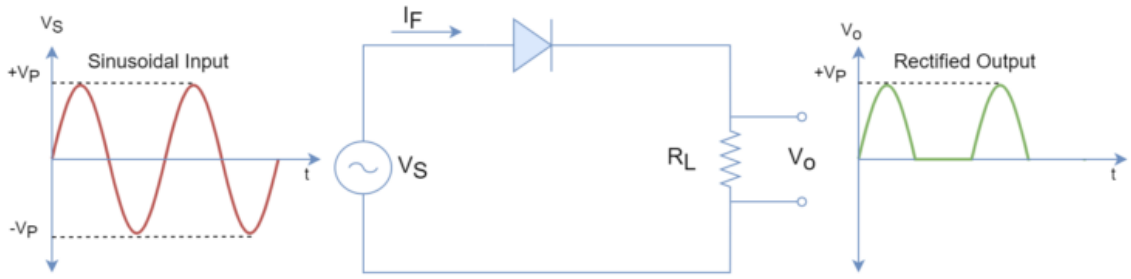
Experiment No: 01
Experiment Date:26.09.2022
Experiment Name: Study of Half Wave and Full Wave Rectifier.
Theory:
We know that a rectifier is an electronic device that converts an alternating current into a direct current by using one or more P-N junction diodes.There are two types of rectifier i)Half wave rectifier and ii)Full wave rectifier.And full wave rectifier can be further divided into other types.

Now, we know that half-wave rectifiers transform AC voltage to DC voltage. A half wave rectifier circuit uses only one diode for the transformation. A half wave rectifier is defined as a type of rectifier that allows only one-half cycle of an AC voltage waveform to pass while blocking the other half cycle.We can do this work by normal diode but in case of normal diode the voltage been rectify is too small.that's why we are using the power diode.The power semiconductor diode, known simply as the Power Diode, has a much larger PN junction area compared to its smaller signal diode cousin, resulting in a high forward current capability of up to several hundred amps (KA) and a reverse blocking voltage of up to several thousand volts (KV).
Now,we know that during the positive half cycle, the diode is forward biased and it conducts and hence a current flows through the load resistor. During the negative half cycle, the diode is reverse biased and it is equivalent to an open circuit, hence the current through the load resistance is zero. Thus the diode conducts only for one half cycle and results in half wave rectification. The input and output voltage waveform may be analytically written as:

$$V_{in} = Vm\ Sin(wt),\ 0<t<2\pi$$

And,

$$V_{out} = Vm\ Sin(wt),\ 0<t<\pi$$
$$V_{out} = 0 \quad ,\ \pi<t<2\pi$$



In case of half wave rectifier we know that

$$V_{av} = V_{dc} = V_m/\pi$$
$$V_{rms} = V_m/2$$

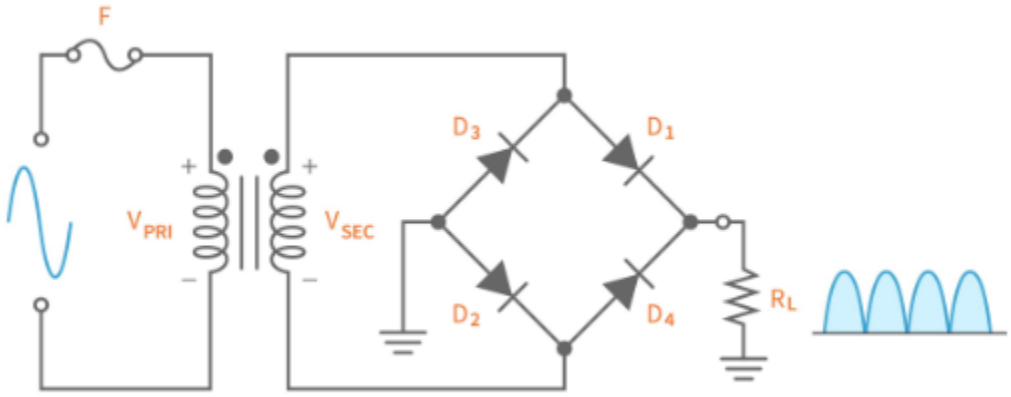
Now,we know that in case of full wave rectifiers there are different types.Here we have done this experiment with full wave R and RL bridge rectifiers.full wave rectifier is defined as a rectifier that converts the complete cycle of alternating current into pulsating DC. Unlike half-wave rectifiers that utilize only the half-wave of the input AC cycle, full wave rectifiers utilize the full cycle.The main advantage of this bridge circuit is that it does not require a special center tapped transformer, thereby reducing its size and cost.On the positive half cycle, (A- Positive & B- Negative) diode D2 & D3 are in forward biased. D1 & D4 are reverse biased, thus the conduction path forms through diode D2, load resistance, and diode D3. Similarly, on the negative half cycle (A- Negative & B- Positive) diode D4 & D1 is forward biased. Diode D3 & D2 are reverse biased. Current flows through D4, load resistance and D1.

