Date : 26-10-‘22

Experiment No : 02

Experiment Name : Study of an uncontrolled three phase (i) half wave and (ii) full wave rectifier.

Theory :

1. Three phase half wave rectifier:

A basic three-phase half-wave uncontrolled rectifier circuit with resistive load is shown in Figure 2.1. The rectifier is fed from an ideal 3-phase supply through delta-star transformer.

The diode in a particular phase conducts during the period when the voltage on that phase is higher than that on the other two phases. For example: from π/6 to 5π/6, D1 has a more positive voltage at its anode, in this period D2 and D3 are off. The neutral wire provides a return path to the load current.

Unlike the single-phase rectifier circuit, the conduction angle of each diode is 2π/3, instead of π. The voltage and current waveforms on resistive load and the voltage and current waveforms on D1 are shown in Figure 2.2.

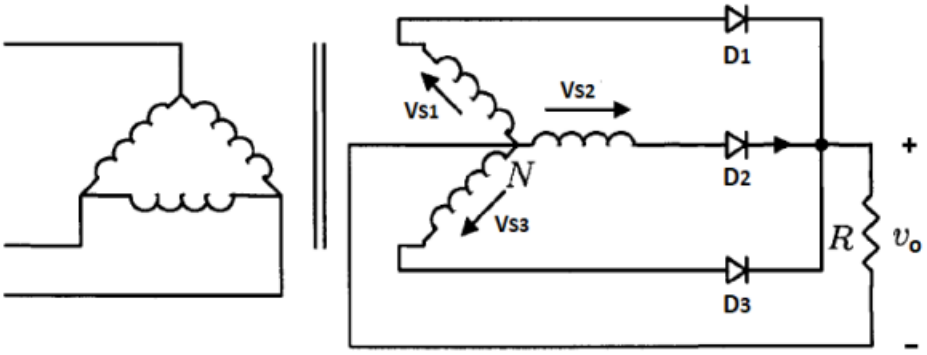

Figure 2.1 : 3 phase uncontrolled half wave rectifier.

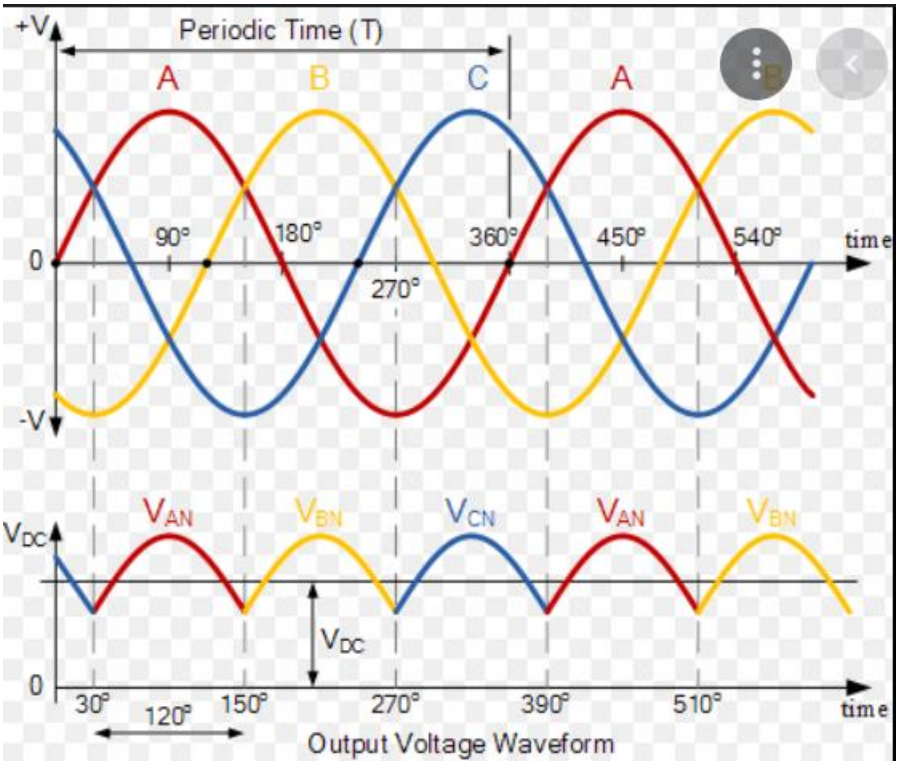

Figure 2.2 : Input -Output wave form of 3 phase uncontrolled half wave rectifier.

2. Three phase full wave rectifier:

A basic three-phase Full-wave uncontrolled rectifier circuit is shown in Figure 2.3. The rectifier is fed from an ideal 3-phase supply through delta-star transformer. The principle of operation of this rectifier can be explained as follows:

• Each three-phase line connects between pair of diodes. One to route power to positive (+) side of load, and other to route power to negative (-) side of load.

