LAB MANUAL

PE&PLC LAB

SEMESTER-5TH

PREPARED BY

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(LECT. (S-II) IN AE&I)

DEPARTMENT OF

EE/EEE ENGINEERING

GOVT. POLYTECHNIC, BARGARH

Pr.2 POWER ELECTRONICS & PLC LAB

Name of the Course: Diploma in Electrical Engineering			
Course code:	Pr.2	Semester	5th
Total Period:	45	Examination	3hrs
Lab. periods:	3 P / week	Term Work	25
Maximum marks:	75	End Semester Examination:	50

LIST OF EXPERIMENTS

(I) Power Electronics

1. Study of switching characteristics of a power transistor.

2. Study of V-I characteristics of SCR.

3. Study of V-I characteristics of TRIAC.

4. Study of V-I characteristics of DIAC.

5. Study of drive circuit for SCR & TRIAC using DIAC.

6. Study of drive circuit for SCR & TRIAC using UJT.

7. To study phase controlled bridge rectifier using resistive load.

8. To study series Inverter.

9. Study of voltage source Inverter.

10. To perform the speed control of DC motor using Chopper.

11. To study single-phase Cyclo-converter.

(II) PLC Programming

1. Introduction/Familiarization PLC Trainer & its Installation with PC

(a) Learn the basics and hardware components of PLC.

(b) Understand configuration of PLC system.

(c) Study various building blocks of PLC.

(d) Determine the No. of digital I/O & Analog I/O.

2. Execute the different Ladder Diagrams

(a) Demonstrate PLC and Ladder diagram-Preparation downloading and running.

(b) Execute Ladder diagrams for different Logical Gates.

(c) Execute Ladder diagrams using timers & counters.

3. Execute the Ladder Diagrams with model applications.

(i) DOL starter (ii) Star- Delta starter.

4. Execute Ladder diagrams with model applications (i) Stair case lighting(ii)

Traffic light controller.

TABLE OF CONTENTS

1. AIM-Switching Characteristics of Transistor.

2. APPARATUS REQUIRED:

Sl.No.	Apparatus	Specification	Quantity
1	CRO	0-20MHz (Dual Channel)	1No.
2	Function Generator	1Hz– 1 MHz	1No.
3	Resistor	1KΩ-100KΩ	1No. each
4	Transistor	BC l07	1No.
5	D.C Power Supply	0-30V	1No.
6	Connecting wires	-	As required
7	Bread board	-	1No.

Theory:

The Transistor can act as a switch. To operate the transistor as a switch, it has to be operated in saturation region for **ON** state and to be operated in cut off region for **OFF** state.

Power BJT has 3 terminals — collector, base and emitter. It is a current controlled device. It is the base current that controls the device

NPN Transistor   PNP Transistor
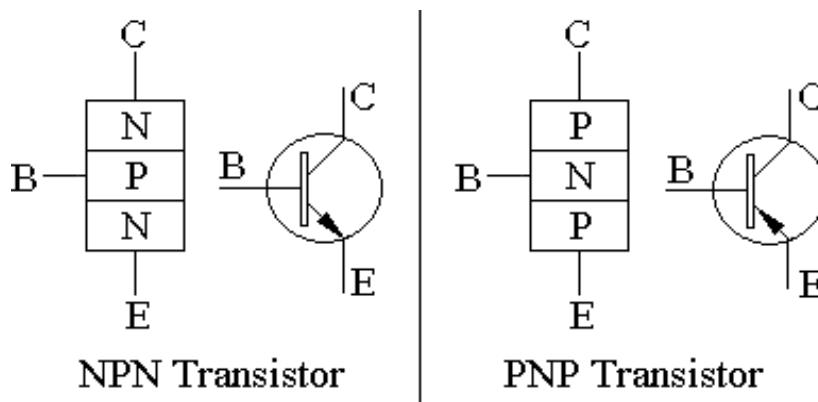
Power Metal Oxide Semiconductor Field Effect Transistor (MOSFET) has 3 terminals — Drain, Source and Gate. It is a voltage controlled device. It is the gate voltage that controls the device.
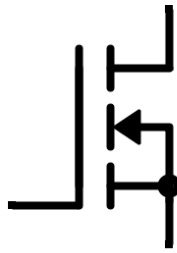
MOSFET: N-Channel Enhancement Type
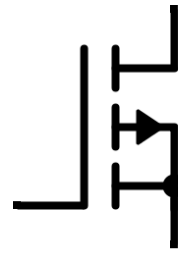
MOSFET: P-Channel Enhancement Type
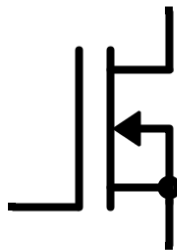
MOSFET: N-Channel Depletion Type

MOSFET: P-Channel Depletion Type

Insulated Gate Bipolar Transistor (IGBT) has 3 terminals — Collector, Emitter and Gate. It is also a voltage controlled device. It is the gate voltage that controls the device.
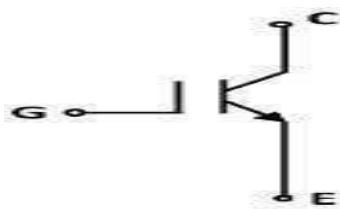
IGBT Symbol

Procedure:

1. Connect the circuit as shown in the above figure.
2. Apply the Square wave of 4 Vp-p at frequency of 1 KHz.
3. Observe the waveforms at Collector and Base of the transistor and plot it.

CONCLUSION:

Hence, we verified the above experiment.

1. AIM: Study of V-I characteristics of SCR

2. APPARATUS REQUIRED:

SI.No	Apparatus	Specification	Quantity
1	SCR Kit		1
2	Voltmeter	0- 50V DC	1
3	Ammeter	0-500 mA DC	1
4	Ammeter	0-25mA DC	1
5	Resister	100omh	1
6	Patch cards	-	As per required

3. THEORY:
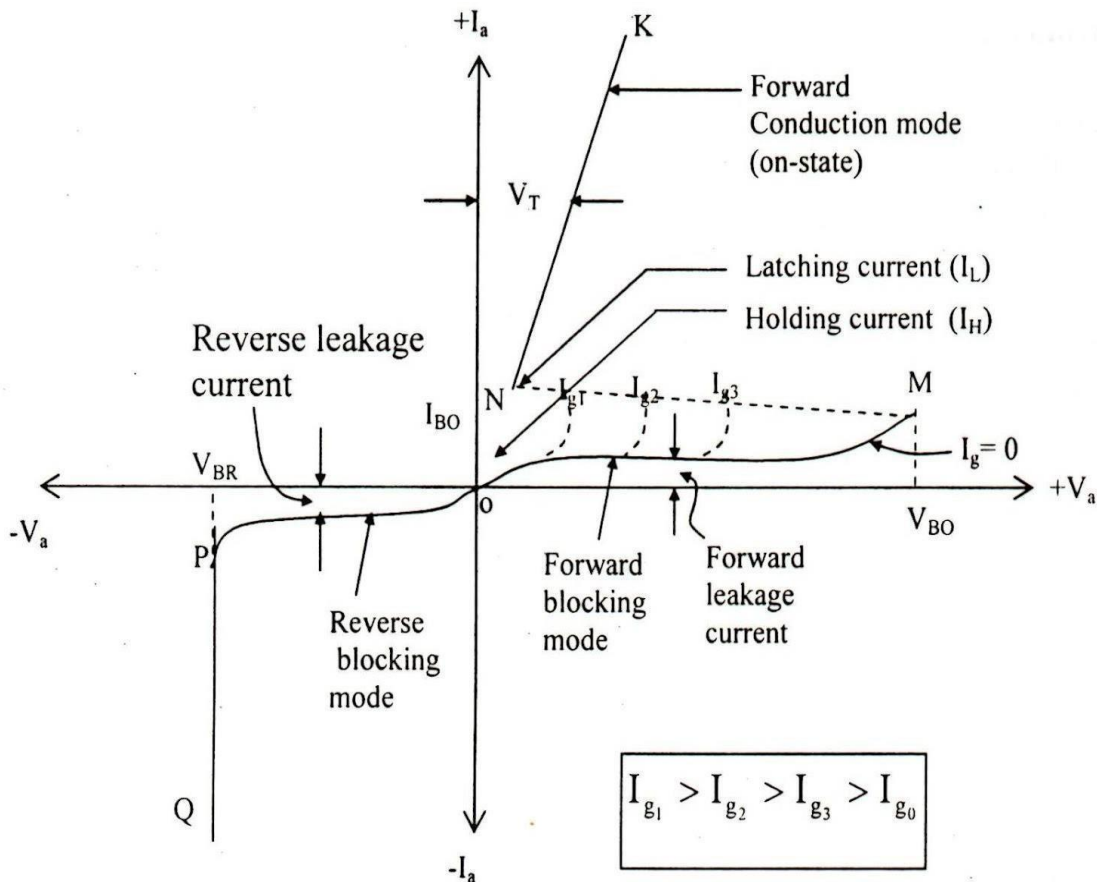
An elementary circuit diagram for obtaining static V-I characteristics of a thyristor is shown in Fig. (a). The anode and cathode are connected to main source through the load. The gate and cathode are fed from a source Es which provides positive gate current from gate to cathode.

Fig. (b) Shows static V-I characteristics of a thyristor. Here Va is the anode voltage across thyristor terminals A, K and Ia is the anode current. Typical SCR V-I characteristicshown in Fig. (b) reveals that a thyristor has three basic modes of operation; namely, reverse blocking mode, forward blocking (off-state) mode and forward conduction (on-state) mode. These three modes of operation are now discussed below:

Reverse Blocking Mode: When cathode is made positive with respect to anode with switch S open, Fig. (a), thyristor is reverse biased. Junctions J1 J3 are seen to be reverse biased whereas junction J2 is forward biased. The device behaves as if two diodes are connected in series with reverse voltage applied across them. A small leakage current of the order of a few mill amperes (or a few microamperes depending upon the SCR rating) flows. This is reverse blocking mode, called the off-state, of the thyristor. If the reverse voltage is increased, then at a critical breakdown level, called reverse break-down voltage VBR, an avalanche occurs at J1 and J3 and the reverse current increases rap-idly. A large current associated with VBR gives rise to more losses in the SCR. This may lead to thyristor damage as the junction temperature may exceed its permissible temperature rise. It should, therefore, be ensured that maximum working reverse voltage across a thyristor does not exceed VBR. When reverse voltage applied across a thyristor is less than VBR, the device offers high impedance in the reverse direction. The SCR in the reverse blocking mode may therefore be treated as an open switch.

Note that V-I characteristic after avalanche breakdown during reverse blocking mode is applicable only when load resistance is zero, Fig.(b). In case load resistance is present, a large anode current associated with avalanche breakdown at VBR would cause substantial voltage drop across load and as a result, V-I characteristic in third quadrant would bend to the right of vertical line drawn at VBR.

Forward Blocking Mode: When anode is positive with respect to the cathode, with gate circuit open, thyristor is said to be forward biased. It is seen from this figure that junctions J1, J3 are forward biased but junction J2 is reverse biased. In this mode, a small current, called forward leakage current, flows. In case the forward voltage is increased, then the reverse biased junction J2 will have an avalanche breakdown at a voltage called forward break over voltage VB0. When forward voltage is less than VBO, SCR offers high impedance. Therefore, a thyristor can be treated as an open switch even in the forward blocking mode.

4. CIRCUIT DIAGRAM:
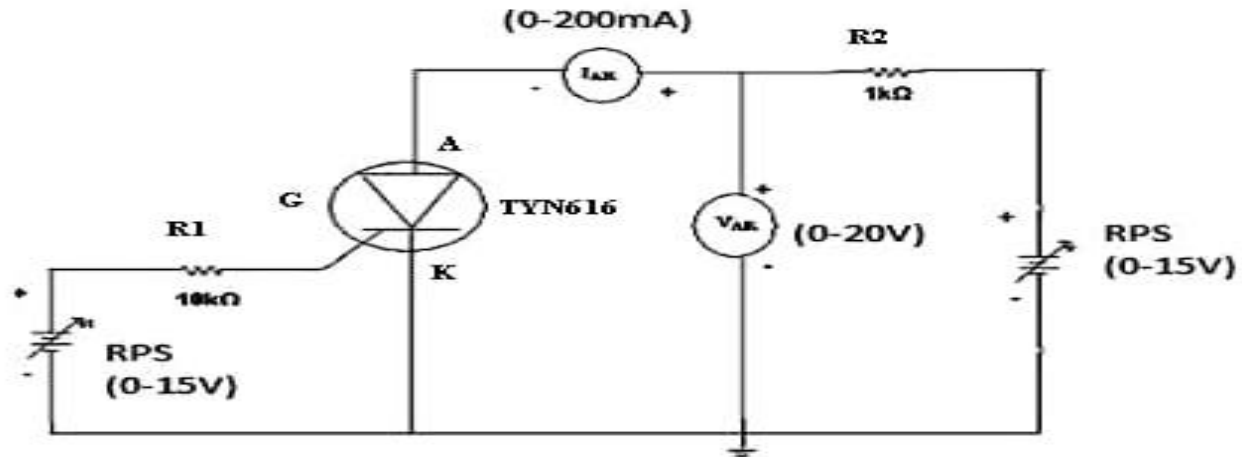
5. PROCEDURE:

- ➢ Connections are made as shown in the circuit diagram.
- ➢ The value of gate current IG, is set to convenient value by adjusting VGG.
- ➢ By varying the anode cathode voltage VAA gradually in step by step, note down the cor-responding values of VAK and IA. Note down VAK and IA at the instant of firing of SCRand after firing (by reducing the voltmeter ranges and ammeter ranges) then increase the supply voltage VAA. Note down corresponding values of VAK and IA.
- ➢ The point at which SCR fires, gives the value of break over voltage VBO.
- ➢ A graph of VAK V/S IA is to be plotted.
- ➢ The on state resistance can be calculated from the graph by using a formula.
- ➢ The gate supply voltage VGG is to be switched off.
- ➢ Observe the ammeter reading by reducing the anode cathode supply voltage VAA .The point at which ammeter reading suddenly goes to zero gives the value of holding current IH
- ➢ Steps no.2, 3, 4, 5, 6, 7, 8 are repeated for another value of gate current IG.

6. OBSERVATION:

For forward bias

SI.No	Voltage (V)	Current (mA)

For reverse bias

SI.No	Voltage (V)	Current (µA)

7. CONCLUSION:

The V-I characteristics of silicon controlled rectifier is plotted on the graph which is true according to theory.

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1. AIM: Study of V-I characteristics of TRIAC

2. APPARATUS REQUIRED:

SI.No	Apparatus	Specification	Quantity
1	TRIAC KIT		1
2	Voltmeter	0- 50V DC	1
3	Ammeter	0-50 mA DC	1
4	Ammeter	0-25mA DC	1
5	Resister	100omh	2
6	Patch cards	-	As per required

3. THEORY:
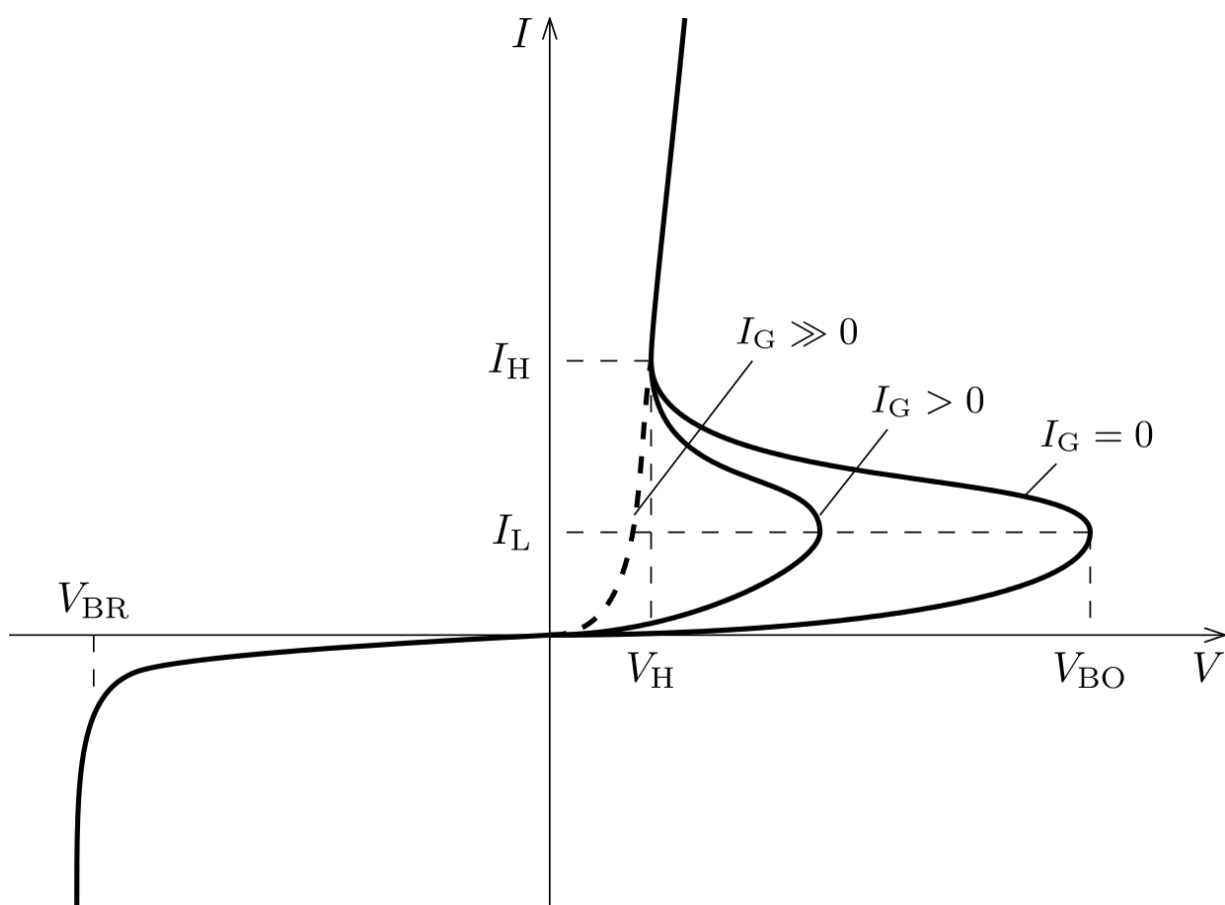
V-I characteristics of TRIAC

Typical V-I characteristics of a triacare shown in figure. The triac has on and off state characteristics similar to SCR but now the characteristic is applicable to both positive and negative voltages. This is expected because triac consists of two SCRs connected in parallel but opposite in directions.

MT2 is positive with respect to MTX in the first quadrant and it is negative in the third quad rant. As already said in previous blog posts, the gate triggering may occur in any of the following four modes.