So we can say that during the positive and negative half cycle, the diode is forward biased and it conducts and hence a current flows through the load resistor. Thus the diode conducts for full cycle and results in full wave rectification. The input and output voltage waveform may be analytically written as:

$$V_{in} = Vm\ Sin(wt),\ 0<t<2\pi$$

And,

$$V_{out} = Vm\ Sin(wt),\ 0<t<\pi$$
$$V_{out} = Vm\ Sin(wt),\ \pi<t<2\pi$$



In case of full wave rectifier we know that

$$V_{av} = V_{dc} = 2V_m/\pi$$
$$V_{rms} = V_m/\sqrt{2}$$

Required Apparatus:

1. Oscilloscope (Tektronix TBS1102B)
2. AC Supply
3. Oscilloscope Probe
4. Power diode
5. Resistor (10K Ohm)

Circuit Diagram:

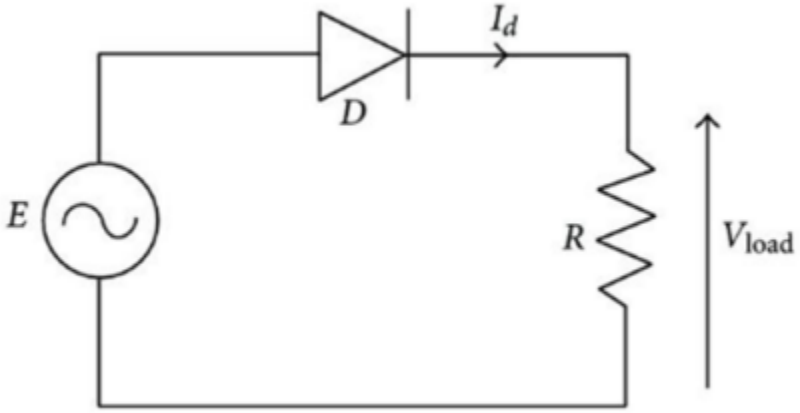


Figure: Half Wave Rectifier

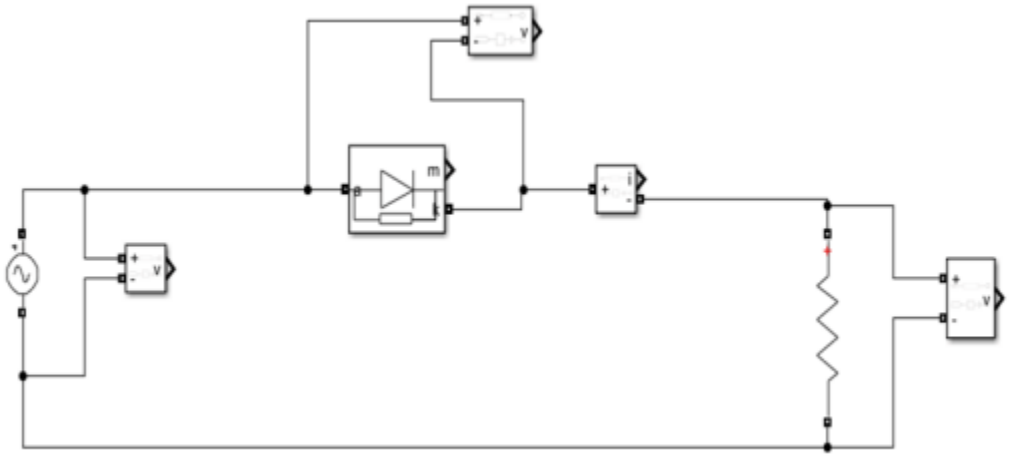


Figure: Simulation Circuit of Half Wave Rectifier

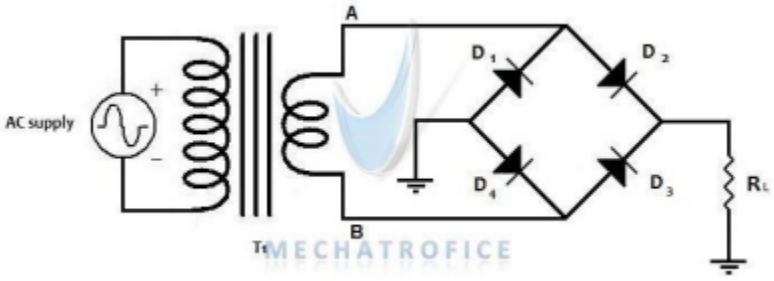


Figure: Full Wave Bridge Rectifier

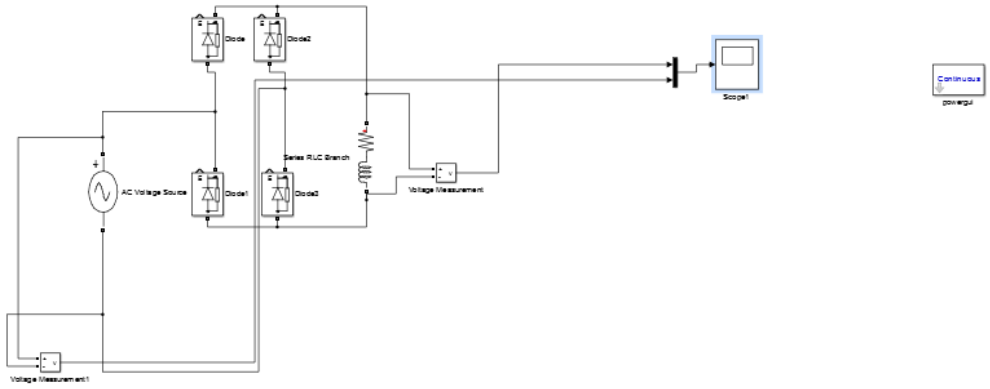


Figure: Simulation Circuit of Full Wave Rectifier With RL load

Output:

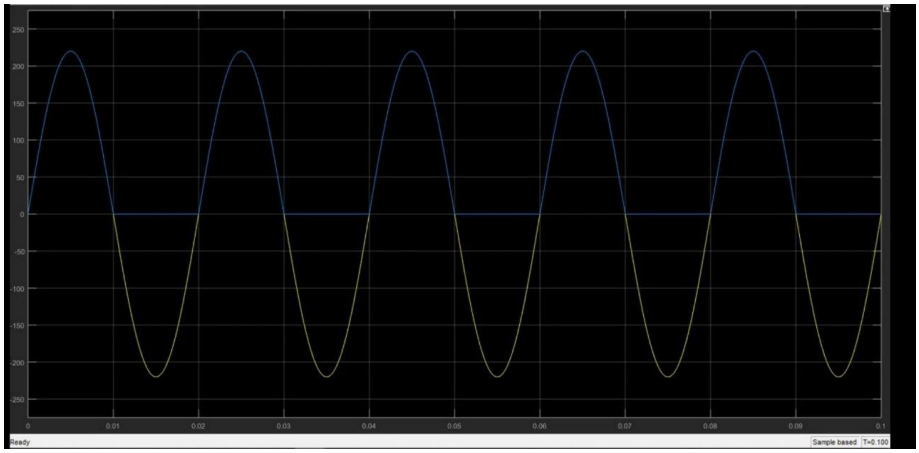


Figure: Half Wave Rectifier in Simulink

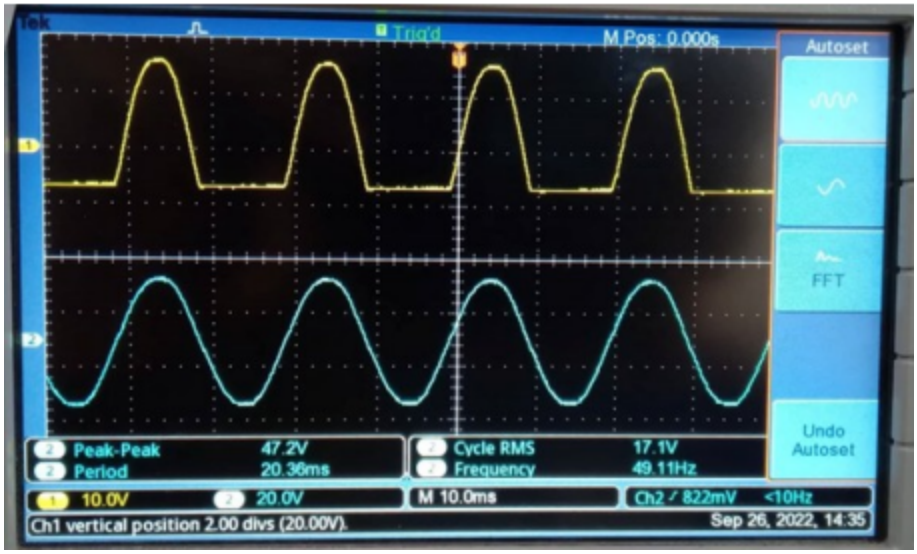


Figure: Half Wave Rectifier in Oscilloscope

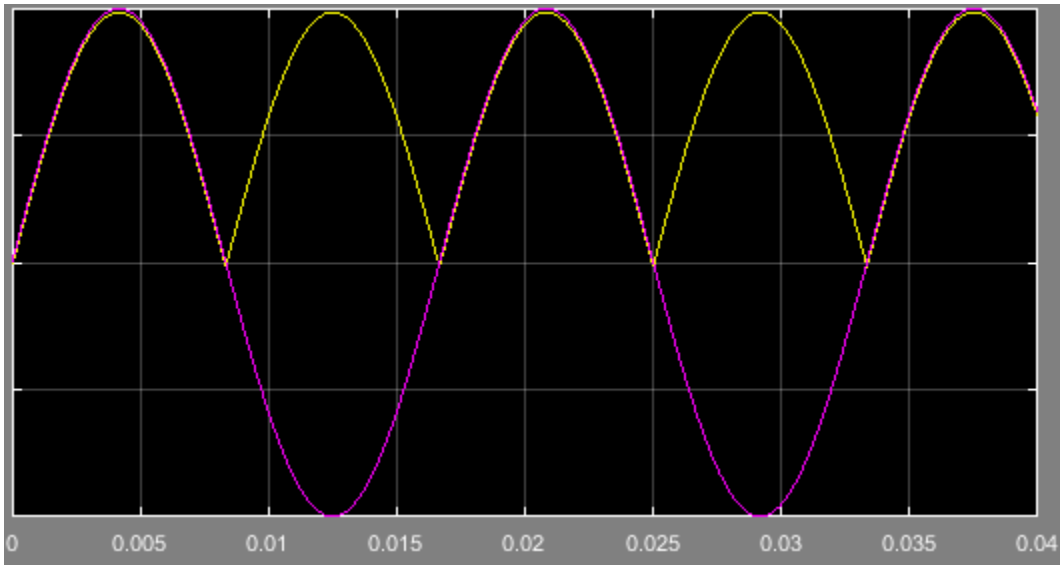


Figure: Full Wave Rectifier in Simulink With RL load

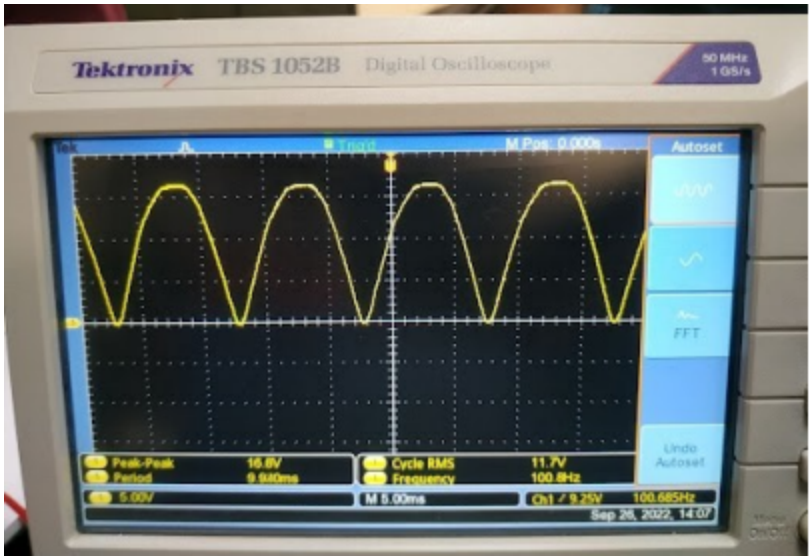


Figure: Full Wave Rectifier in Oscilloscope With RL load

Conclusion and Discussion:

After doing this experiment we can see that we are getting an DC voltage in case of a Half wave rectifier which is not fully DC but pulsating DC.As Half wave rectifiers are used to convert AC into DC voltage. We can successfully convert an AC signal into DC.This is the main success of this experiment though the efficiency is very poor.We can increase it in Full wave rectifiers.

Now,in the case of the full wave rectifier we are getting a DC voltage but it's also a pulsating DC which means it is not fully DC. In a full wave rectifier both positive half cycle and negative half cycle are rectified. This output could be smoothed by using an inductor series to load. Increasing the value of the inductor the output signal will be more like a DC supply.Here we have done both full wave rectifiers with just R load and RL load and we can observe that in case of RL load we are getting a more smooth output.Again four diodes are used to build a full wave bridge rectifier. This is more efficient than a center tap rectifier because a bridge rectifier center tap transformer is not required.