

PROGRAMMABLE LOGIC CONTROLLERS AND AUTOMATION LABORATORY

LAB MANUAL

Subject Code : AEE110
Regulations : IARE-R16
Branch : EEE
Class : VI Semester



Department of Electrical and Electronics Engineering

**INSTITUTE OF AERONAUTICAL ENGINEERING
(AUTONOMOUS)**

Dundigal – 500 043, Hyderabad



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Department of Electrical and Electronics Engineering

Program Outcomes	
PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, APPRATUS, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life - Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life - long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	Professional Skills: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.

PSO2	Problem - Solving Skills: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.
PSO3	Successful Career and Entrepreneurship: The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test, maintain power system and applications.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Direct Online Starter for Three Phase Induction Motor	PO3, PO5	PSO3
2	Star Delta Starter for Three Phase Induction Motor	PO3, PO5	PSO3
3	Automatic Forward And Reverse Control of Three Phase Induction Motor	PO3, PO5	PSO3
4	Plugging of Three Phase Induction Motor	PO3, PO5	PSO3
5	Sequential Control of Motors	PO3, PO5	PSO3
6	Speed Control of DC Motor	PO2, PO3	PSO3
7	Control of Lift	PO3, PO5	PSO3
8	Fault Annunciation System	PO3, PO5	PSO3
9	Traffic Signal Control	PO3, PO5	PSO3
10	Up Down Counter	PO3, PO5	PSO3
11	Timers	PO3, PO5	PSO3
12	Digital Clock	PO3, PO5	PSO3
13	Temperature Control System	PO3, PO,	PSO3
14	Solar Tracking	PO3, PO5, PO7	PSO3

PROGRAMMABLE LOGIC CONTROLLERS AND AUTOMATION LAB

OBJECTIVE

The primary objective of the PLC lab is to familiarize students with how signals from input devices (i.e. switches, sensors, etc.) can interface with PLC units in order to invoke certain actions (i.e. start/stop an electric motor, turn on a light, etc.). A PLC functions similar to your computer. A computer processes input (i.e. keyboard entries, sounds from microphones, etc.) and invokes a certain output (i.e. showing the letter you typed on the screen, sending a request through the internet, etc.). Similarly, PLC unit processes input and invokes output, but the inputs to a PLC unit are usually devices such as sensors, buttons, switches, etc. The outputs are usually signaling to start/stop motors, turn on/off lights, sound a horn, etc.

OUTCOMES:

Upon the completion of **Programmable Logic Controllers and Automation Laboratory**, the student will be able to attain the followings:

1. Know the importance of automation in industry.
2. Have the knowledge of different input devices used and how to connect them with the PLC.
3. Get the knowledge of timers and counters in PLC.
4. Develop a direct online starter, star delta starter using PLC.
5. Know the importance and of sequential operation of motors in industry and how to perform sequential operation using PLC.
6. Can be able to control the temperature inside a room using PLC.
7. Can be able to track the position of sun using single axis tracking with PLC.

EXPERIMENT – 1

DIRECT ONLINE STARTER FOR THREE PHASE INDUCTION MOTOR

1.1 AIM:

To implement the direct online starter for three phase induction motor using PLC.

1.2 APPARATUS:

S. No	Name of the equipment	Quantity
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	2
4	Push Buttons (NO)	2
5	Contactors	1
6	MCB	1
7	3phase squirrel Induction motor	1
8	Personnel computer with Wplsoft Software	1