Quadrant I operation: VMT2, positive; VG1 positive
Quadrant II operation: VMT21 positive; VGl negative
Quadrant III operation: VMT21 negative; VGl negative
Quadrant IV operation: VMT21 negative; VG1 positive

Where VMT21 and VGl are the voltages of terminal MT2 and gate with respect to terminal MT1.

The device, when starts conduction permits a very heavy amount of current to flow through it. This large inrush of current must be restricted by employing external resistance; otherwise the device may get damaged.

The gate is the control terminal of the device. By applying proper signal to the gate, the firing angle of the device can be controlled. The circuits used in the gate for triggering the device are called the gate-triggering circuits. The gate-triggering circuits for the triac are almost same like those used for SCRs. These triggering circuits usually generate trigger pulses for firing the device. The trigger pulse should be of sufficient magnitude and duration so that firing of the device is assured. Usually, duration of 35 us is sufficient for sustaining the firing of the device.

A typical triac has the following voltage/current values:

➢ Instantaneous on-state voltage – 1.5 Volts

➢ On-state current – 25 Amperes

➢ Holding current, IH - 75 Milli Amperes

➢ Average triggering current, IG – 5 Milli Amperes

4. CIRCUIT DIAGRAM:
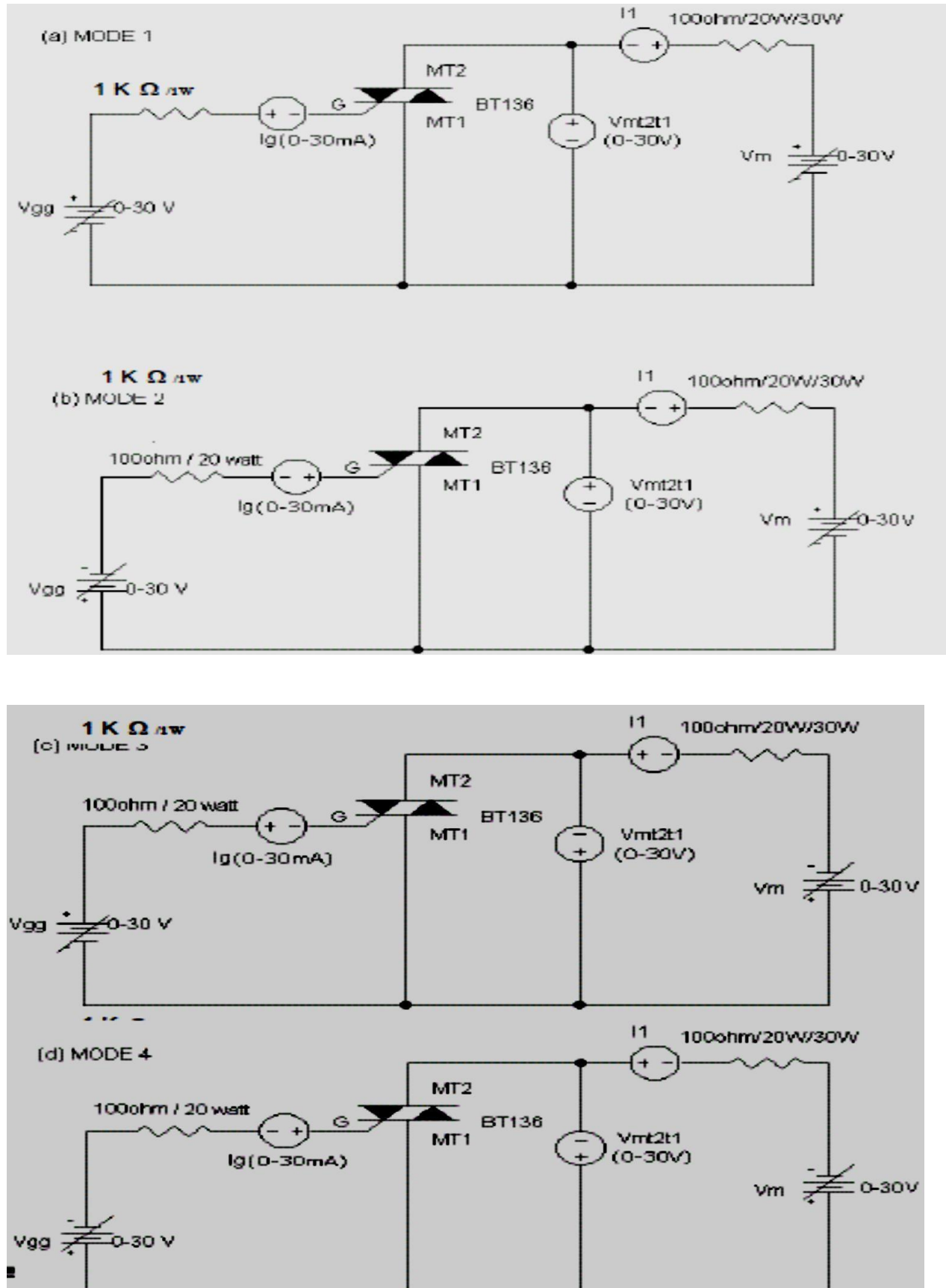
5. PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Adjust the value of I_g to zero or some minimum value.
3. By varying the voltage (V_{mt1mt2}) from 0- 10v, note down the corresponding values of current (I_1).
4. Now apply the gate voltage gradually, until SCR fires, then note down the values of I_g and also the values of Vmt1mt2 $_{and}$ I1.
5. Increase V_m to some value and note down $V_{mt1mt2\ and}$ I1.
6. Reduce the gate voltage to zero; observe ammeter reading by reducing V_m which gives the values of I_H (Holding current) at the point at which, current suddenly drops to zero.
7. Repeat the above process 2,3,4,5,6 for different values of break over voltages.

8. Plot the graph of V_{mt1mt2} Vs I_1

6. OBSERVATION:

For forward bias

SI.No	Voltage (V)	Current (mA)

For reverse bias

SI.No	Voltage (V)	Current (µA)

7. CONCLUSION:

The V-I characteristics of TRIAC is plotted on the graph which is true according to theory.

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1. AIM: Study of V-I characteristics of DIAC

2. APPARATUS REQUIRED:

SI.No	Apparatus	Specification	Quantity
1	DIAC KIT		1
2	Voltmeter	0- 50V DC	1
3	Ammeter	0-50 mA DC	1
4	Ammeter	0-25mA DC	1
5	Resister	100omh	2
6	Patch cards	-	As per required

3. THEORY:

A diac is an important member of the thyristor family and is usually employed for trigger-ing triacs. A diac is a two-electrode bidirectional avalanche diode which can be switched from off-state to the on-state for either polarity of the applied voltage. This is just like a triacwithout gate terminal, as shown in figure. Its equivalent circuit is a pair of inverted four layer diodes. Two schematic symbols are shown in figure. Again the terminal designations are arbitrary since the diac, like triac, is also a bilateral device. The switching from off-state to on-state is achieved by simply exceeding the avalanche break down voltage in either direction.
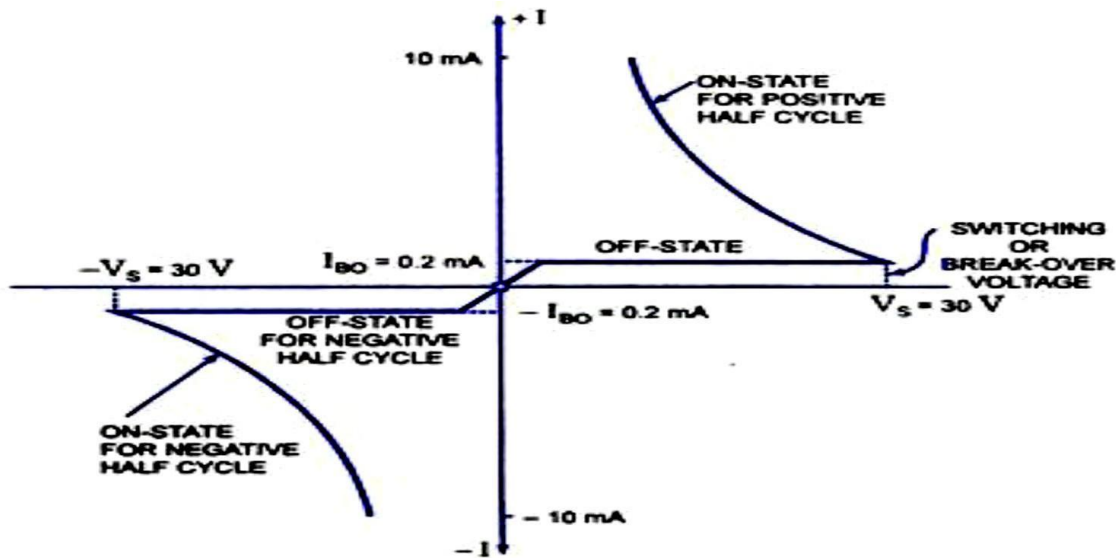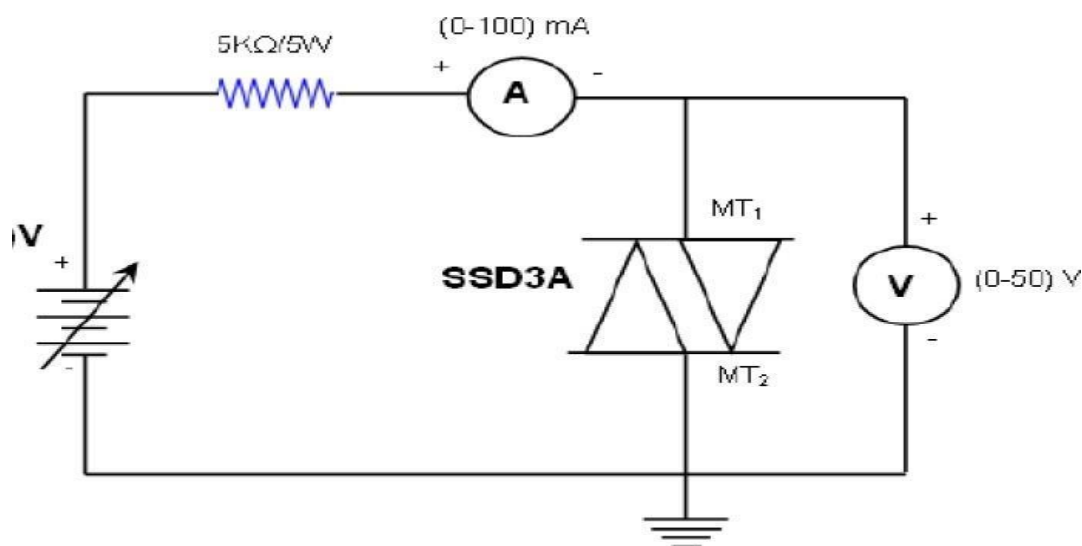

V-I Characteristic of a Diac

Volt-ampere characteristic of a diac is shown in figure. It resembles the English letter Z because of the symmetrical switching characteristics for either polarity of the applied volt-age.

The diac acts like an open-circuit until it's switching or break over voltage is exceeded. At that point the diac conducts until its current reduces toward zero (below the level of the holding current of the device). The diac, because of its peculiar construction, does not switch sharply into a low voltage condition at a low current level like the SCR or triac. In-stead, once it goes into conduction, the diac maintains an almost continuous negative resistance characteristic, that is, voltage decreases with the increase in current. This means that, unlike the SCR and the triac, the diac cannot be expected to maintain a low (on) voltage drop until its current falls below a holding current level.

4. CIRCUIT DIAGRAM:

5. PROCEDURE:
1. Connect the millimeter, DIAC, Voltmeter to the circuit.
2. Switch on the power supply.
3. Increase the supply voltage in steps; note the corresponding currents and voltages for each step.
4. Plot the graph of VI characteristics.
5. Reverse the terminal of DIAC. Increase the supply voltage in steps; note the corresponding currents and voltages for each step.
6. Plot the graph of VI characteristics.

6. OBSERVATION:

For forward bias

SI.No	Voltage (V)	Current (mA)

For reverse bias

SI.No	Voltage (V)	Current (µA)

7. CONCLUSION:

The V-I characteristics of DIAC is plotted on the graph which is true according to theory.

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1. AIM OF THE EXPERIMENT:

Study of drive circuit for SCR & TRIAC using DIAC.

2. APPARATUS REQUIRED:

| SL. No.	Name of the Equipment	Quantity
1	Drive circuit for SCR and TRIAC using DIAC kit	1
2	Lamp (50V)	1
3	CRO	1

3. THEORY:

SCR's and Triacs, we saw that in ON-OFF switching applications, these devices could be triggered by simple circuits producing steady state gate currents as shown.

When switch, S1 is open no gate current flows and the lamp is ‒OFF‖. When switch S1 is closed, gate current I_G flows and the SCR conducts on the positive half cycles only as it is operating in quadrant I.

We remember also that once gated ‒ON‖, the SCR will only switch ‒OFF‖ again when its supply voltage falls to values such that its Anode current, I_A is less than the value of its holding current, I_H.

4. CIRCUIT DIAGRAM:

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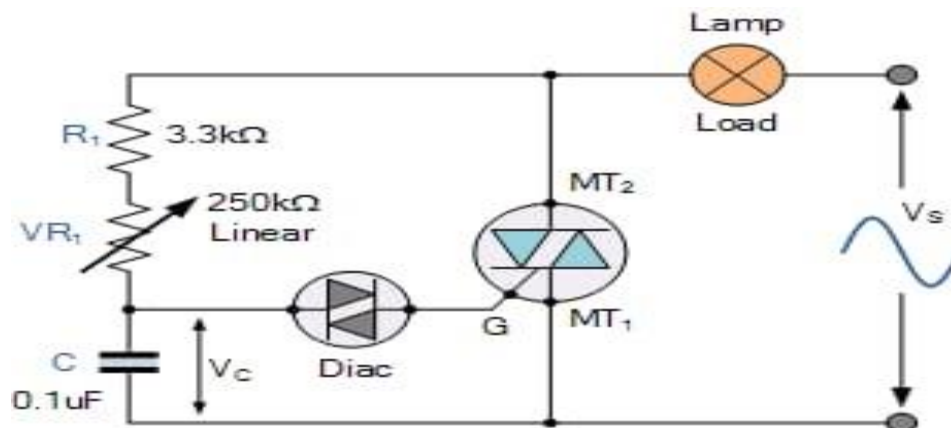
5. PROCEDURE:

1. Make the connection as per the circuit diagram.
2. Connect the lamp at load terminal.
3. Switch ON the mains supply, vary the firing angle potentiometer and Observe the variation in lamp brightness and also note down the voltage(AC volts) variation across the lamp using multimeter.
4. Write down these readings in table.
5. Observe the wave form.

6. OBSERVATION:

SL. NO.	Input Voltage AC in volts	Firing angle in degrees	Output voltage DC in Volts

7. CONCLUSION:

Drive circuit for SCR and TRIAC using DIAC is studied.

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1. AIM OF THE EXPERIMENT:

Study of drive circuit for SCR & TRIAC using UJT.

2. APPARATUS REQUIRED:

SL. No.	Name of the Equipment	Range	Quantity
1	Drive circuit for SCR and TRIAC using UJT kit		1
2	Resistive load	25 watt	1
3	CRO		1

3. THEORY:

UJT Triggering circuit: A unit junction transistor (UJT) is an electronic semiconductor device that has only one junction. The UJT has three terminals: an emitter (E) and two bases (B1 and B2). The base is formed by lightly doped n-type bar of silicon. Two ohmic contacts B1 and B2 are attached at its ends. The emitter is of p-type and it is heavily doped. The resistance between B1 and B2, when the emitter is open-circuited is called inter base resistance.

Initially the capacitor charges through R whose voltage is applied to the emitter of UJT. When the capacitor voltage reaches peak point voltage of UJT. The UJT will switch to ON condition. Now the capacitor discharges through the output resistance. Thus the pulse is generated in the circuit.

4. CIRCUIT DIAGRAM:

FIG A : FIRING ANGLE CONTROL USING UJT - HALF WAVE CIRCUIT

FIG B : (A) CAPACITOR CHARGING - DISCHARGING WAVE FORMS
(B) PULSE AT B1 TERMINAL OF THE UJT
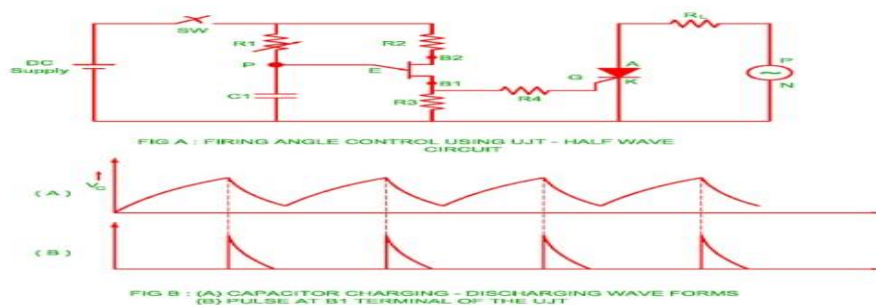
5. PROCEDURE:

1. The connections are made as per the circuit diagram given above.
2. The R Load must be 60W bulb.
3. When the load is Rheostat, then it must be in maximum position.
4. Turn on the SW2 and observe the waveform across between G1&K1
5. Turn ON SW1 and observe the waveform across the R load.
6. Measure the X-axis time interval of ON time of Load Voltage and OFF Time of Load Voltage.
7. Adjust the value of Firing angle and note down the load voltage.
8. Repeat the step 6.
9. Repeat the experiment for different values of α and note down Vo.

6. OBSERVATION:

Sl. NO.	Firing Angle	Load Voltage

7. CONCLUSION:

UJT triggering circuit using SCR and TRIAC is constructed and found the load voltage for various firing angles.

Experiment No: 07

1. AIM: To study phase controlled bridge rectifier using resistive load.

2. APPARATUS REQUIRED:

| SI.No	Apparatus	Specification	Quantity
1	Single Phase Fully Controlled Bridge Rectifier module		1
2	CRO with probes	20MHz	1
3	Resistive load	500Ω,1KΩ	2
4	Multi Meter	-	1
5	Ammeter	(0-1A,MC)	1
6	RPS , Dual Channel	0-30V	1
7	Transformer 230/0-30V	230/00-30V	1
8	Connecting wire	-	As required

3. THEORY:

One important application of an SCR is the controlled half wave rectification. The AC supply to be rectified is supplied at the anode. Let the peak inverse voltage appearing across secondary is less than the reverse breakdown voltage of the SCR. This ensures that SCR will not breakdown during negative half cycles of AC supply. The circuit action can be explained as follows:.

i. During the negative half cycles of AC voltage appearing across secondary, the SCR doesn't conduct irrespective of the gate voltage. In this condition anode is negative w.r.t cathode and also PIV is less than reverse breakdown voltage.

ii. The SCR will conduct during positive half cycles provided proper gate current is made to flow. The larger the gate current, the lesser the supply voltage at which SCR is turned ON.