• Only one diode in the top half of the bridge may conduct at one time (D1, D3, or D5). The diode that is conducting will have its anode connected to the phase voltage that is highest at that instant.

• Only one diode in the bottom half of the bridge may conduct at one time (D2, D4, or D6). The diode that is conducting will have its cathode connected to the phase voltage that is lowest at that instant.

• There are six combinations of line-to-line voltages (three phases taken two at a time). Considering one period of the source to be 2π, a transition of the highest line-to-line voltage

must take place every 2π/6 = π/3. Because of the six transitions that occur for each period of the source voltage, the circuit is called a six-pulse rectifier.

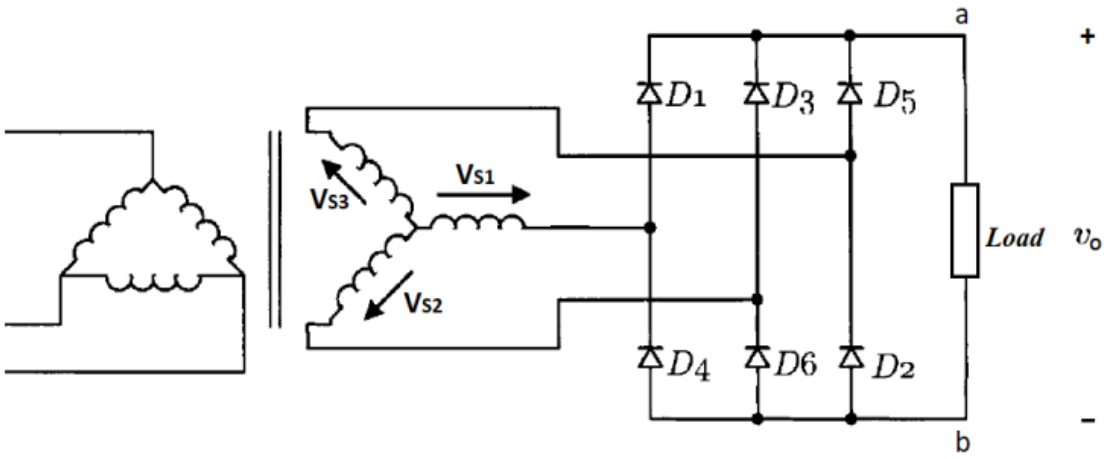

Figure 2.3 : 3 phase full wave uncontrolled rectifier .

Similar to the three-phase rectifier circuit, the conduction angle of each diode is 2π/3. If L is much higher than R (L>>>R), the load time constant L/R is very high and can be considered infinity. Consequently, the load current is assumed constant. The current and voltage waveforms of the three-phase full-wave uncontrolled rectifier loaded with highly inductive load are shown in Figure 2.4.

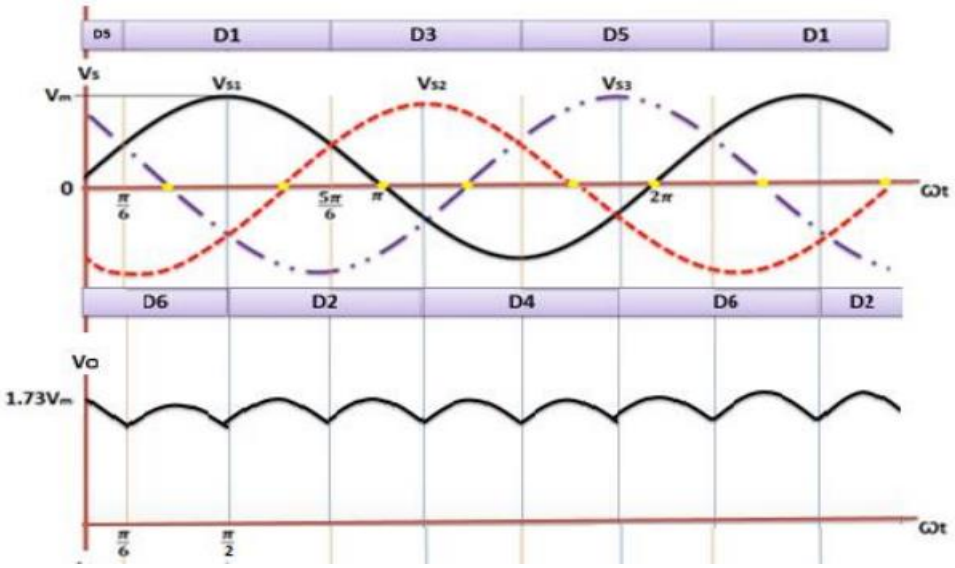

Figure 2.4 : Wave shape of 3 phase full wave uncontrolled rectifier .

Figure :

1.

