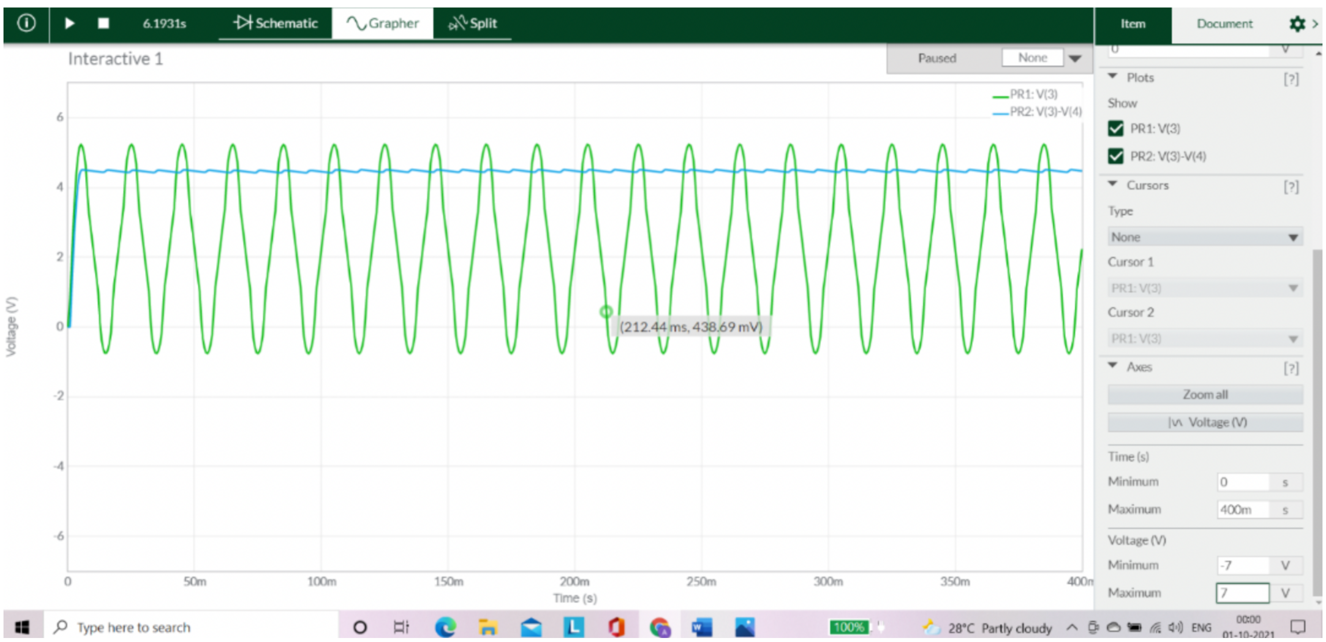
Simulation waveform for without filter:





Simulation waveform for with filter:





Result:

Thus, the performance characteristics of single phase. Half wave and Full wave rectifier were obtained.