The SCR half-wave rectifier can be compared with the ordinary half-wave rectifier. The ordinary half-wave rectifier will conduct full positive half-cycle whereas SCR half-wave rectifier can be made to conduct full or part of a positive half-cycle adjusting the gate current. Therefore, an SCR can control power fed to the load and hence the name controlled rectifier.

The SCR full wave rectifier, in all respects resembles the ordinary center tap circuit except that the two diodes have been replaced by two SCR's. The gates of both SCR's get their supply from the two gates controls. One SCR conducts during the positive half cycle and the other during the negative half-cycle. Thus, full wave rectified output is obtained across the load. During the positive half-cycle of AC across secondary, the upper end of secondary is positive and lower end negative. SCR1 will conduct. During the negative half-cycle of AC input the upper end of secondary becomes and the lower end positive. Now SCR2 will conduct it may be noted that current through the load is in the same direction on both half-cycles of input AC. The advantage of this circuit over ordinary full-wave rectifier circuit is that by adjusting the gate currents, the conduction angle and so the output voltage can be changed.

4. CIRCUIT DIAGRAM:
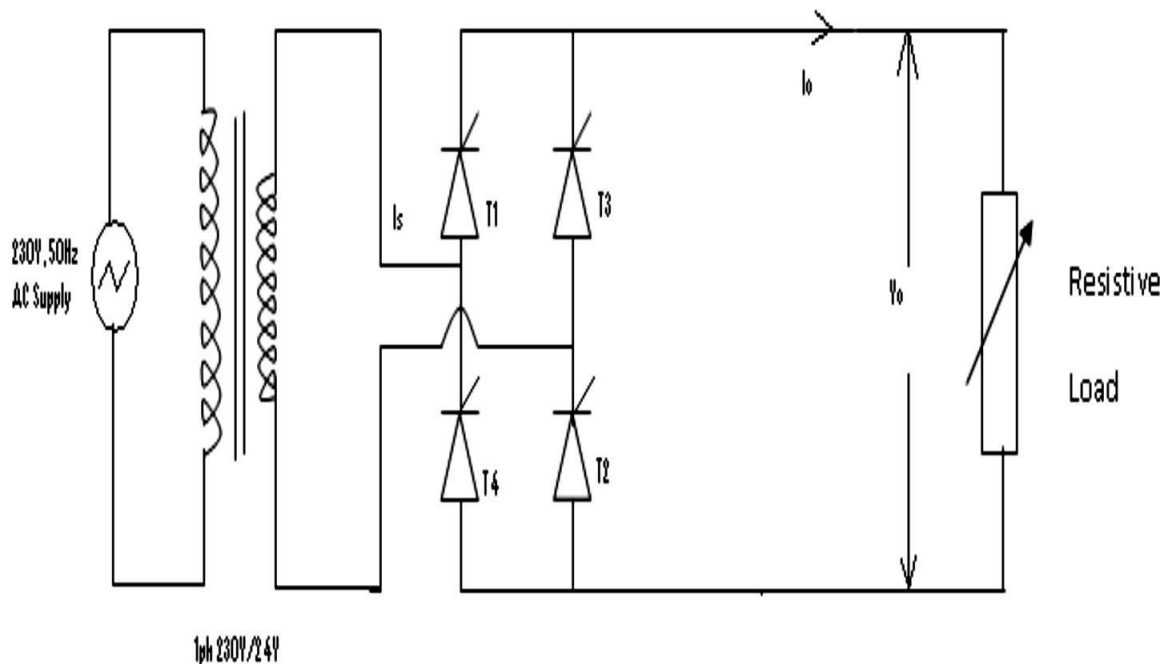
(Controlled bridge rectifier using resistive load)
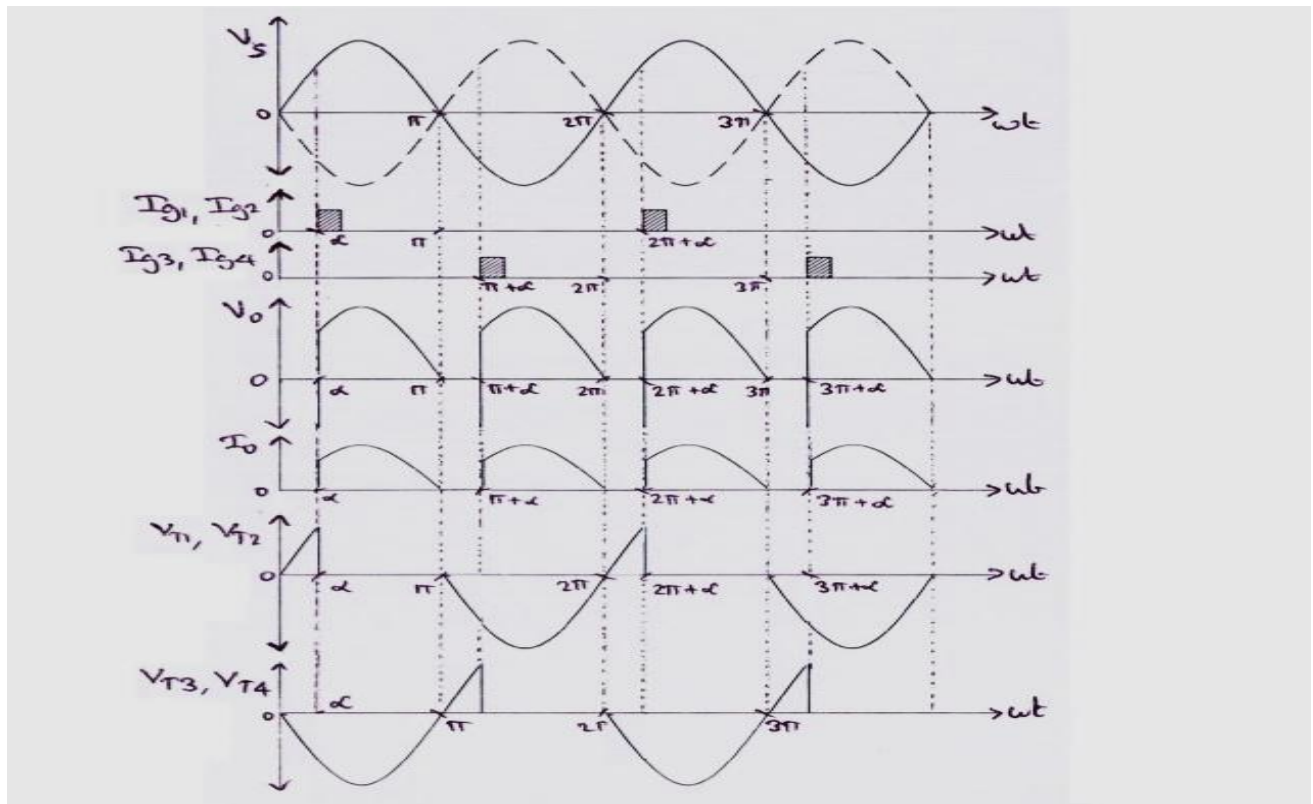
5. PROCEDURE:

For Half Wave Rectifier

1. Connect the circuit as shown in Fig. (1) by connecting the dotted line through patch cords.
2. To observe the change in phase angle connect CRO across voltmeter points. Connect load resistance (RL) in circuit by connecting dotted line though patch cord. Also connect voltmeter, milli ammeter& AC voltmeter in the circuit through patch cords.
3. Set the load Resistance RL to 1 KΩ and switch ON the instrument as well as CRO.
4. Now set the VR_1 Potentiometer to get complete half wave rectified signal on CRO. Note down Average DC Voltage, DC Current & AC Ripples. Calculate the value of Ripple factor by using formula.

    Ripple Factor = AC Ripples (Voltage) / DC Voltage

(Standard value of Ripple Factor = 1.21)

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5. Now change the firing angle of SCR by varying potentiometer VR_1 and every time note down the observations of Average DC voltage, Current & AC Ripples. Also note down Firing Angle from CRO.

6. Also note down the observations of Voltage, Current & AC Ripples by varying the Load Resistances (RL).

For Full Wave Rectifier

1. Connect the circuit as shown in Fig.(2) by connecting the dotted lines through patch cords.

2. To observe the change in phase angle connect CRO across voltmeter points. Connect load resistance (RL) in the circuit by connecting dotted line through patch cord. Also connect voltmeter, milli ammeter& AC voltmeter in the circuit through patch cords.

3. Set the load Resistance RL to 1 KΩ and switch ON the instrument as well as CRO.

4. Now set VR_1& VR_2 Potentiometer to get complete full wave rectified signal on CRO. Note down average DC voltage, DC current & AC ripples. Calculate the value of Ripple factor by using formula :

Ripple Factor = AC Ripples (Voltage) / DC Voltage

(Standard value of Ripple Factor = 0.48)

5. Now change the firing angle of SCR by varying potentiometer VR_1& VR_2 and every time note down the observations of Average DC voltage, Current & AC Ripples. Also note down firing angle from CRO.

6. Also note down the observations of Voltage, Current & AC supplies by varying the load resistance (RL).

For Fully Controlled Bridge Rectifier

1. Connect the circuit as shown in Fig. (3) by connecting the dotted line through patch cords.

2. To observe the change in phase angle connect CRO across voltmeter points. Connect load Resistance (RL) in the circuit by connecting dotted line through patch cord. Also connect Voltmeter, millimeter& AC Voltmeter in the circuit through patch cords.

3. Set the Load Resistance (RL) to 1KΩ and switch ON the instrument as well as CRO.

4. Now set the VR_1, VR_2, VR_3, VR_4 Potentiometers to get complete full wave rectified (Through Bridge circuit) signal on CRO. Note down average DC voltage, DC current & AC ripples. Calculate the value of Ripple factor using formula:

Ripple Factor = AC Ripples (Voltage) / DC Voltage
(Standard value of ripple factor = 0.48)

5. Now change the firing angle of SCR by varying potentiometer VR_1, VR_2, VR_3 & VR_4 every time note down the observations of Average DC voltage, Current & AC Ripples. Also note down Firing Angle from CRO.

6. Also note down the observations of Voltage, Current & AC Ripples by varying the Load Resistances (RL).

6. OBSERVATION:

For Half Wave Rectifier

Firing Angle	DC voltage	DC current	Load Resistance	Ripple (AC voltage)	Ripple Factor= AC volts/DC volts

For Full wave Rectifier

Firing Angle	DC voltage	DC current	Load Resistance	Ripple (AC voltage)	Ripple Factor= AC volts/DC volts

For Bridge Rectifier

Firing Angle	DC voltage	DC current	Load Resistance	Ripple (AC voltage)	Ripple Factor= AC volts/DC volts

7. CONCLUSION:

From the above experiment we studied the phase controlled bridge rectifier using resistive load.

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1. AIM: To study series Inverter.

2. APPARATUS REQUIRED:

Sl.No	Apparatus	Specification	Quantity
1	Series Inverter Module		1
2	CRO	30MHz	1
3	Capacitor		2
4	Inductor		1
5	Connecting wire	-	As per required
6	Patch cards	-	As per required

3. THEORY:

The commutating components L and C are connected in series with the load therefore this inverter is called as SERIES INVERTER. The value of commutating components is selected such that the circuit becomes under damped. The anode current itself becomes zero in this inverter resulting the SCR turns off automatically therefore this inverter is also called as self commutated or load commutated inverter.

4. CIRCUIT DIAGRAM:
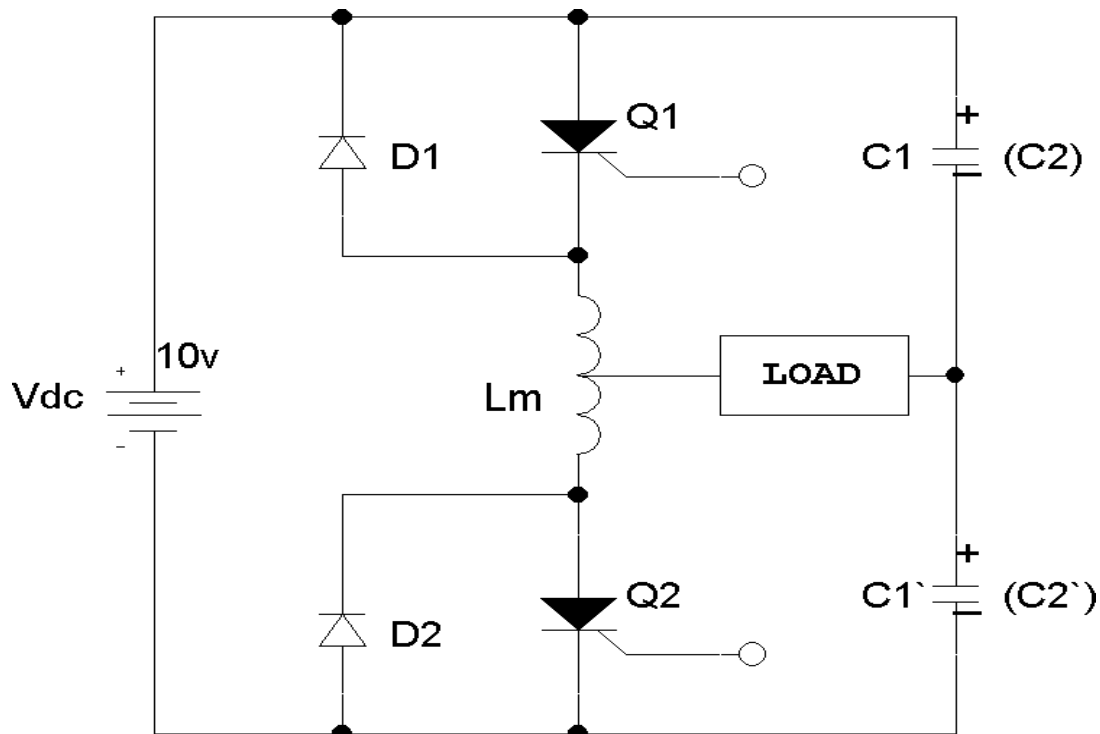
MODEL GRAPH
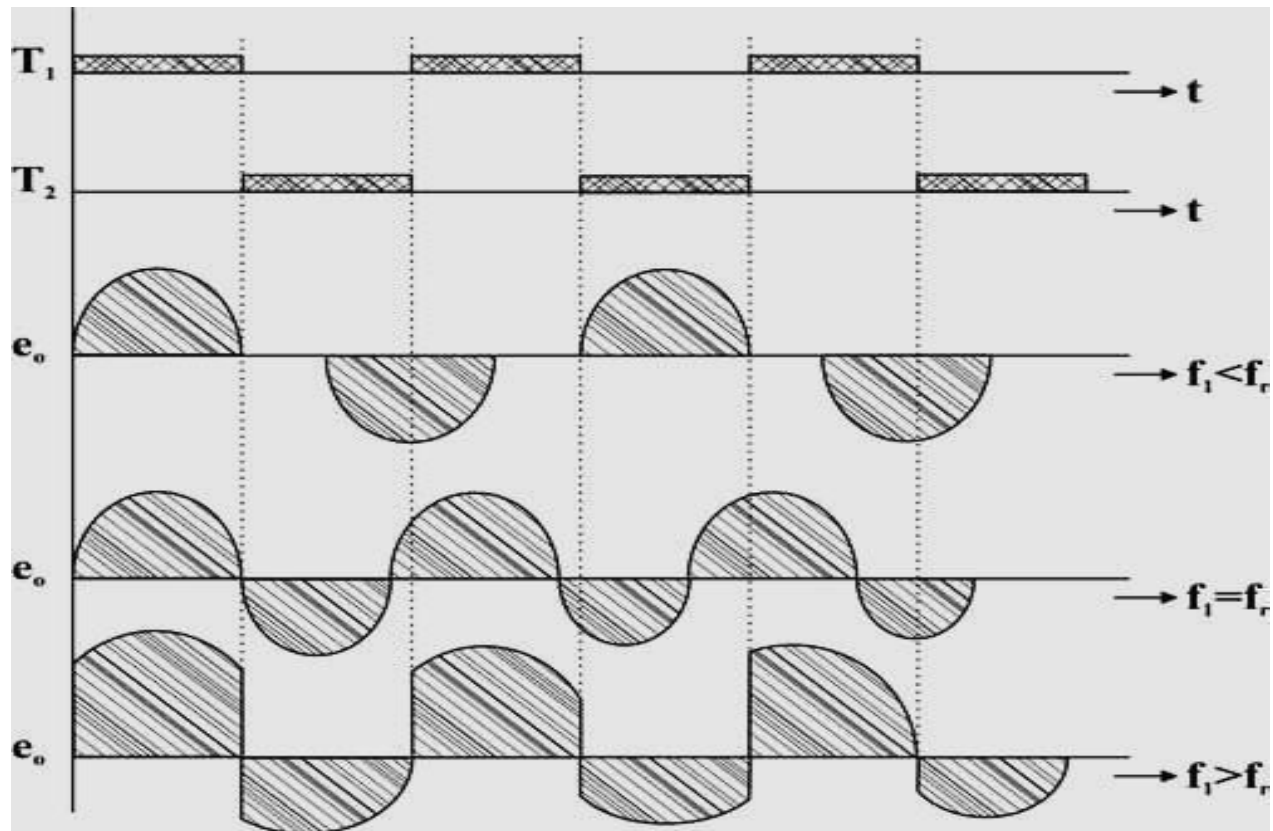
5. PROCEDURE:

➢ To begin with switch on the power supply to the firing circuit check that trigger pulses by varying thefrequency.

➢ Connections are made as shown in the circuitdiagram.

➢ Now connect trigger outputs from the firing circuits to gate and cathode of SCRs T1 &T2.

➢ Connect DC input from a 30v/2A regulated power supply and switch on the input DCsupply.

➢ Now apply trigger pulses to SCRs and observe voltage waveform across theload.

➤ Measure V_{orms} & frequency of o/p voltagewaveform.

6. OBSERVATION:

Sl.No	Amplitude in Volt	T_{ON} (ms)	T_{OFF} (ms)

7. CONCLUSION:

Thus the operation of a series inverter is studied.

----

1. AIM: Study of voltage source Inverter.

2. APPARATUS REQUIRED:

SL. NO.	EQUIPMENT REQUIRED	Specification	QUANTITY
1	inverter kit		1
2	CRO		1

3. THEORY:

Inverters are static power converters that produce an AC output waveform from a DC power supply. They are applied in adjustable AC speed drives, Uninterruptible Power Supplies (UPS), shunt active power filter, etc. For sinusoidal AC outputs, the magnitude, frequency, and phase should be controllable. If a DC input is a voltage source, then the inverter is called a Voltage Source Inverter (VSI).

