Experiment: 02

Study of 1-phase and 3-phase diode rectifiers with capacitive filter

Objective:

1. To design the 3KW Rectifier circuit for 1 phase & 3 phase Rectifier.
2. To simulate the single phase & three phase Rectifier circuit with ideal & non-ideal components for load of 1 kw, 1.5 kw, 2 kw, 2.5 kw.
3. To Implement the circuit for single phase & three phase Rectifier.
4. To plot the output voltage wave forms & input current wave forms.
5. To measure the PF & estimate both simulation & experiment.

Specifications:

Input Voltage for single phase: 230 V

Output Voltage for three phases: 440 V

Voltage ripple factor = 5%

Input frequency = 50Hz

Power = 3 kw

Circuit diagram:

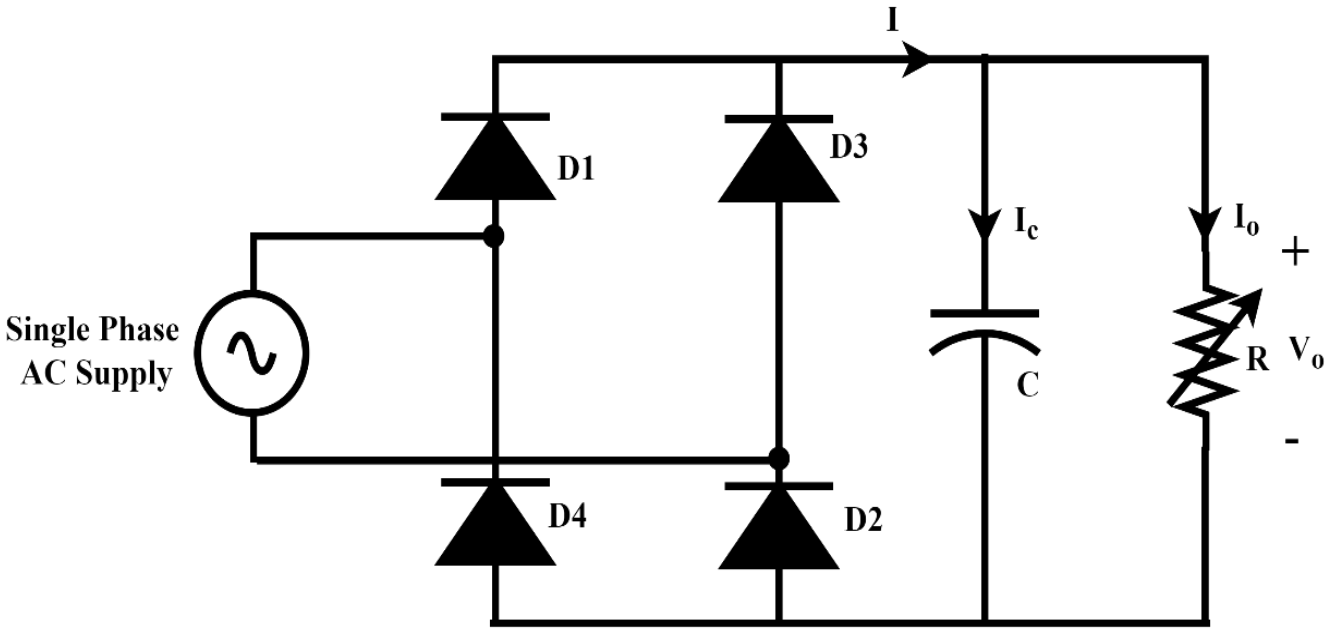

Fig. 1. Single phase Full Wave diode Bridge Rectifier

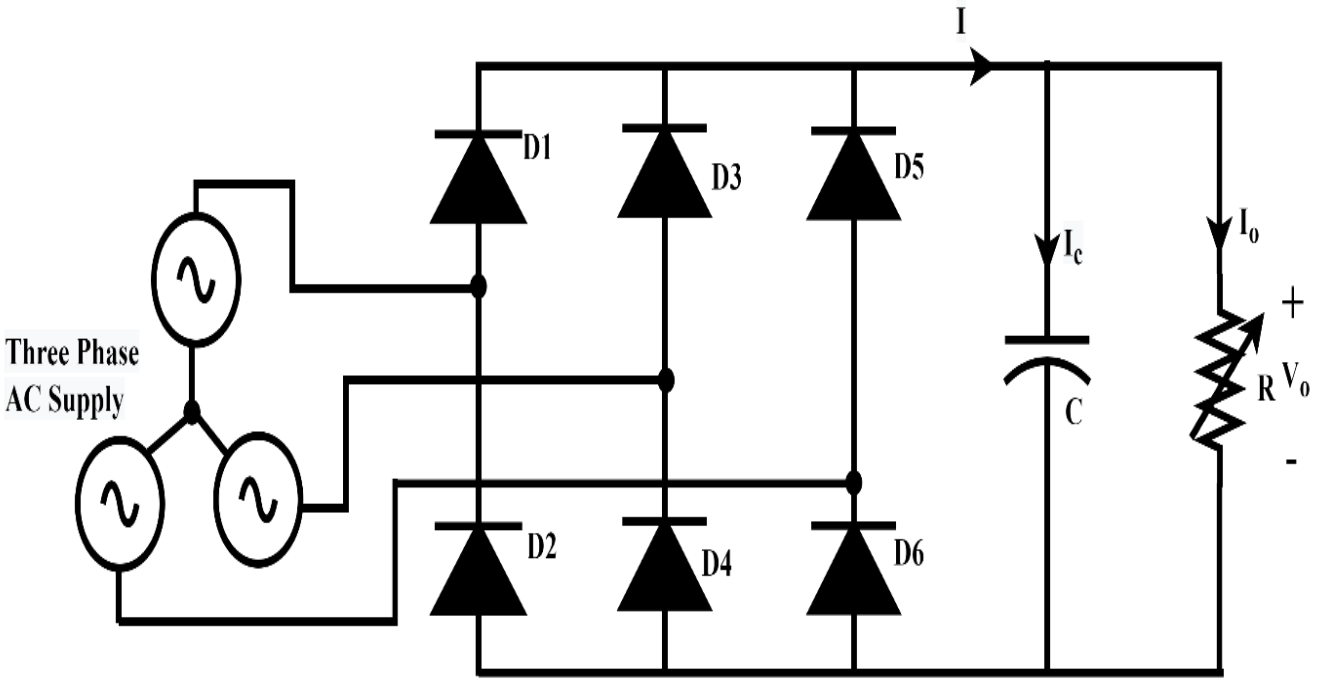

Fig.2. Fig. 2. Three phase Full Wave diode Bridge Rectifier

Theory:

(a) For single phase full bridge diode rectifier

The circuit diagram of diode bridge rectifier circuit is given in Fig. 1. During the positive half cycle of the input voltage, the load current flows from the positive input terminal to the negative through D1, R and D2. During this time, the positive input terminal is applied to the cathode of D3 and D4, so it is reversed biased. These two diodes are forward biased during negative half cycle; D1 and D2 are reverse biased. And finally, both half cycles are rectified and the output is unidirectional voltage. In order to convert unidirectional to ripple free/reduced ripple DC voltage filters are used. The size of the filter depends on load current, line frequency, ripple factor. In other words, the ripple content depends on the load current and capacitor values. Hence, in this experiment ripple contents are measured for different load resistor and filter capacitor values.

(b) For three phase full bridge diode rectifier