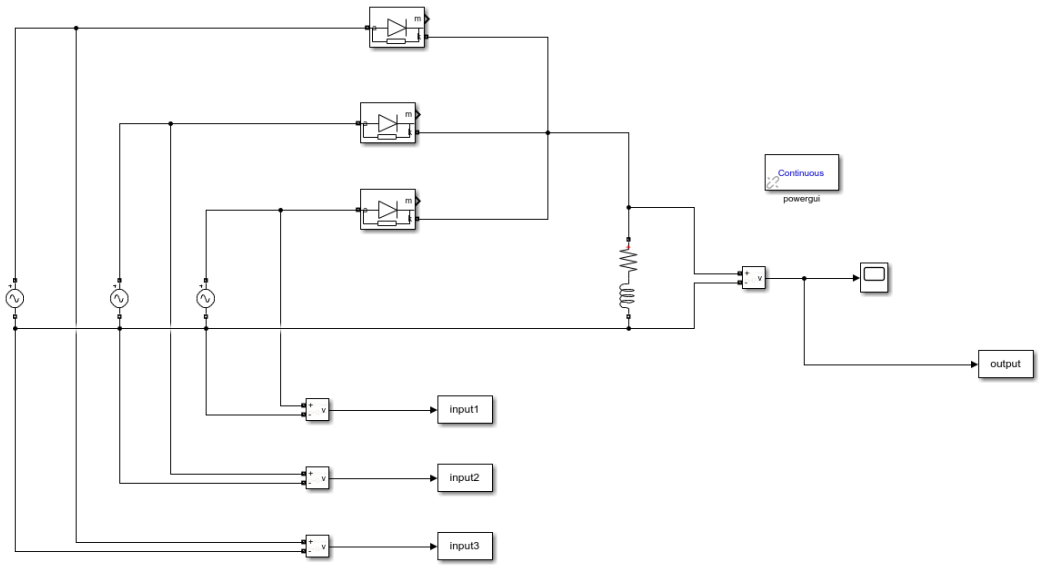

Figure 2.3 : Three phase uncontrolled half wave rectifier .

2.

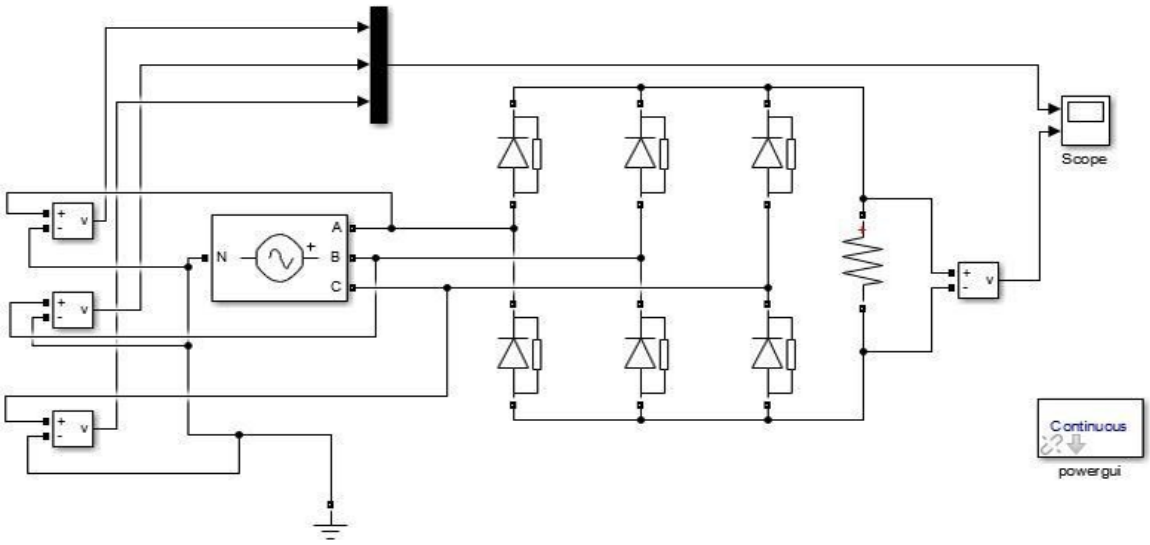

Figure 2.4 : Three phase full wave uncontrolled rectifier.

Output :

1.