According to a number of phases, inverters are classified into two types

1. Single Phase Voltage Source Inverter

2. Three Phase Voltage Source Inverter

4. CIRCUIT DIAGRAM:(**Single Phase Voltage Source Inverter**)
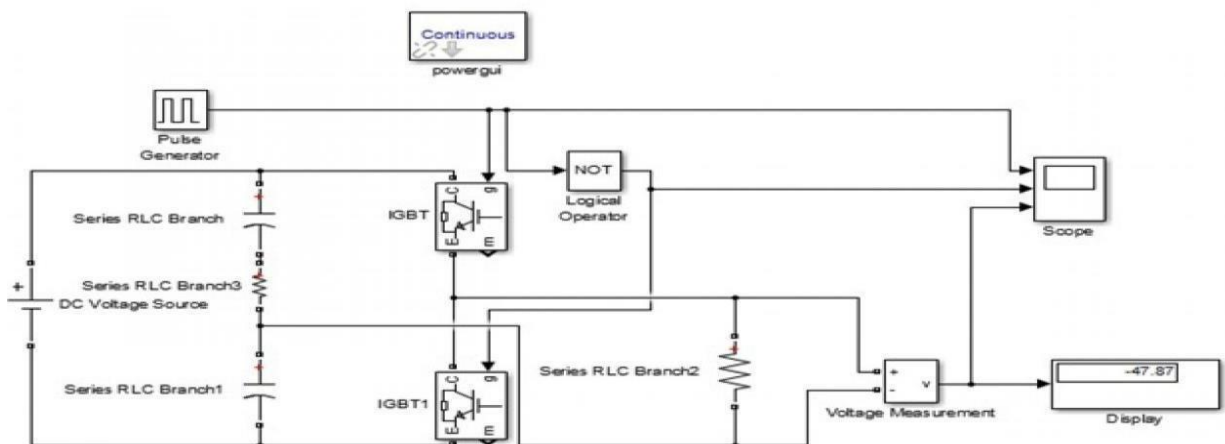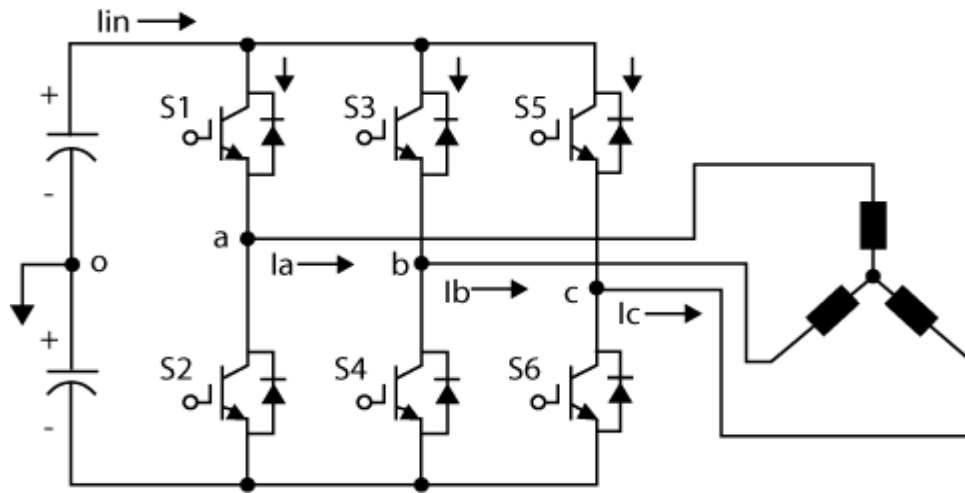
(Three Phase Voltage Source Inverter)

5. PROCEDURE:

1. Switch on the firing circuit.
2. Observe the trigger outputs by varying frequency potentiometer and by operating ON/OFF switch.
3. Then connect input DC supply to the power circuit. Connect trigger outputs to Gate and Cathode of SCR.
4. Apply trigger pulses to SCR 4.
5. Observe voltage waveforms across load. Output voltage is square wave only.
6. Vary the load, vary the frequency and observe waveforms.

6. CONCLUSION:

Hence we verified the above experiment.

Experiment No: 10

1. AIM: To perform the speed control of DC motor using Chopper.

2. APPARATUS REQUIRED:

SL.No	Apparatus	Specification	Quantity
1	Power electronic kit		1
2	Servo motor		1
3	DSO		1
4	Connecting lead		As per required

3. THEORY:

Circuit diagram is shown in fig. (1) and it consist of RC network which control the speed of motor. There are two method of Triggering to SCR using RC network. They are explained below and we are using RC half wave circuit to control the speed of motor .SCR is here acting as an half wave rectifier and allows only half cycle of ac signal to the armature. This is an method of voltage control of armature by using SCR whose firing angle is varied and accordingly voltage of armature is varied.

RC FIRING CIRCUITS:

The limited range of firing angle control by resistance firing circuit can be overcome by RC firing circuit .There are several variations of RC trigger circuits. Here only two of them are presented.

(i) RC Half wave Trigger Circuit

By varying the value of R ,firing angle can be controlled from 0-180.In negative half cycle ,capacitor c charges through resistance with lower plate positive to the peak supply voltage V_m at wt = -90^0.after wt= -90^0 ,sources voltage V_S decreases from $-V_m$ to zero. During this period capacitor voltage V_C may fall from $-V_m$ at wt=-90^0 to some lower value at wt=0^0. Now, as the SCR anode voltage passes through zero and becomes positive, C begins to charge through variable resistance R from the initial voltage. When capacitor charges to positive voltage equal to gate trigger voltage V_{gt} SCR is fired and after this capacitor holds

to a small positive voltage. Diode D1 is used to prevent the breakdown of cathode to gate junction the negative half cycle. Firing angle α cannot lay to zero or 180^0.
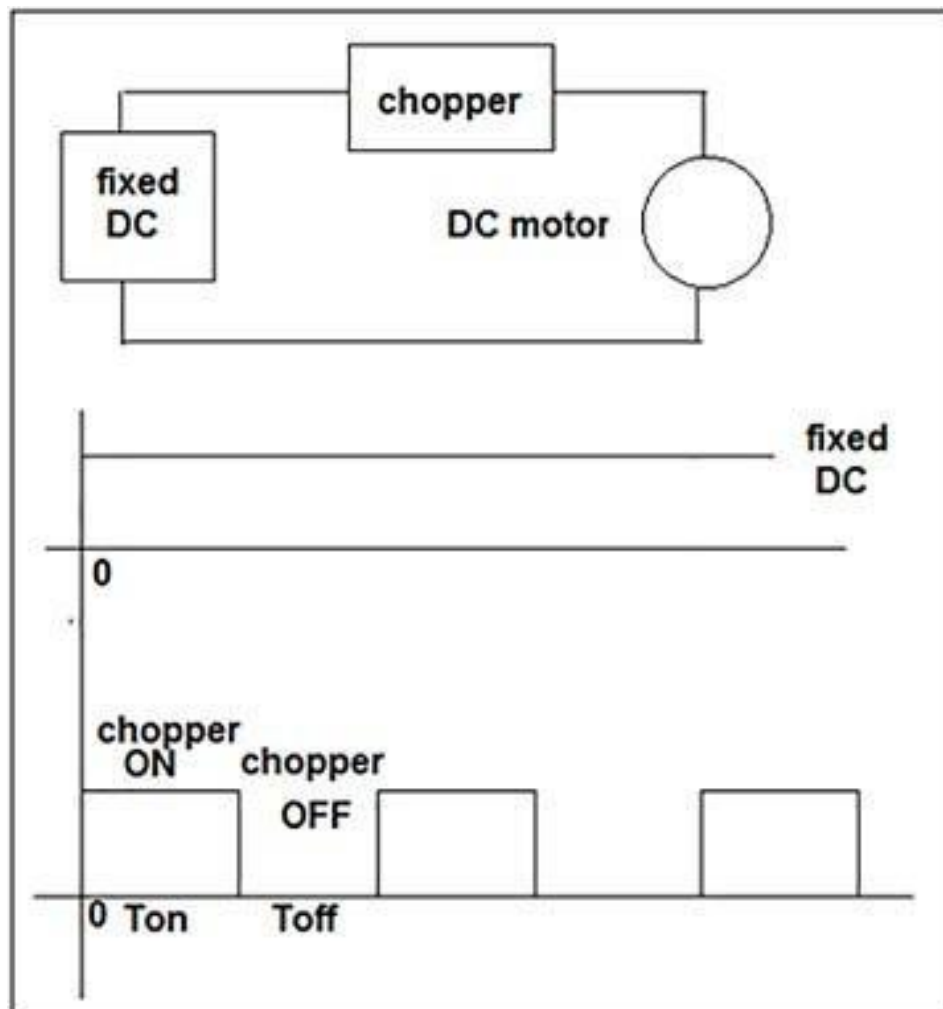
The SCR will trigger when $V_C = V_{gt} + V_d$, where V_d is the voltage drop across diode D1. At the instant of triggering, if V_C is assumed constant, the current I_{gt} must be supplied by voltage source through R, D1 and gate to cathode circuit. Hence the maximum value of R is given by

$$V_s \geq RI_{gt} + V_c$$

Or $\quad V_s \geq RI_{gt} + V_{gt} + V_d$

Or $\quad R \leq \dfrac{V_s - V_{dt} - V_d}{I_{dt}}$

4. CIRCUIT DIAGRAM:

5. PROCEDURE:

1. Connect motor unit with main unit through patch cords as per the ckt diagram**.**

2. Connect the main lead of instrument in the mains plug. Keep ‒SET SPEED" potentiometer at minimum position initially i.e. fully anticlockwise and switch ON the instrument.

3. Very the speed of motor using ‒SET SEED‖ potentiometer slowly. Note down the reading on the current meter at equal interval of voltage in the observation table

given in the procedure.

4. Connect the CRO across the SCR using attenuation lead and observe different wave form at different firing angle.
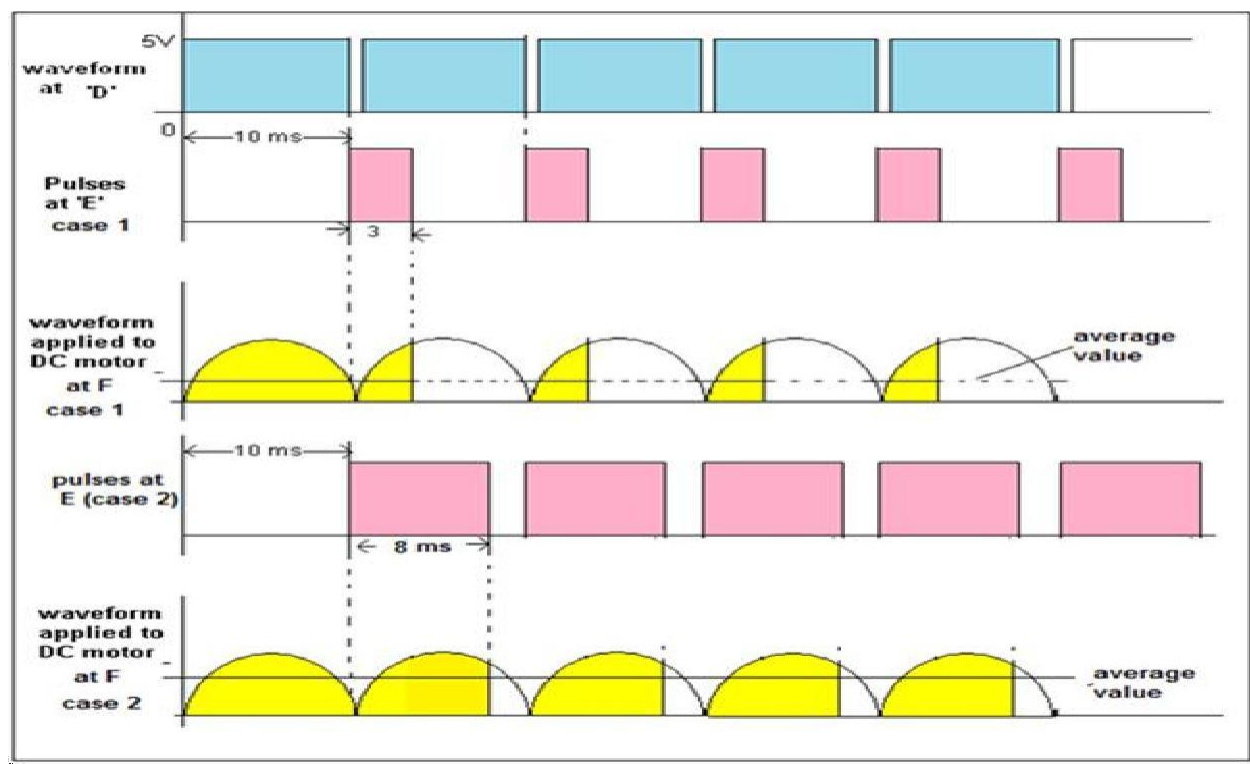
(Timing Diagram of Output Waveforms from the Chopper Circuit)

6. CONCLUSION:

Hence we proved the experiment and traced the wave form.

Experiment No: 11

1. AIM: To study single-phase Cyclo-converter.

2. APPARATUS REQUIRED:

SL.No	Apparatus	Specification	Quantity
1	Cycloconverter power ckt.with firing ckt.		1
2	Transformer	230V(150V-15V)	1
3	Rheostat	100Ω/2A	1
4	Multimeter		1
5	CRO	30MHz	1
5	Connecting wire	-	As per required
6	Patch cards	-	As per required

3. THEORY:

A cycloconverter converts input power at one frequency to output power at a different frequency with one stage conversion. Cycloconverter is used in speed Control of high power AC drives, induction heating etc.

The circuit shown is for obtaining single phase frequency divided output from a single phase AC input. One group of SCR's produces positive polarity load voltage and other group produces negative half cycle of the output. SCR's T1 andT3 of the positive group are gated together depending on the polarity of the input, only one of them will conduct, when upper AC terminal is positive with respect too, SCR T1will conduct and when upper AC terminal is negative, SCR T3willconduct thus in both half cycles of input, the load voltage polarity will be positive by changing firing angle, the duration of conducting of each SCR (and there by the magnitude of the output voltage) can be varied.

For the sake of simplicity it is assumed that the load is positive. Then each SCR will have a conduction angle of $(\pi - \alpha)$ and turn off by natural commutation at the end of every half cycle of the input. At the end of each half period of the output, the firing pulses to the SCR'sof the positive group will be stopped and SCR's T2 and T4 of the negative group will be fired.

4. CIRCUIT DIAGRAM:

C1 G1 T1   A1

230v

A2   T2 G2   C2

230v AC

0v

MOTOR LOAD

CRO

A3   T3   C3

G3

230v

G4

C4   T4   A4

(a) V_s

(b) V_o — Average voltage per pulse (half-cycle of v_s) — $\alpha_P=0$, $\alpha_N=0$

(c) V_o — $\alpha_P=60$, $\alpha_N=60$

(d) V_o — α varying for different pulses
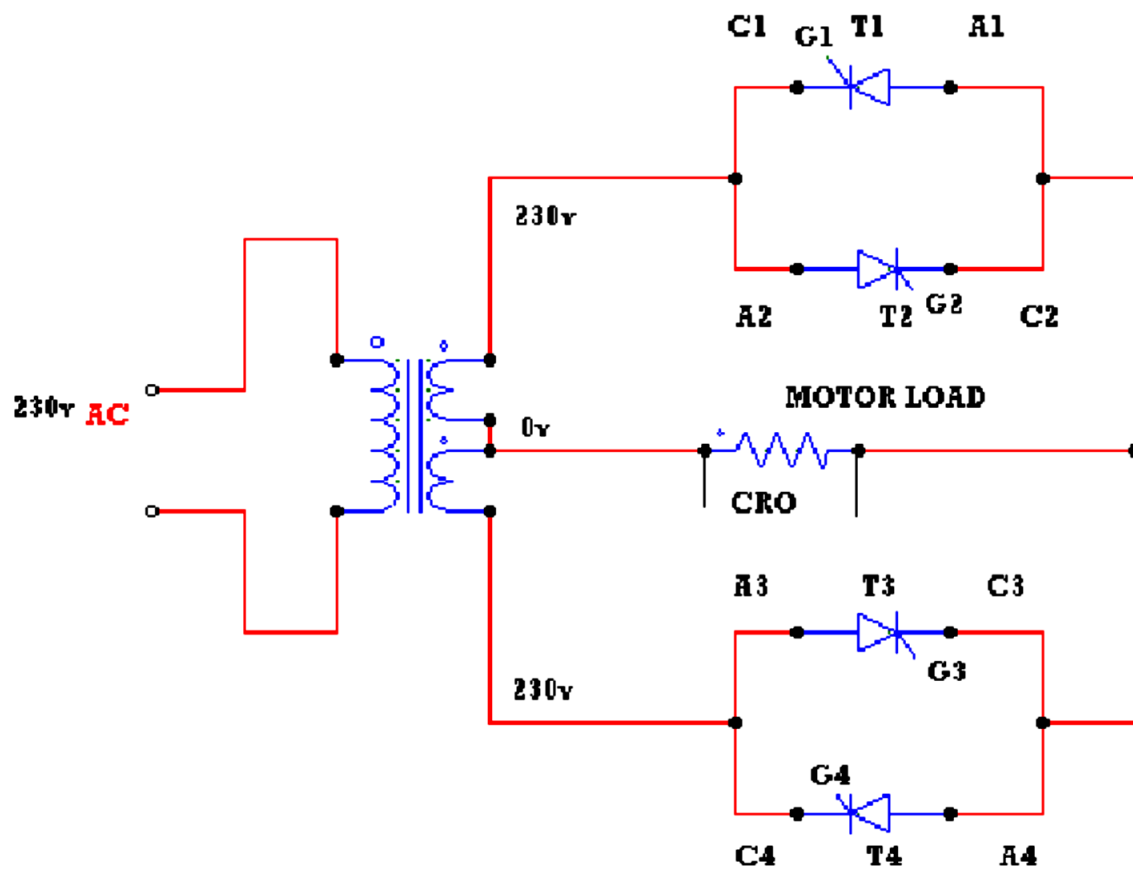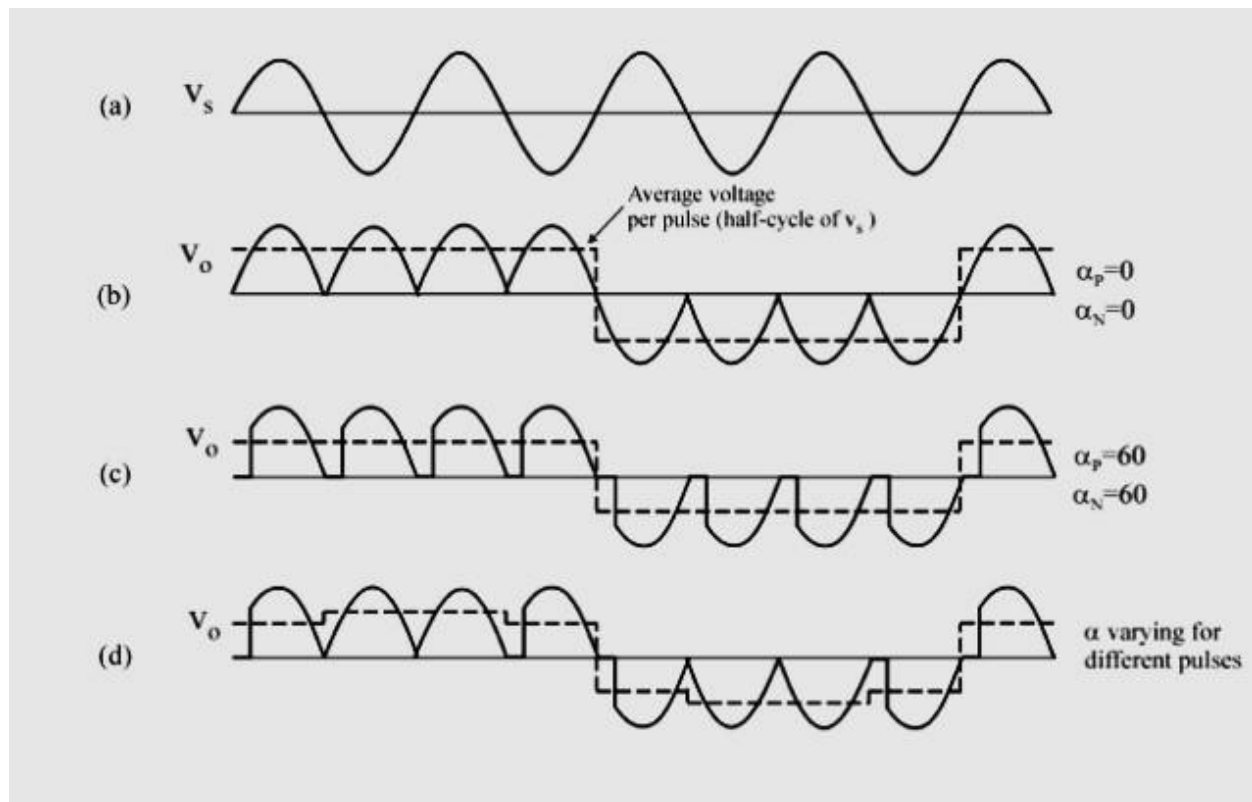
5. PROCEDURE:

- ➢ The connections are made as shown in the circuit of single phase
- ➢ Cycloconverter with Motor Load with divided by 2 frequency.
- ➢ The gate cathode terminals of the thyristors are connected to the
- ➢ Respective points on the firing module.
- ➢ Check all the connections and confirm connections made are correct
- ➢ Before switching on the equipment.
- ➢ Switch ON unit.
- ➢ The output wave forms are seen on a CRO.
- ➢ The firing angle is varied and AC output voltage across the load is noted.
- ➢ A graph of Vacverses load voltage is plotted.
- ➢ Repeat the above procedure for divided by four frequencies.