1.3 THEORY

A Direct On-Line (DOL) or across the line starter applies the full line voltage to the motor terminals. This is the simplest type of motor starter. A DOL motor starter also has protection devices and, in some cases, condition monitoring. Smaller sizes of direct on-line starters are manually operated; larger sizes use an electromechanical contactor (relay) to switch the motor circuit. Solid-state direct on line starters also exist. A direct on line starter can be used if the high inrush current of the started motor does not cause excessive voltage drop in the supply circuit. The maximum size of a motor allowed on a direct on line starter may be limited by the supply utility for this reason. For example, a utility may require rural customers to use reduced-voltage starters for motors larger than 4KW (5HP). DOL starting is sometimes used to start small water pumps, compressors, fans and conveyor belts. In the case of an asynchronous motor, such as the 3-phase squirrel-cage motor, the motor will draw a high starting current until it has run up to full speed. This starting current is typically 6-7 times greater than the full load current. To reduce the inrush current, larger motors will have reduced voltage starters or variable speed drives in order to minimize voltage dips to the power supply, or series resistance and inductance can be added.

1.4 ELECTRICAL CIRCUIT DIAGRAM:

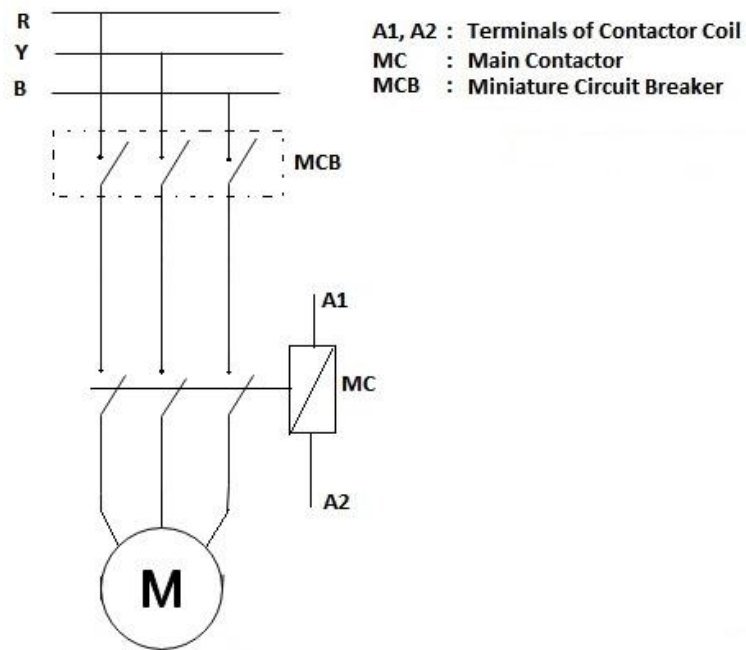


Figure.1.1 Electrical Circuit for DOL starter of three phase induction motor

1.5 PLC CONNECTION DIAGRAM:

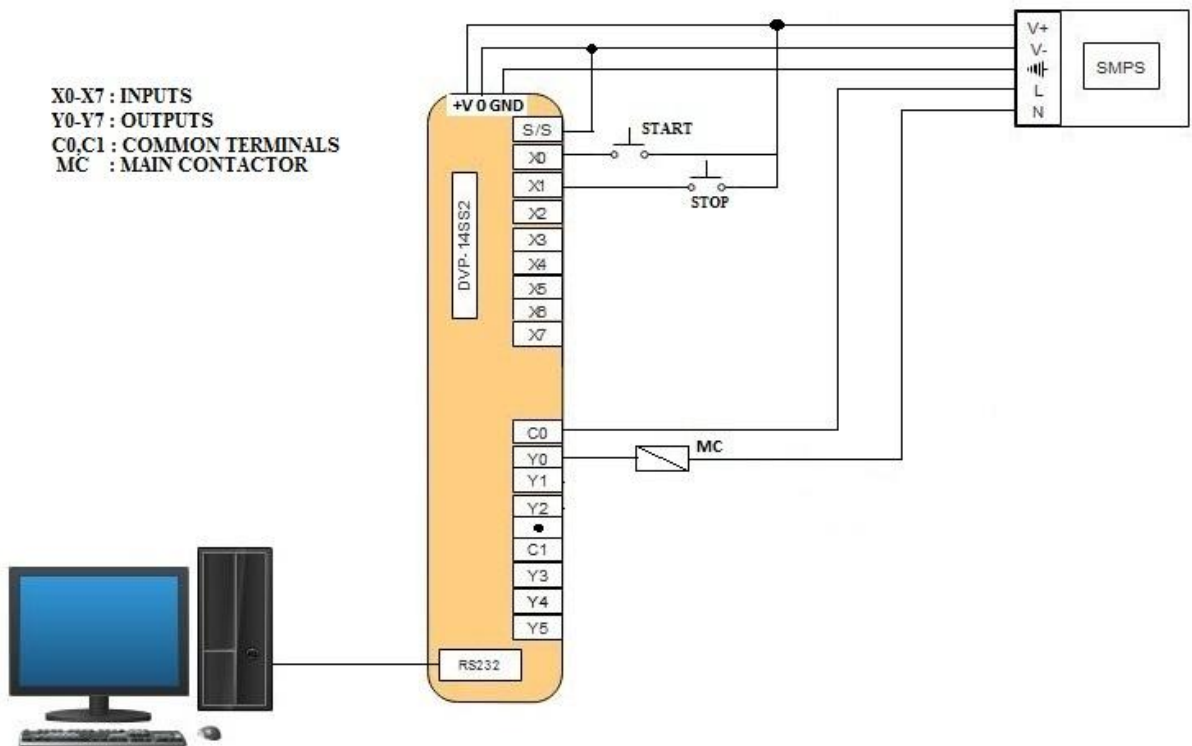


Figure.1.2 PLC Connection diagram

1.6 LADDER PROGRAMMING:

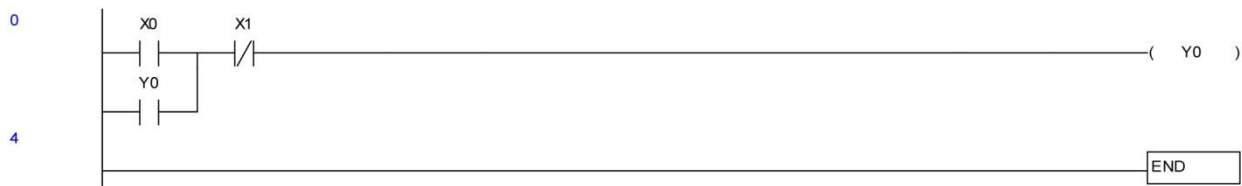


Figure: 1.3 PLC Ladder Programing

1.7 PROGRAM DESCRIPTION

1. Make the connection as per the electrical circuit diagram and PLC connection diagram.
2. Click on the WPL soft and write the PLC ladder Program.
3. Dump the program to the PLC using RS232 cable.
4. Turn on the power supply to the PLC and Push the START button.
5. Observe that the main contactor will be closed and a three phase supply is applied to the motor to start running.
6. Push the STOP button and turn OFF the supply to PLC.

1.8 RESULT:

1.9 PRE LAB VIVA QUESTIONS

1. What is Direct on Line Starter and why is it used
2. What are the applications of DOL starter
3. What are the disadvantages of DOL starter
4. What are the safety features to be incorporated when PLC is used to implement DOL starter
5. What is DOL starter?
6. How DOL starter works?

1.10 POST LAB VIVA QUESTIONS

1. What do you mean by holding contact?
2. How do we use an NO contact in PLC to switch on the motor?
3. Compare DOL starter and Star Delta starter.
4. Can we use DOL starter with slip-ring induction motor.
5. Why OLR is used in the control circuit of DOL starter?
6. What is difference between maintained push button and momentary contact push button?
7. What is the difference between Relay and Contactor?

EXPERIMENT - 2

STAR-DELTA STARTER FOR THREE PHASE INDUCTION MOTOR

2.1 AIM:

To implement the star-delta starter for three phase induction motor using PLC.