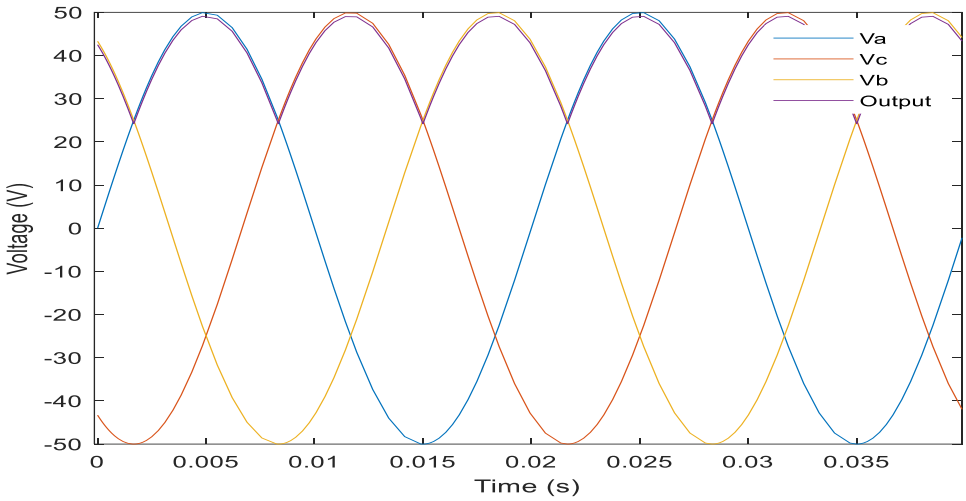

Figure 2.5 : Wave Shape of 3 phase uncontrolled halfwave rectifier .

2.

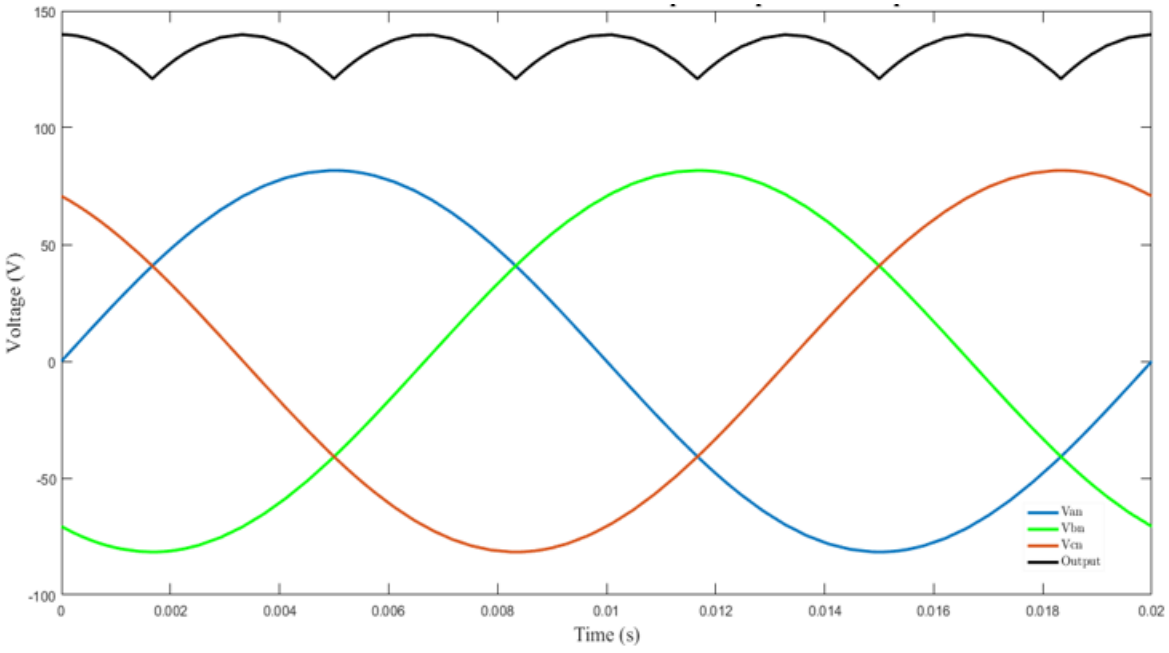

Figure 2.6 : Wave shape of 3 phase uncontrolled full wave rectifier.

Discussion :

From the above experiment we can see that for a half-wave rectifier each diode passes current for one third of each cycle, with the output waveform being three times the input frequency of the AC supply. Therefore there are three voltage peaks in a given cycle, so by increasing the number of phases from a single-phase to a three-phase supply, the rectification of the supply is improved, that is the output DC voltage is smoother.

In 3-phase power rectifiers, conduction always occurs in the most positive diode and the corresponding most negative diode. Thus as the three phases rotate across the rectifier terminals, conduction is passed from diode to diode.

Then each diode conducts for 120^{o} (one-third) in each supply cycle but as it takes two diodes to conduct in pairs, each pair of diodes will conduct for only 60^{o} (one-sixth) of a cycle at any one time as shown above.

Therefore we can correctly say that for a 3-phase rectifier being fed by “3” transformer secondaries, each phase will be separated by $360^{o}/3$ thus requiring 2*3 diodes.

Conclusion :

All the output wave shape was exactly same as we expected and according to the theoretical concept. And we have found that the ripple count is more than the single phase rectifiers. And at the same time , they have more efficiency.

Rajashahi University of Engineering and Technology

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