6. OBSERVATION:

Frequency divided by 2

SI.No	Firing angle α (degrees)	Load voltage in volts using AC voltmeter in volts	RPM
1	180^0		
2	150^0		
3	120^0		
4	90^0		
5	60^0		
6	30^0		
7	0^0		

7. CONCLUSION:

Thus the operation of a single-phase Cyclo-converter is studied.

PLC LAB

Learn the basics and hardware components of PLC

The basic elements of a PLC include input modules or points, a Central Processing Unit (CPU), output modules or points, and a programming device. The type of input modules or points used by a PLC depends upon the types of input devices used. Some input modules or points respond to digital inputs, also called discrete inputs, which are either on or off. Other modules or inputs respond to analog signals.

PLC Hardware components

Alright, now that we've got that out of the way, let's look at what we mean by the

term **PLC Hardware**. The Hardware components of a PLC include the following:

Processor, Power Supply, Input/output Modules, and a Programming Device.

Let's look at each piece of hardware, or module one at a time.
1) Power Supply

The Power Supply is connected to AC mains for the supply voltage.
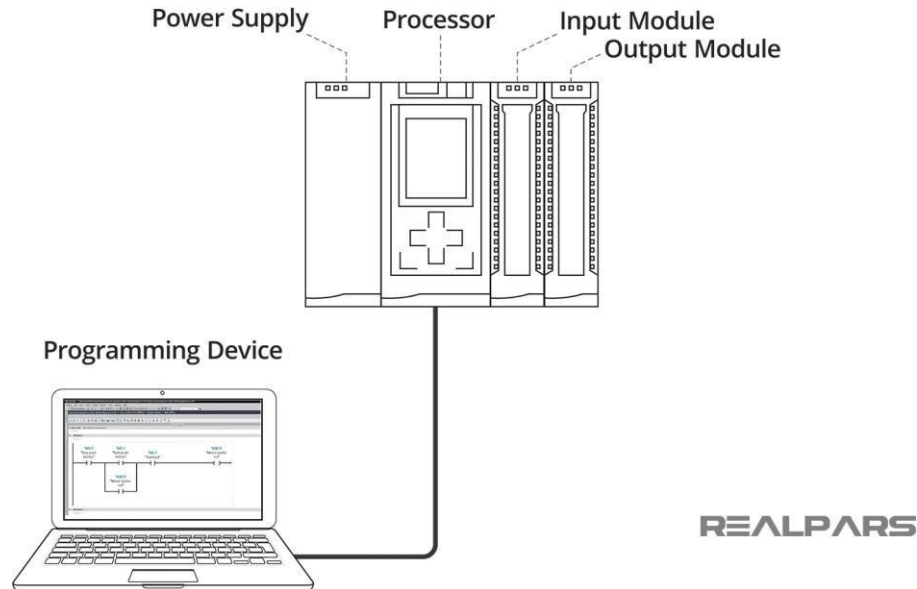
The output of the Power supply is a DC voltage used to power all of the other modules associated with the PLC.

The Power supply DOES NOT provide power for field devices.

2) Input/output

Input field devices include switches, encoders, and transmitters for example.

Typical output field devices are relays, lamps, and proportional valves.
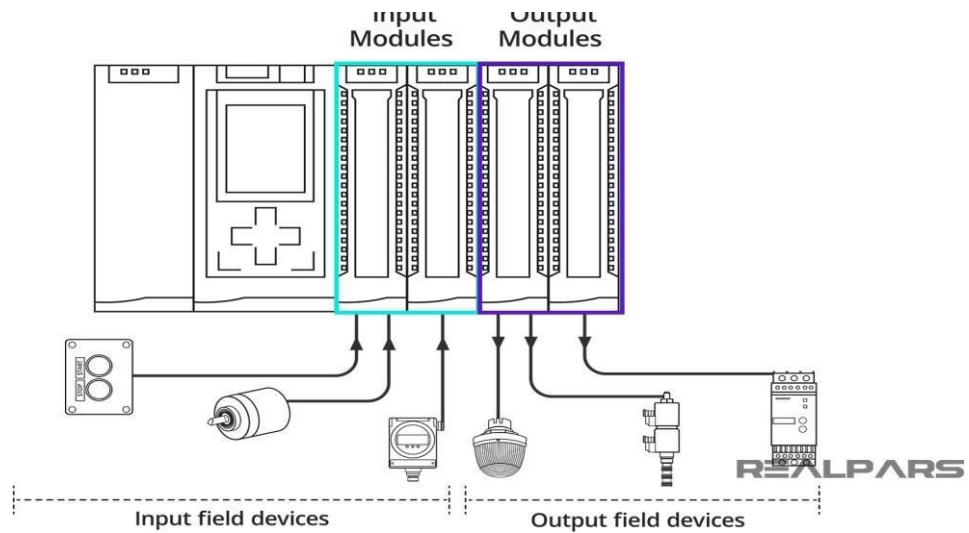
3) Processor

The Processor consists of the CPU (central processing unit) and memory.

The processor section makes decisions needed to observe and operate the field devices connected to the Input/output modules.
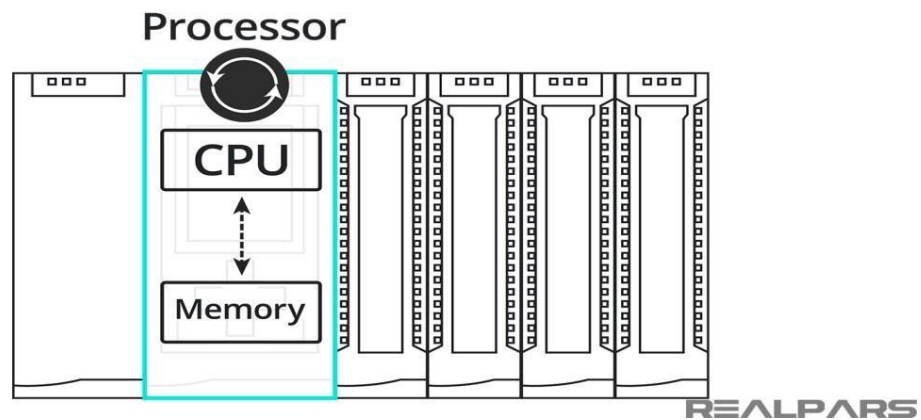
The decisions are based upon a user-created program saved in the memory. The memory also stores data representing the condition of all input field devices and contains the data telling the output field devices what to do.

Name	Address	Value
Stop	I0.0	True
Start	I0.1	False
Overload	I0.2	True
Motor Coil	Q0.0	False
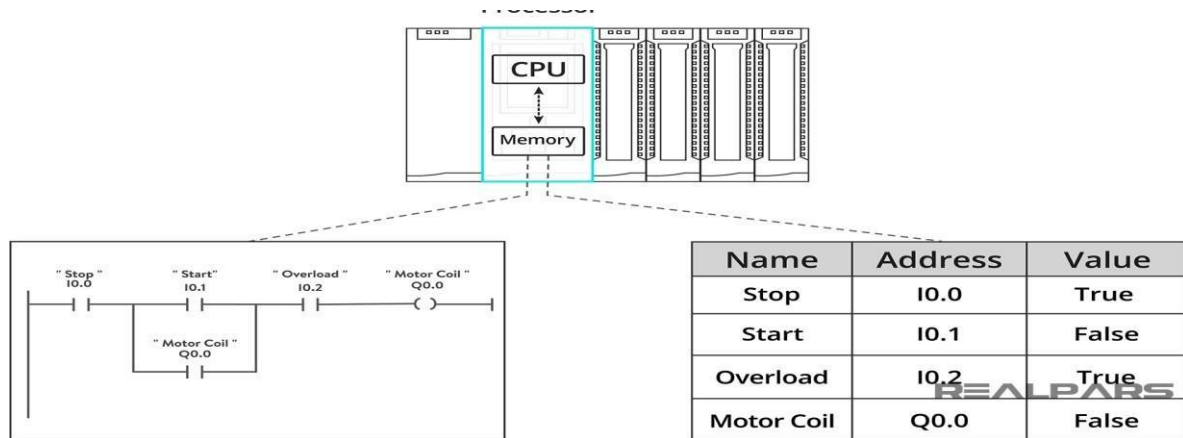
4) Programming Device

The Programming Device in today's industrial applications is usually a laptop or a desktop computer that facilitates the creation of decision-making programs destined for the PLC.

(b) Understand configuration of PLC system

Configuration is used to group all resources of the **PLC system** together. It also provides means for data exchange between them. A resource is the processing facility, able to execute IEC programs. It is defined in order to assign task to the physical resources of a **PLC system**.

(C) Study various building blocks of PLC

PLC Block Diagram
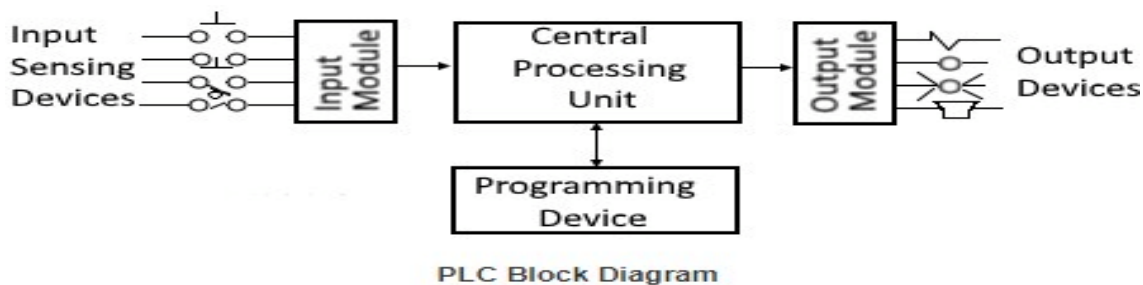
Power Supply Module

This module is used to provide the required power to the whole PLC system. It converts the available AC power to DC power which is required by the CPU and I/O module. PLC generally works on a 24V DC supply. Few PLC uses an isolated power supply.

CPU Module and Memory

CPU module has a central processor, ROM & RAM memory. ROM memory includes an operating system, drivers, and application programs. RAM memory is used to store programs and data. CPU is the brain of PLC with an octal or hexagonal microprocessor. Being a microprocessor-based CPU, it replaces timers, relays, and counters. Two types of processors as a single bit or word processor can be incorporated with a PLC. One bit processor is used to perform logic functions. Whereas word processors are used for processing text, numerical data, controlling, and recording data.

CPU reads the input data from sensors, processes it, and finally sends the command to controlling devices. DC power source, as mentioned in the previous discussion is required voltage signals. CPU also contains other electrical parts to connect cables used by other units.

Input and Output Module

Input devices can be either start and stop pushbuttons, switches, etc and output devices can be an electric heater, valves, relays, etc. I/O module helps to interface input and output devices with a microprocessor. The input module of PLC is explained in the below figure.
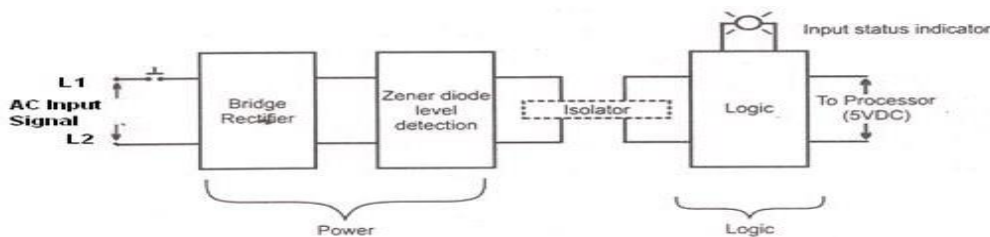
The output module of PLC works similarly to the input module but in the reverse process. It interfaces the output load and processor. So here the first section would be logic session and the power section comes next. The working of the output module is shown in the below figure
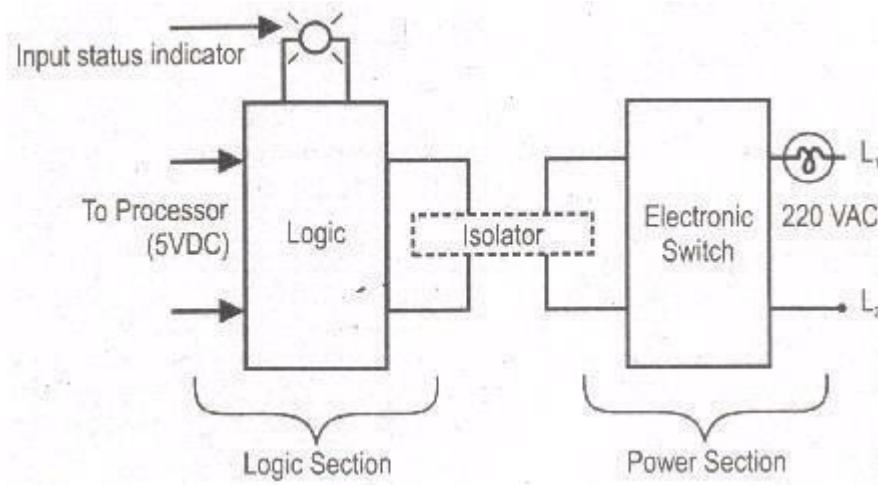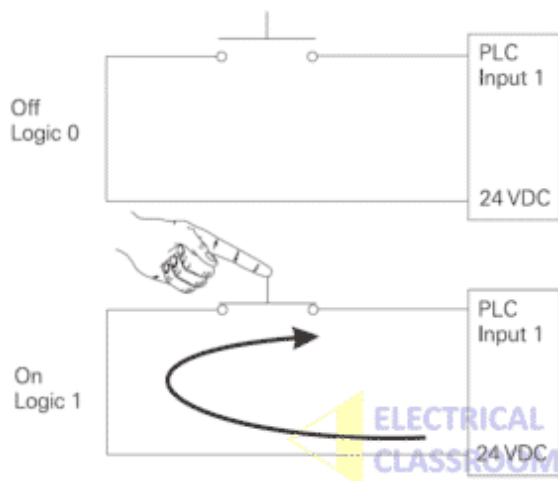
PLC Output Module

Determine the No. of digital I/O & Analog I/O

Basically, PLC inputs and outputs are classified as follows:

- Digital Input – DI
- Digital Output – DO
- Analogue Input – AI
- Analogue output – AO

Apart from this, there are various other I/O types which are not discussed in this article.Difference between DI, DO, AI and AO

Digital Input – DI

Digital inputs are binary inputs (0 or 1) that are applied to the PLC. Binary inputs are basically voltages, varying from 5V to 230V depending upon the type of card used. In simple words, any push-button, switches or sensors produces digital inputs to a PLC. Digital inputs are used to check the status of any devices whether it is ON or OFF. For an Input module of 24Vdc, 0Vdc acts as OFF state (Binary 0) and 24Vdc acts as ON state (Binary 1).

Digital Output
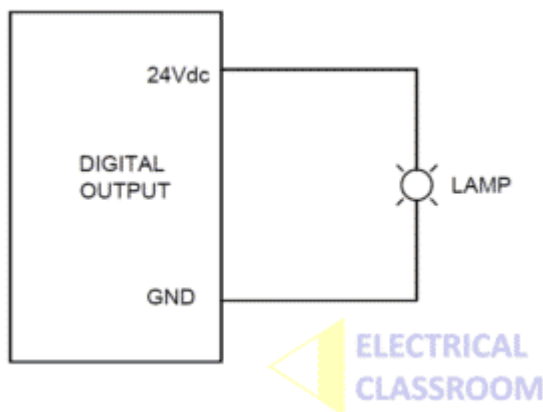
Digital outputs are binary outputs (0 or 1) from the PLC. It is a processed control output from the PLC to the field. It is used to ON or OFF any piece of field equipment. DO is like a contact of a relay when the preprogrammed conditions are satisfied the contacts are closed. DO can be used to operate solenoid valves, relays, indicating lamps or as a command to any other devices.