The circuit diagram of diode bridge rectifier circuit is given in Fig. 2. Each phase connects between a pair of diodes as shown. One diode of the conducting pair powers the positive (+) side of load, while the other diode powers the negative (-) side of load. Diodes D_1, D_3, D_2 and D_4 form a bridge rectifier network between phases A and B, similarly diodes D_3, D_5, D_4 and D_6 between phases B and C and D_5, D_1, D_6, and D_2 between phases C and A. Diodes D_1, D_3, and D_5 feed the positive rail. The diode which has a more positive voltage at its anode terminal conducts. Likewise, diodes D_2, D_4, and D_6 feed the negative rail and whichever diode has a more negative voltage at its cathode terminal conducts. Then we can see that for three-phase uncontrolled rectification the diodes conduct in matching pairs with each conduction path passing through two diodes in series. Thus, a total of six rectifier diodes are required with commutation of the circuit taking place every 60^o, or six times per cycle.

Procedure:

1. Connect the circuit as shown in the circuit diagram for single-phase and three-phase system.
2. Vary the input voltage up to rated value with the help of variac.
3. Note down the values AC and DC parameters under the variation of load from the DSO and observe the waveforms respectively.
4. Capture the DSO waveforms of input voltage, input current, output voltage, output current and ripple content in output voltage.

Precautions:

1. Perform your experiment wearing your shoes.
2. Get familiar with the different circuit boards before starting with the experiment.
3. Do not touch the live part with your hands, it may be fatal.
4. Before giving power to the circuit be sure that your circuit has been checked by one of the instructors in the lab.

Result: Plot both the simulated waveforms & experimental waveforms.

Submission:

A) Lab Report
B) MATLAB/SIMULINK file.