Analog Input – AI
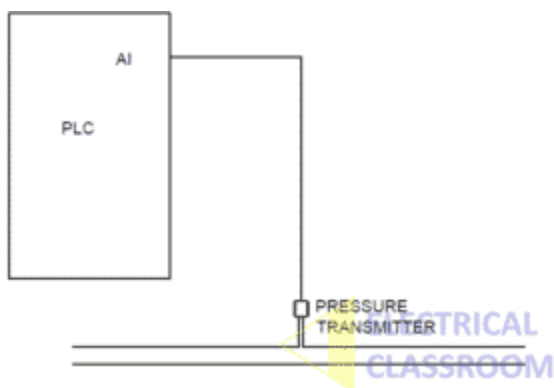
Analog input is a continuous input from the field to the PLC. Unlike digital signals, is not a constant voltage signal. It can vary depending on the field conditions. The commonly

used analogue signals are 4-20mA signal and 0-10Vdc Signal. Depending on the field conditions the input signal can vary between 4-20mA or 0-10Vdc. For Example, if you are monitoring a pressure of water flowing through a pipe using a pressure transmitter of range 0-10 Bar, the transmitter will give a signal between 0 and 10V proportional to the pressure in the pipe.

Analog Output
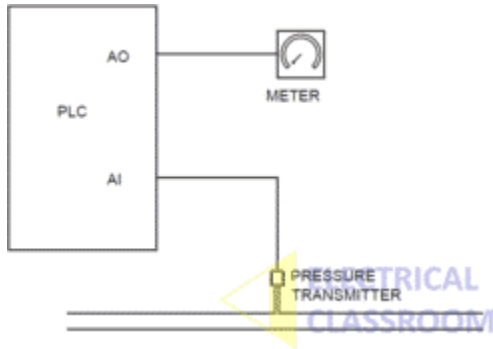
Analogue output is a continuous output from PLC to the field devices. For example, if you have a variable frequency drive and you want to give a speed reference signal to it you can use analogue output. Otherwise, if you are measuring the pressure using analogue input as explained above and you would like to display it on an analogue meter you can use an analogue output of PLC.

Execute Ladder diagrams for different Logical Gates

Aim: Study of various logic Execution in ladder diagram.

Equipment

1) Computer with SIMATIC software.
2) Siemens S7-1200 PLC.
3) LEDs.
4) Switches.
5) Connecting wires.

Theory: The majority of PLC manufacturers use the ladder logic diagram programming language to program their programmable logic controllers (PLCs). Some manufacturers prefer using logic gate circuits or Boolean expressions to program their PLCs. Therefore, it is beneficial to know how to convert one type of PLC programming language to the other. In this practical, you will learn how to create logic gate circuits from ladder logic diagrams and vice versa. You will review the functions associated with the combinational logic gates. These gates are the NOT, AND, OR, NAND, NOR, XOR, and XNOR gates. You will learn how to create PLC ladder logic diagrams that emulate the functions of these gates.

1. NOT GATE
In electronics, NOT GATE is also called an ‗Inverter‘ or ‗Buffer‘.
Working: NOT gate works as inversion. It takes one input and gives one output. When the input is high then the output is low and vice-versa.
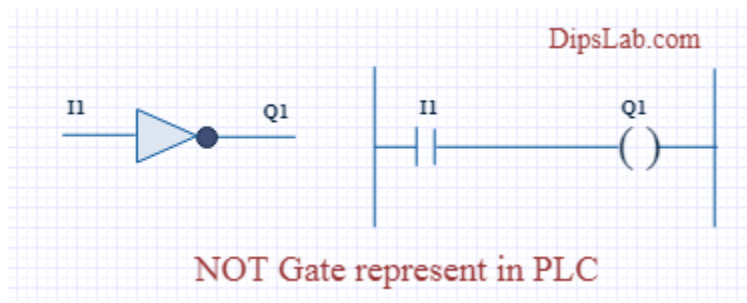
Logic Gate Truth Table for NOT Gate:

Input (I1)	Output (Q1)
0	1
1	0

NOT Gate in PLC programming:

In the case of PLC ladder, there will be a push button to provide input. When (I1) is pressed then the coil (Q1) is on. And when Input (I1) is released then coil(Q1 is off.
Symbolic Representation.

NOT Gate represent in PLC

2. AND GATE

Working: In AND Gate, when both inputs (I1 and I2) are high then the output (Q1) will be high. For all other inputs, output (Q1) will be the low.
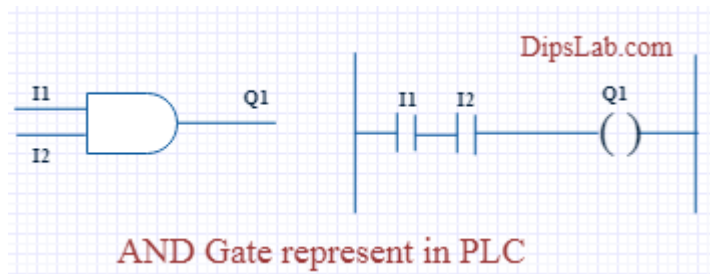
Logic Gate Truth Table for AND Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	0
0	1	0
1	0	0
1	1	1

AND Gate in PLC programming:
Using Ladder diagram programming, we are connecting two switches (I1 and I2) as input and coil/lamp (Q1) as output.

In the case of both switches (I1 and I2) are closed, the lamp (Q1) will glow. In another case, if any of the switches (I1 or I2) are open then lamp (Q1) will not glow.

Symbolic Representation as,

AND Gate represent in PLC

3. OR GATE

Working: If both inputs are low in the OR gate, then the output will be low. For all other cases, the output will be high.
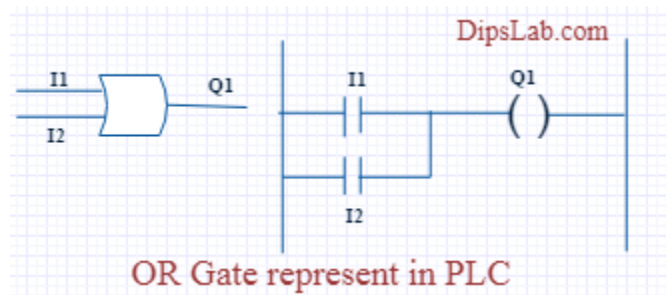
Logic Gate Truth Table for OR Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	0
0	1	1
1	0	1
1	1	1

OR Gate in PLC programming:
In case both or anyone inputs (I1 and I2) are closed then coil (Q1) will on.

Symbolic Representation as,

OR Gate represent in PLC

In the above circuit diagram, switch (I1) is pressed then the coil (Q1) will be energized. After releasing switch (I1), the energizing coil (Q1) is providing supply to switch (I2). Then switch (I2) will become automatically activated.

4. NAND GATE
NAND gate is operated as an AND gate and followed by the inverter.

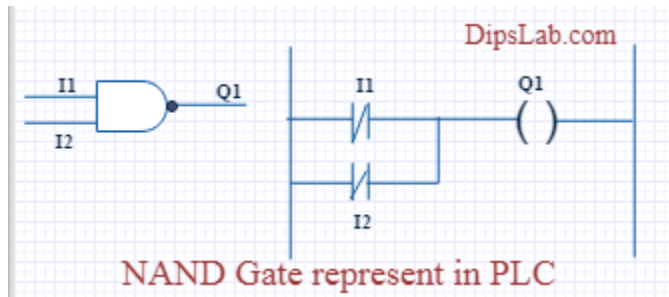**Working:** In NAND Gate, the output will be low when both inputs are high. For all other cases, the output will be high.

Logic Gate Truth Table for NAND Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	1
0	1	1
1	0	1
1	1	0

NAND Gate in PLC programming:
If both switches (I1 and I2) or anyone switch (I1 or I2) are closed, the lamp will be glow. In the case, both switches are open then the lamp will not be glow.

Symbolic Representation as,

NAND Gate represent in PLC

5. NOR GATE

NOR Gate is operated OR Gate followed by the NOT Gate.

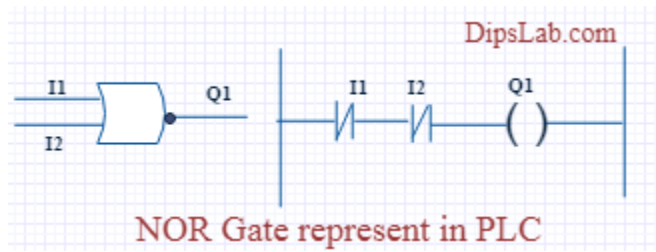When both inputs are low then the output will be high. Otherwise, the low output will occur if both inputs are high.

Logic Gate Truth Table for NOR Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	1
0	1	0
1	0	0
1	1	0

NOR Gate in PLC programming:
The Coil (Q1) will be activated if both inputs are closed. Coil (Q1) will be deactivated if anyone or Bothe the inputs are open.

Symbolic Representation as,

NOR Gate represent in PLC

6. EX-OR GATE

Working: If both inputs are high or low, the output will become low. For any other input condition, the output will be high.
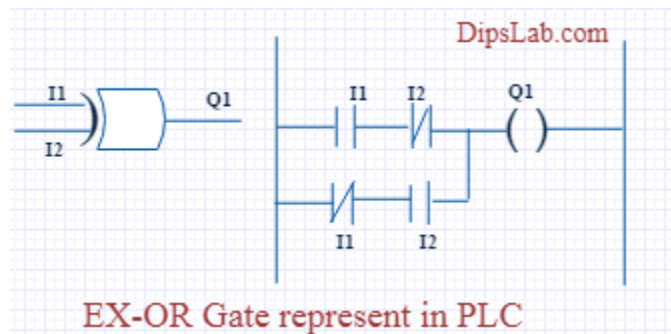
Logic Gate Truth Table for EX-OR Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	0
0	1	1
1	0	1
1	1	0

EX-OR Gate in PLC programming:
In the function of EX-OR Gate, the lamp will be on if one switch is closed and another switch is opened.

Symbolic Representation as,

EX-OR Gate represent in PLC

7. EX-NOR GATE

Working: When both inputs (I1 and I2) are high or low then the output will high. If anyone input is high or low then the output will become low.
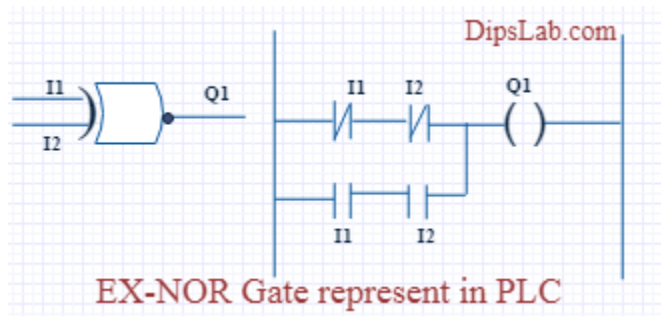
Logic Gate Truth Table for EX-NOR Gate:

Input (I1)	Input (I2)	Output (Q1)
0	0	1
0	1	0
1	0	0
1	1	1

EX_NOR gate in PLC programming:
The function of EX-NOR Gate, the lamp (Q1) will be on if both switches (I1 and I2) are open or closed. The lamp (Q1) will not be on if anyone switches (I1) is activated and another switch (I2) is deactivated.

Symbolic Representation as,

EX-NOR Gate represent in PLC

Procedure:

- Connect two switches to the digital input module.

- Connect one LED to the digital output module.

- Write down the ladder diagram to implement AND-logic function using SIMATIC Manager software.
- Download the program to the PLC.
- Repeat steps 1 through 4 to implement OR-logic function.
- Repeat steps 1 through 4 to implement Parallel NOT-logic function.

Conclusion:

This is all about different logic gates using PLC ladder programming. As well as PLC programming rules and programming instructions are also important for writing the program.

Execute Ladder diagrams using timers & counters

**AIM:** To differentiate the usage of the timer and counter in Ladder Diagram.

Equipment

1) Computer with SIMATIC software.
2) Siemens S7-1200 PLC.
3) LEDs.
4) Switches.
5) Connecting wires

THEORY

TIMERS

On-Delay Timer The On-Delay Timer (TON) instruction counts time when the enabling input is ON. When the current value (Txxx) is greater than or equal to the present time (PT), the timer bit is ON. The On-Delay timer current value is cleared when the enabling input is OFF. This timer continues counting after the Preset is reached, and it stops counting at the maximum value of 32767.
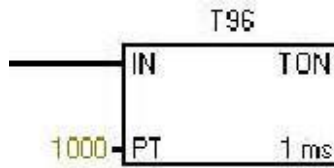

The timer shown in figure will delay for 1000*1ms= 1000ms = 1 second then it will be activated ON. Here when you activate the input I0.0, the timer T37 starts delaying time, until it reaches 1000ms, then T37 bit turns ON, hence Q0.0 will be ON. As a result Q0.0 will be activated after 1 second activating I0.0.

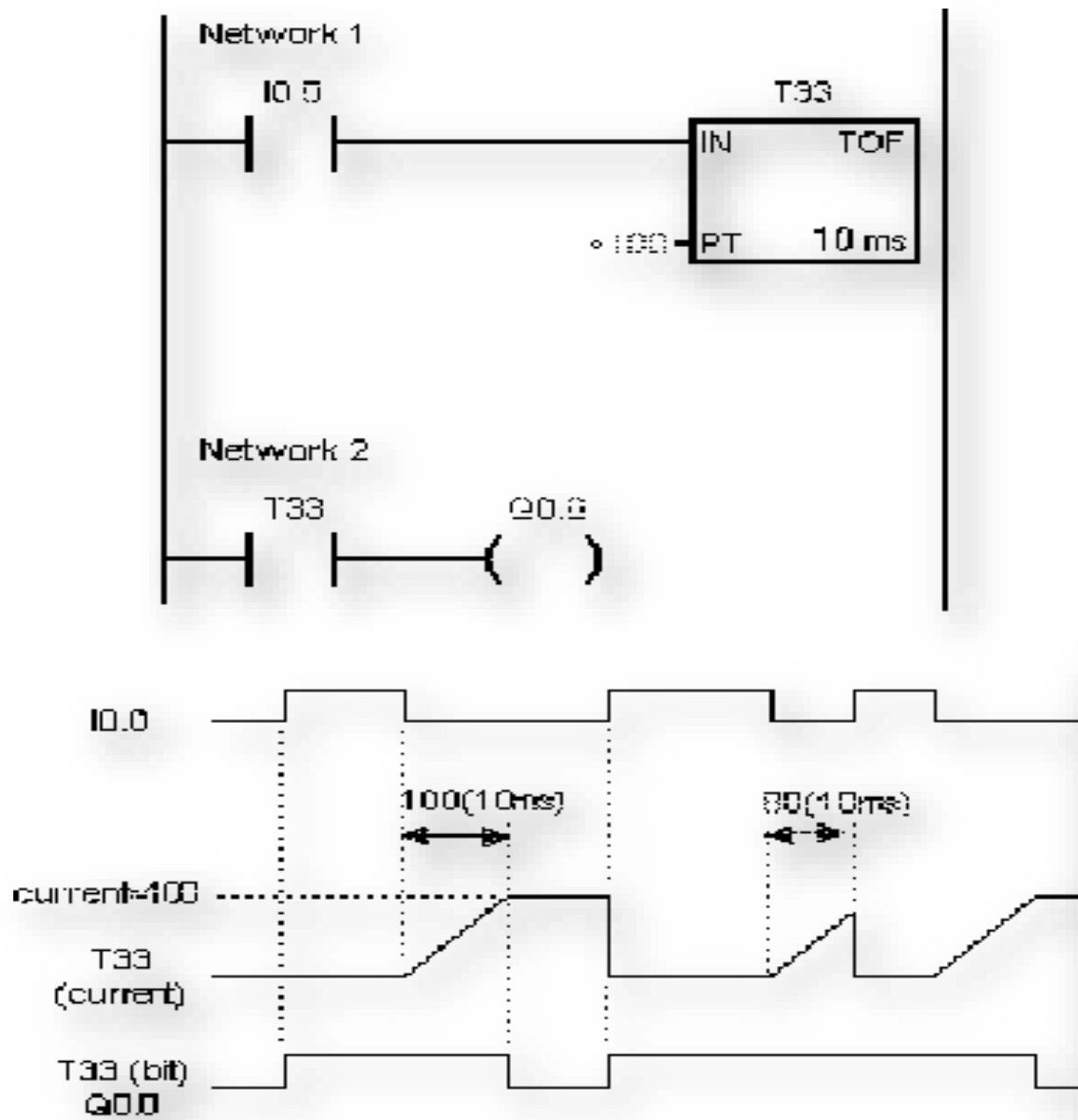**Ladder logic diagram for on-delay timer. the timing diagram**
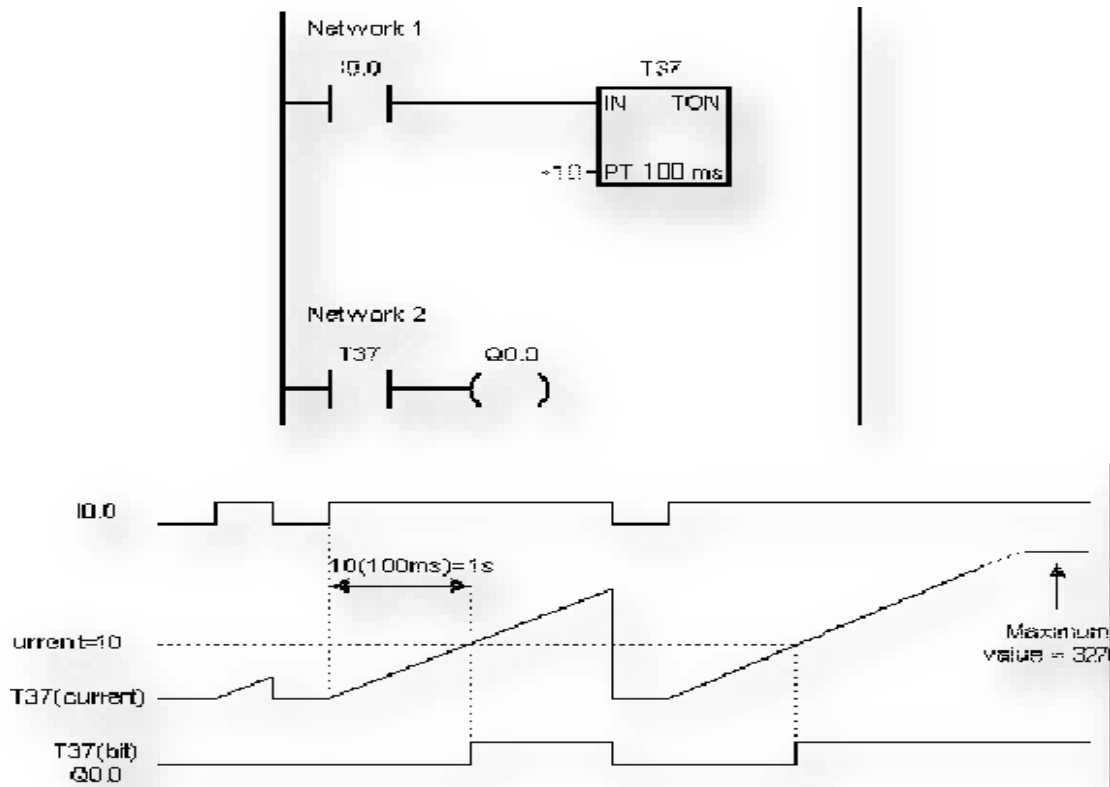
Off-Delay Timer

The Off-Delay Timer (TOF) is used to delay turning an output OFF for a fixed period of time after the input turns OFF. When the enabling input turns ON, the timer bit turns ON immediately, and the current value is set to 0. When the input turns OFF, the timer counts until the elapsed time reaches the preset time. When the preset is reached, the timer bit turns OFF and the current value stops counting. If the input is OFF for a time shorter than the preset value, the timer bit remains ON. The TOF instruction must see an ON to OFF transition to begin counting.
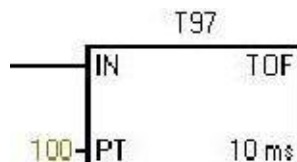
(Ladder logic diagram for off-delay timer. The timing diagram)

Network 1

```
          I0.5                                T33
      ───┤ ├───────────────────────────────┤IN      TOF│
                                            │           │
                                ○ 100 ──────┤PT     10 ms│
```

Network 2

```
          T33              Q0.0
      ───┤ ├───┤ ├────────( )
```

I0.0

100(10ms)   90(10ms)

current=100

T33
(current)

T33 (bit)
Q0.0

COUNTER

Count Up Counter

The Count Up (CTU) instruction counts up from the current value each time

the count-up input CU makes the transition from off to on. When the current value (Cxxx) is greater than or equal to the Preset Value (PV), the counter bit (Cxxx) turns on. The counter is reset when the Reset (R) input turns on, or when the Reset instruction is executed. The counter stops counting when it reaches the maximum value (32,767).

Counter ranges: Cxxx=C0 through C255

Count Down Counter

The Count Down (CTD) instruction counts down from the current value of that counter each time the countdown input CD makes the transition from off to on. When the current value Cxxx is equal to zero, the counter bit (Cxxx) turns on. The counter resets the counter bit (Cxxx) and loads the current value with the preset value (PV) when the load input (LD) turns on. The Down Counter stops counting when it reaches zero, and the counter bit Cxxx turns on.

Counter ranges: Cxxx=C0 through C255
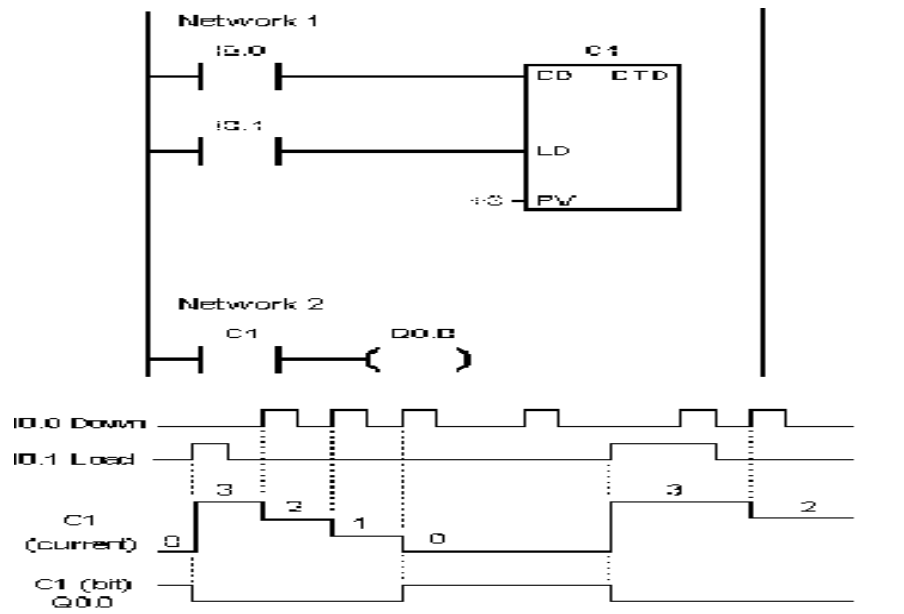
PROCEDURE:

1. Turn the PC ON.
2. Turn the PLC ON.
3. Start V4.0 STEP 7 Micro WIN SP5.
4. Select View>>Ladder.
5. Form Bit Logic double, click the normally open contact.
6. Click on the red question marks, and rename the normally open contactor with a physical input name, I0.0- I0.7 or I1.0-I1.5, let us say I0.0.
7. Now from the Bit Logic, double click the output, and name it with a physical output name, Q0.0-Q0.7 or Q1.0-Q1.1, let us say Q0.0, the result rung will be as shown in the next figure.
8. Select PLC>>Compile All; make sure that the "Total Errors" is zero.
9. Select PLC>>STOP to place the PLC in the stop mode.
10. To download the ladder diagram to the PLC, click download (shown to the right), the window for downloading appears then click to download.
11. Now place the PLC in the run mode, by selecting PLC>>RUN.
12. Now the PLC is ready for use performing the function of the ladder diagram that you have drawn.

Conclusion:

This is all about different timer and counter using PLC ladder programming. As well as PLC programming rules and programming instructions are also important for writing the program.
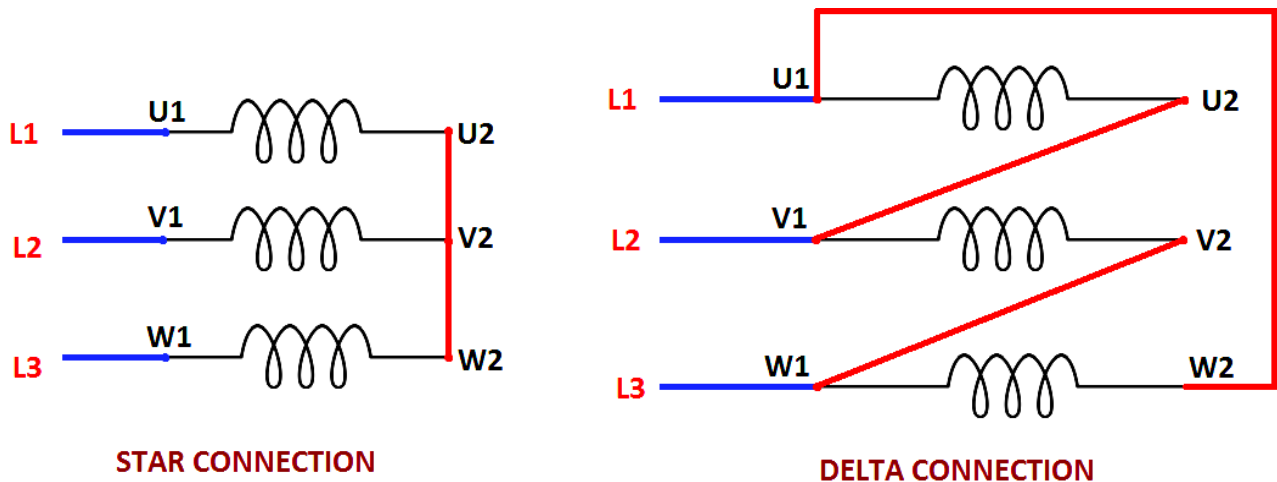
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Execute the Ladder Diagrams with model applications (i) DOL starter (ii)Star- Delta starter

AIM: Execute the Ladder Diagrams with model applications (i) DOL starter (ii)Star- Delta starter

THEORY
Star Delta Motor Starter

The following figure shows the winding connections in star and delta configuration one by one.

STAR CONNECTION   DELTA CONNECTION

InstrumentationTools.com

It can be seen that in star connection, one end of all three windings are shorted to make star point while other end of each winding is connected to power supply.
In delta configuration, the windings are connected such that to make a close loop.

The connection of each winding is shown in above figure. In actual motor the three phase connections are provided in the following order as shown

STAR CONNECTION   DELTA CONNECTION

InstrumentationTools.com

So in order to make winding connection in star and delta style in practical motor, the connection is shown above.

Three Phase Motor

InstrumentationTools.com
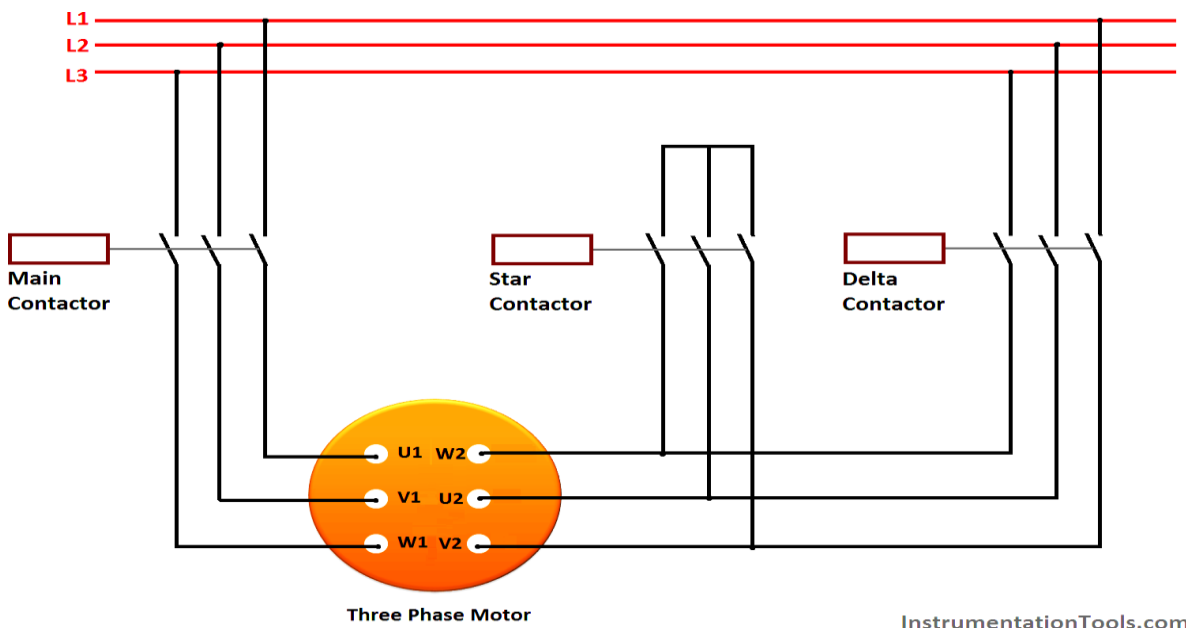
Main contractor is used to supply power to the windings. It must be turned on all the time. Initially the star contactor is closed while delta contactor is open It makes the motor windings in star configuration.
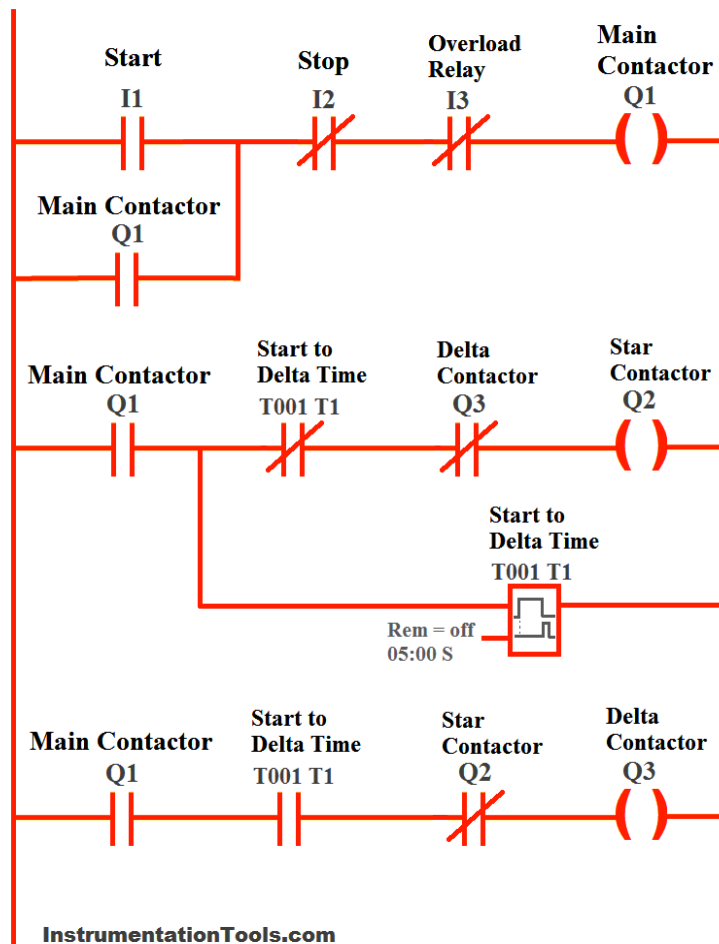
The contactors are controlled by using PLC. The following section of PLC tutorial will explain the ladder programming for star delta motor starter.

PROCEDURE

PLC program for star delta motor starter:
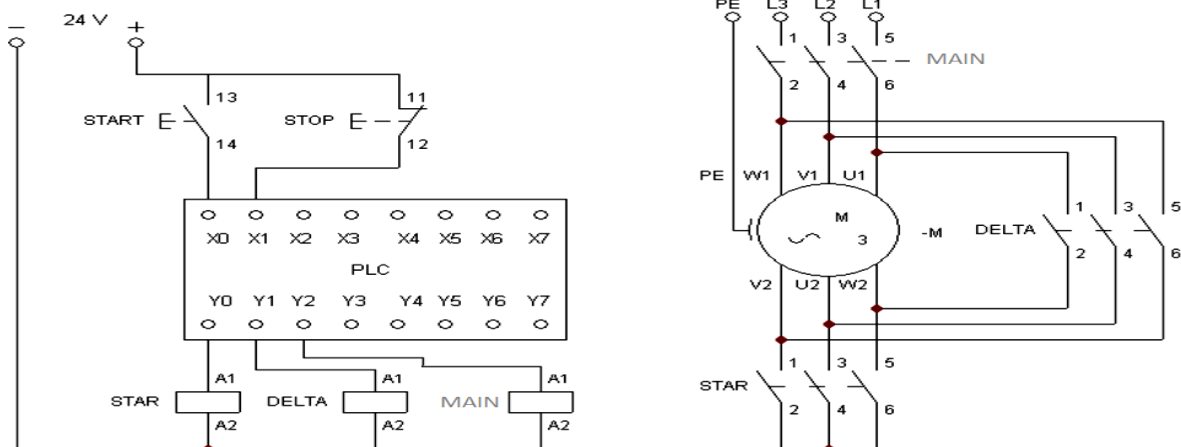
STAR-DELTA MOTOR STARTER LADDER LOGIC

InstrumentationTools.com

Rung 1 Main contactor :

The main contactor depends upon the normally open input start push button (I1), normally closed stop button (I2) and normally closed overload relay.

It means that Main contactor will only be energized if start button is pressed, while stop is not pressed and overload relay is not activated. A normally open input named (Q1) is added in parallel to the start button I1.
By doing so, a push button is created which means that once motor is started, it will be kept started even if start button is released

Rung 2 Star contactor:

Star contactor depends upon main contactor, normally close contacts of <u>timer</u> (T1), and normally close contacts of output delta contactor (Q3).
So star contactor will only be energized if main contactor is ON, time output is not activated and delta contactor is not energized.

Timer T1:

Timer T1 measures the time after which the winding connection of star delta starter is to be changed. It will start counting time after main contractor is energized.

Rung 3 Delta contactor:

Delta contactor will be energized when main contactor (Q1) is energized, timer T1 is activated and star contactor (Q3) is de-energized.

Also see Programming of push button and other requirements for simple motor starter is explained in PLC Tutorial: Motor starter

DOL Starter Ladder Diagram
The ladder diagram of the dol starter.dol (Direct-On-Line) starter is used to start the motor by applying full line voltage to the motor. Dol starter is used for the motors having rating up to the 05HP. Figure shows the control diagram of the dol starter.

DOL (Direct-On-Line) Starter Control Diagram
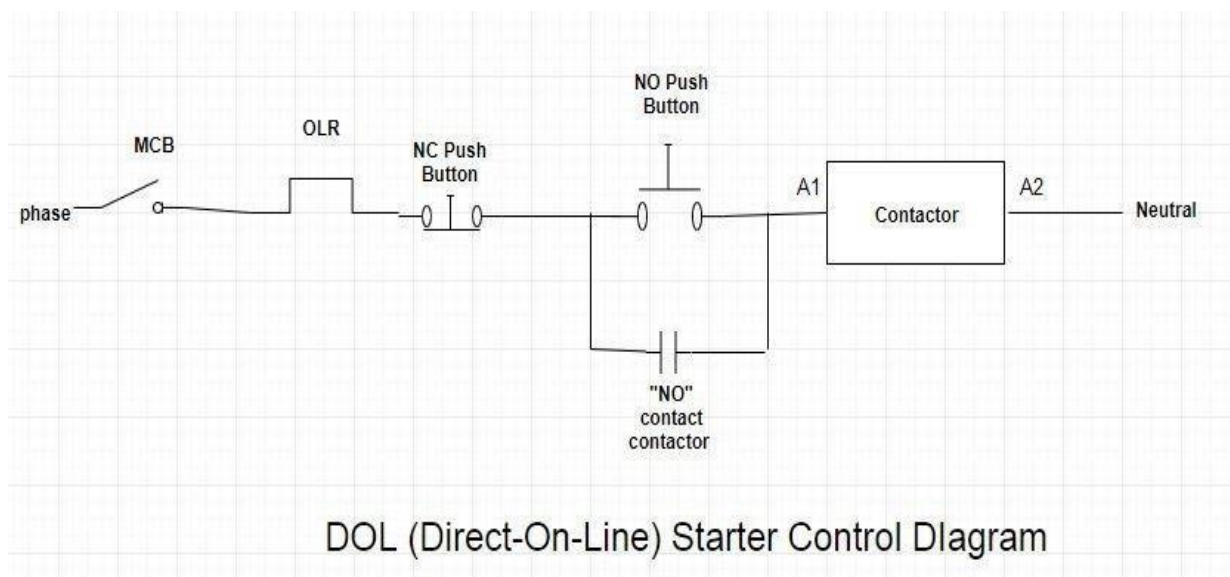
PROCEDURE

- START push button for starting of the starter
- STOP push button to stop the circuit
- CONTACTOR for holding
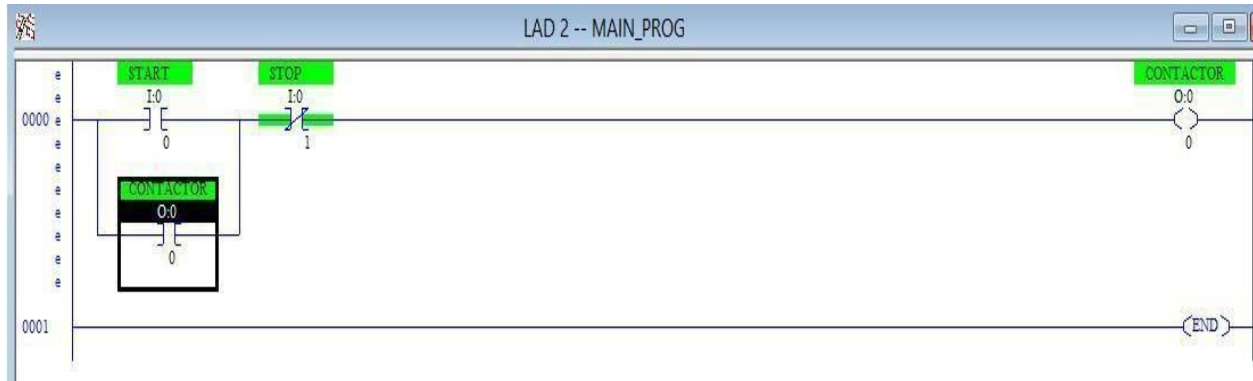
When START push button is pressed contactor will be ON and it starts until the STOP push button is not pressed. When we have pressed the start push button the contactor NO behind the start push button holds the circuit. STOP push button is pressed the CONTACTOR will be OFF untill START button is not pressed again.

We can also made this program using latching here is the ladder diagram of dol starter using latching.
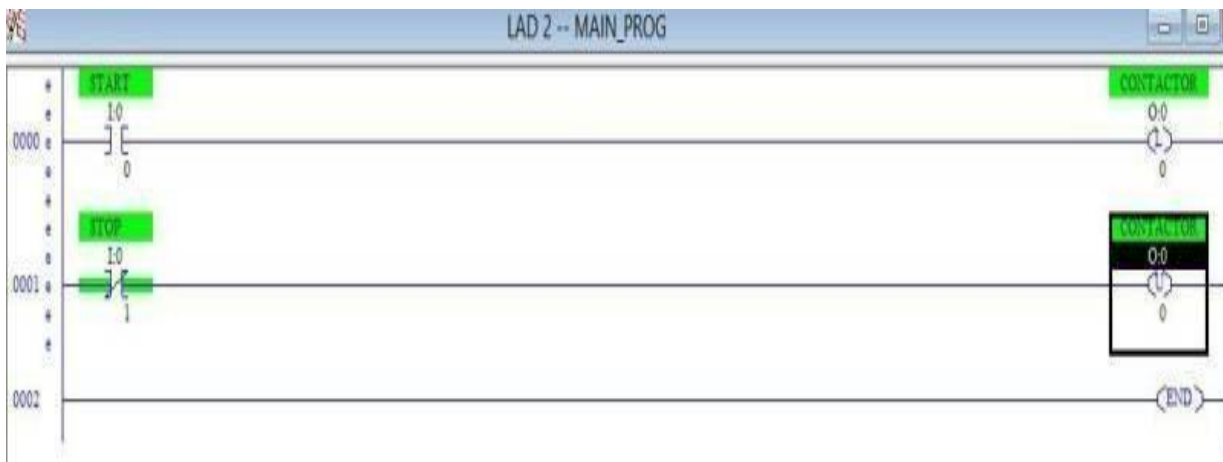
CONCLUSION:

This is all about the Ladder Diagrams with model applications (i) DOL starter (ii)Star- Delta starter.

…………………………………………………………………………………….

Execute Ladder diagrams with model applications (i) Stair case lighting (ii) Traffic light controller

AIM: Execute Ladder diagrams with model applications Stair case lighting.

Equipment:
- I0.0 & I0.1: Input toggle switches.
- Q0.0: Output signaling device.

THEORY;

This ladder logic of stair-case wiring works on the X-OR logic i.e. Y is $(A.B^\wedge) + (A^\wedge. B)$

Suppose initially only I0.0 is pressed and I0.1 remains open physically as shown then the upper branch of rung 1 goes TRUE and Q0.0 gets energized.

Now, if I0.0 is also pressed then it will make its interlock N-C contact I0.1 to go open and as a result Q0.0 de-energizes .

Again, if switch I0.0 is pressed it will also make its interlock contact I0.0 in parallel branch to go again N-C, which in turn makes the parallel branch logic true and Q0.0 again energizes but if the I0.1 input is also pressed again the logic goes FALSE and Q0.0 again de-energizes. This is the basic concept of an X-OR logic gate.

PLC Program for Two way Switch Logic for Staircase Light

:-
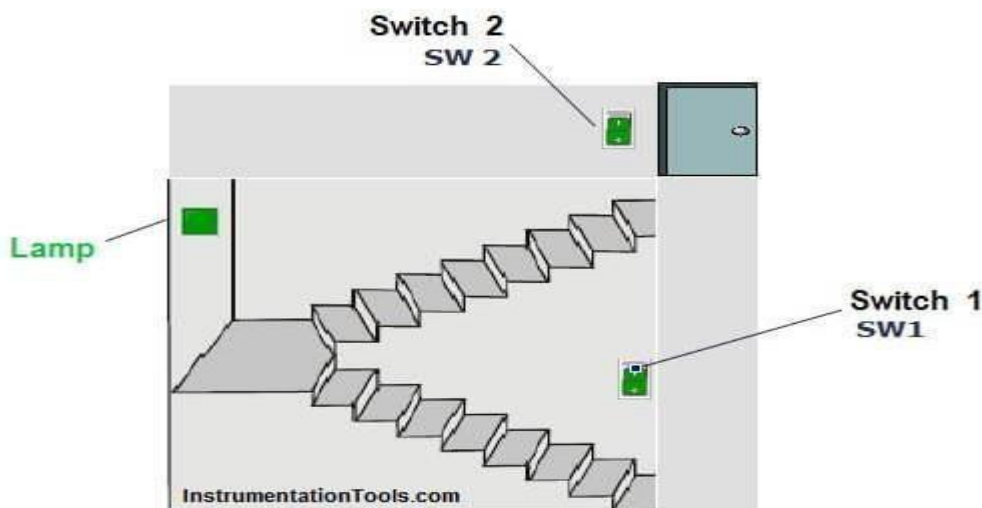
PROCEDURE:

- For this application, we used S7-1200 PLC and TIA portal software for programming.
- In above program, we have added two NO contacts of SW 1 (I0.1) and SW 2 (I0.2) in series and NC contacts of SW1 (I0.1) and SW2 (I0.2) in parallel of this series SW1 & SW2 NO Contacts.
- If the status of the bottom switch (SW1) and status of the top switch (SW2) are same then lamp will be ON. And if either status of the bottom or top switch is different from other then lamp (Q0.0) will be OFF.
- When lamp (Q0.0) is OFF then user can ON the lamp by changing status of any switch. Also user can turn OFF the lamp by changing the status of one of the two switches.

List of inputs/outputs

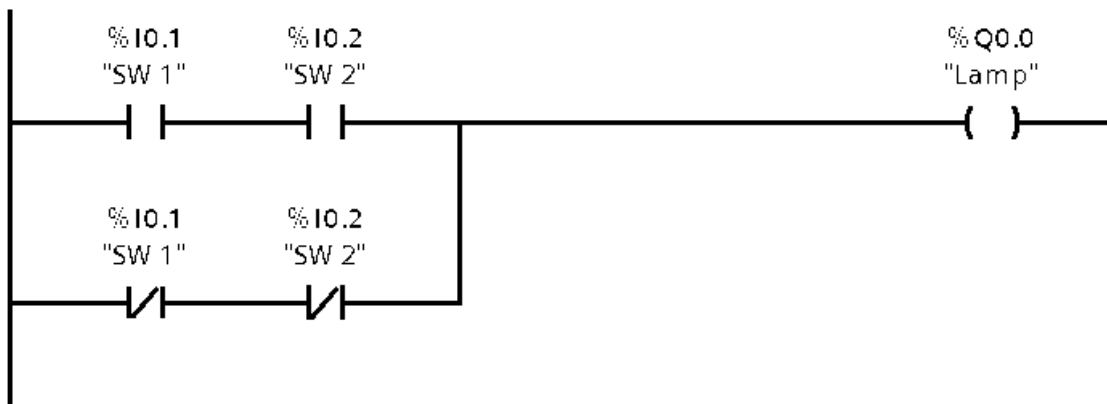### Digital Inputs

- SW1 : I0.1
- SW2 : I0.2

Digital Outputs

- Lamp : Q0.0

PLC Ladder diagram for two ways switch logic

Network 1 : Two Way Switch Logic InstrumentationTools.com

Runtime Test Cases

PLC Program for Two Way Switch Logic

Inputs	Outputs	Physical Elements
I0.1=1 & I0.2=1	Q0.0=1	Lamp on
I0.1=0 & I0.2=0	Q0.1=1	Lamp on
I0.1=0 & I0.2=1	Q0.1=0	Lamp off
I0.1=1 & I0.2=0	Q0.1=0	Lamp off

CONCLUSION:

The above PLC Logic provided for basic idea about application of PLC for Stair case lighting Two Way Switch Logic.

……………………………………………………………………………….

AIM: PLC Program to Control Traffic Lights

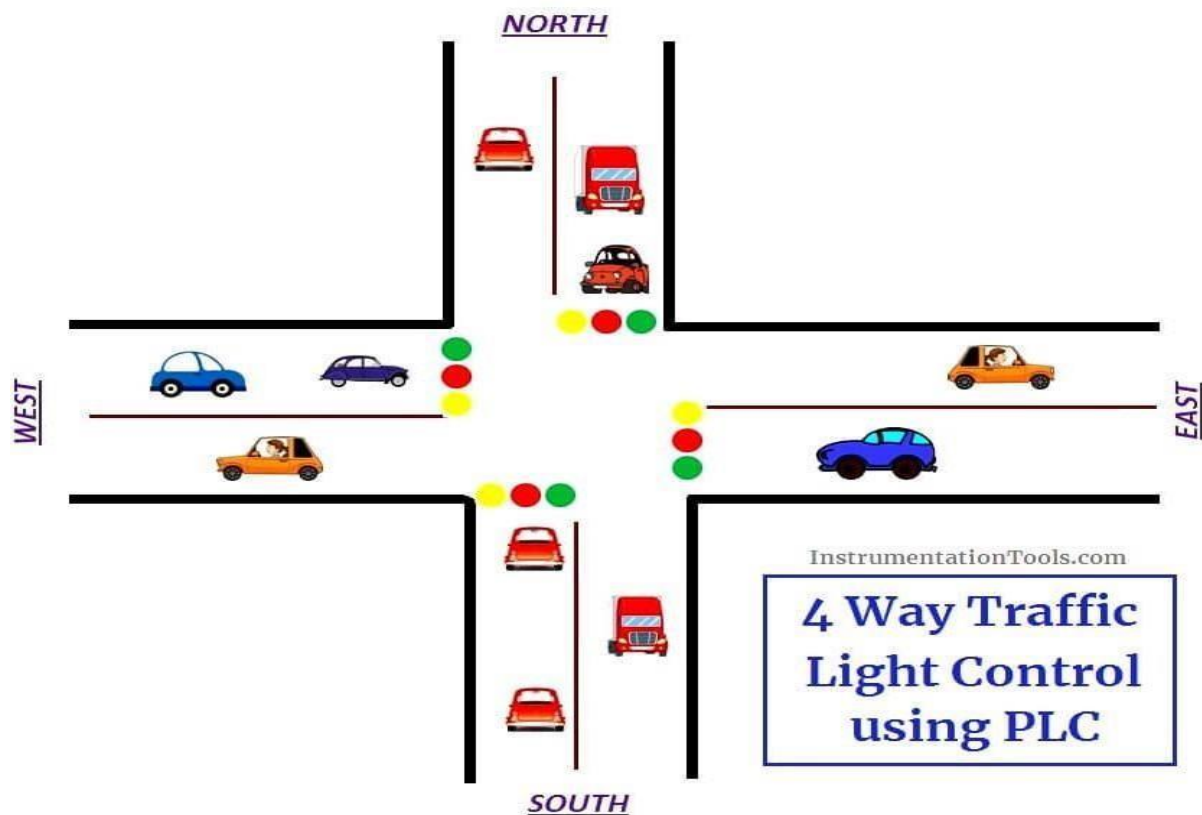**Equipment:**

1) Computer with SIMATIC software.
2) Siemens S7-1200 PLC.
3) LEDs.
4) Switches.
5) Connecting wires

THEORY:

We most often come across four way traffic jam in our city. This PLC ladder logic gives the solution to control city traffic using programmable logic control.

4 Way Traffic Light Control

List of Inputs and Outputs

S.no	Address	Name	Input/Output
1	I:0/0	Start	Input
2	I:0/1	Stop	Input
3	B3.0	Memory	Memory
4	O:0/0	East Green	Output
5	O:0/1	North Red	Output
6	O:0/2	West Red	Output
7	O:0/3	South Yellow	Output
8	O:0/4	East Yellow	Output
9	O:0/5	North Yellow	Output
10	O:0/6	North Green	Output
11	O:0/7	East Red	Output
12	O:0/8	West Yellow	Output

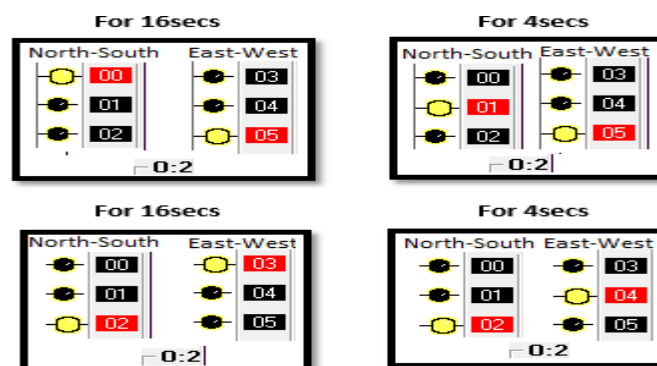| 13	O:0/9	West Green	Output
14	O:0/10	South Yellow	Output
15	O:0/11	South Green	Output

Sequence of Operation

Below tabular column gives the Steps or sequence of outputs to turn ON the traffic system lamps (RED, GREEN, YELLOW)

S.NO	EAST	WEST	NORTH	SOUTH
1	G	R	R	R
2	Y	R	Y	R
3	R	R	G	R
4	R	Y	Y	R
5	R	G	R	R
6	R	Y	R	Y
7	R	R	R	G
8	Y	R	R	Y

PLC Ladder Logic
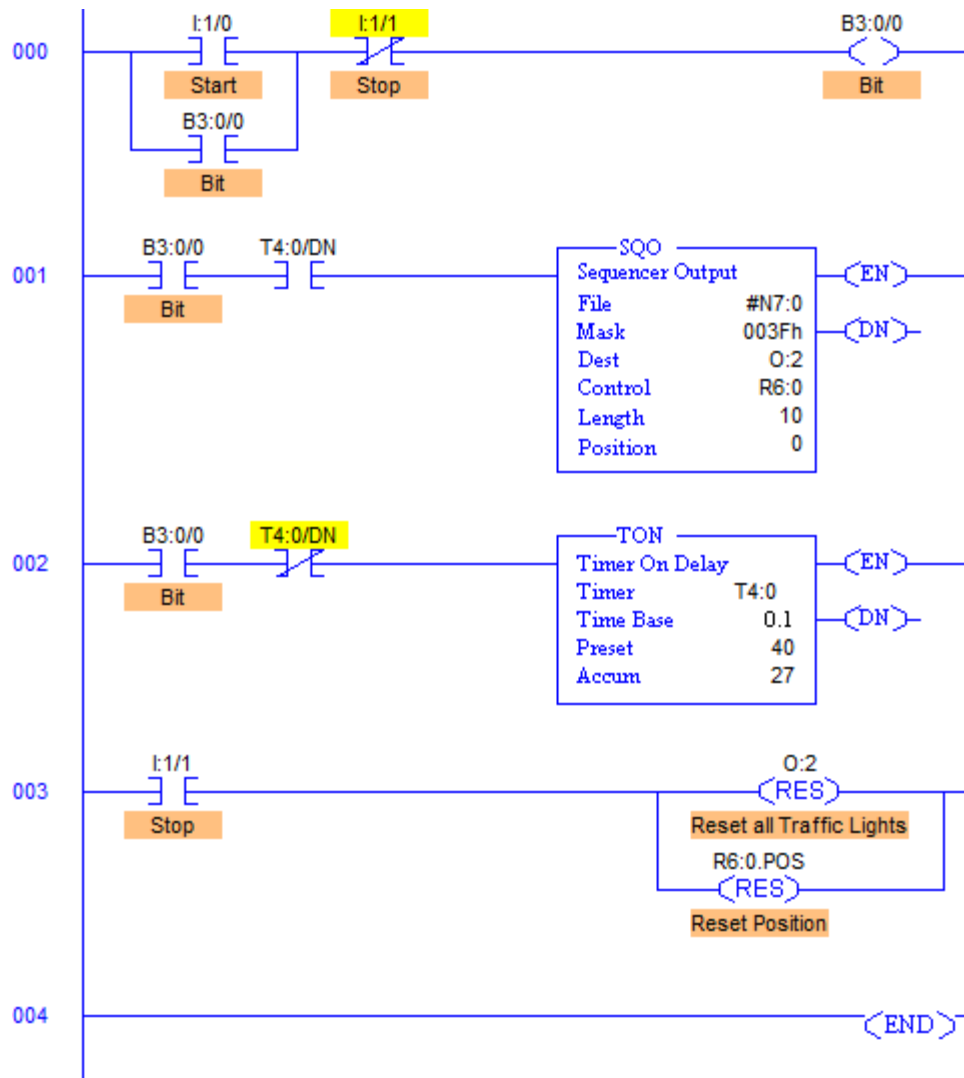
Runtime Test Cases

PROCEDURE

- RUNG000 again here is for Master Start and Stop the process.
- File; #N7:0 and File length is 10, hence output sequence is varied from N7:0 to N7:10 with each input.
- Destination is set to O:2 hence with each transition, N7:0 to N7:10 are moved to O:2 with masking.
- O:2/0 to O:2/5 are used as the output address to Traffic Lights and hence Mask has value 003Fh which means data flow of N7:0/0…N7:10/0 to N7:0/5…N7:10/5 is passed and the remaining N7:0/6…N7:10/6 to N7:0/15…N7:10/15 are blocked.
- Control parameters are assigned to register R6:0.
- Sequence of traffic lights to be operated are stored in the registers from N7:0 to N7:10 as following
- Time base is set to 4secs, hence after every 4secs, output sequence is changed to its next register pattern outputs which is then transferred to O:2 and O:2/0 to O:2/5 are energized accordingly.
- As we can see, from N7:1 to N7:4 have the same bit pattern. So, these bits are set to 1 for 4 cycles that is 16secs. These bits are used for South-North Green light and East-West Red light.
- Similarly the entire sequence is followed.
- When Stop I:1/1 is pressed, Position is reset to 0 and all the outputs are de- energized.

Conclusion:

The above explained 4 ways traffic light control using PLC is for example only. It may vary from real time. We can use this example program to understand the working of timers and Interlocking function in PLC.