2.2 APPARATUS:

S. No	Name of the equipment	Quantity
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	2
4	Push Buttons (NO)	2
5	Contactors	3
6	MCB	1
7	3phase squirrel Induction motor	1
8	Personnel computer with Wpl soft Software	1

2.3 THEORY:

Most induction motors are started directly on line, but when very large motors are started that way, they cause a disturbance of voltage on the supply lines due to large starting current surges. To limit the starting current surge, large induction motors are started at reduced voltage and then have full supply voltage reconnected when they run up to near rotated speed. Two methods are used for reduction of starting voltage are star delta starting and auto transformer starting. The Star Delta Starter is a very common type of starter and is used extensively as compared to the other type of starting methods of the induction motor. A star delta is used for a cage motor designed to run normally on the delta connected stator winding. When the switch S is in the **START** position, the stator windings are connected in the star. When the motor picks up the speed, about 80 percent of its rated speed, the switch S is immediately put into the **RUN** position. As a result, a stator winding which was in star connection is changed into **DELTA** connection now. Firstly, the stator winding is connected in star and then in Delta so that the starting line current of the motor is reduced to one-third as compared to the starting current with the windings connected in delta. At the starting of an induction motor when the windings of the stator are star connected, each stator phase gets a voltage $V_L/\sqrt{3}$. Here V_L is the line voltage. Since the developed torque is proportional to the square of the voltage applied to an induction motor. Star delta starter reduces the starting torque to one-third that is obtained by direct delta starting.

2.4 ELECTRICAL CIRCUIT DIAGRAM:

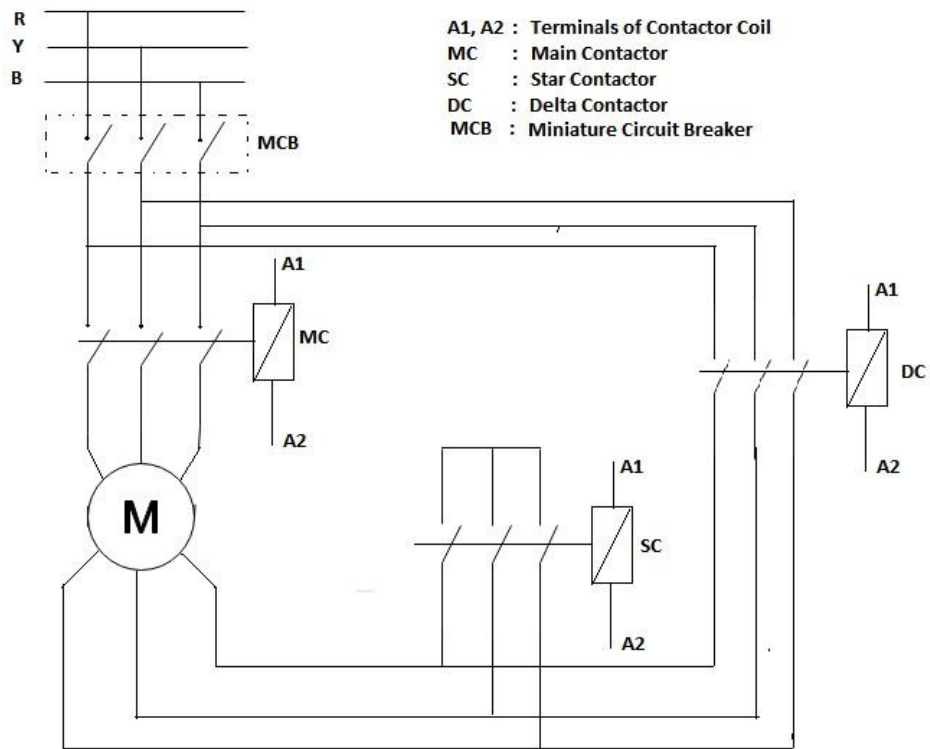


Figure: 2.1 Circuit Diagram for Star-Delta Starter for Three Phase Induction Motor

2.5 PLC CONNECTION DIAGRAM:

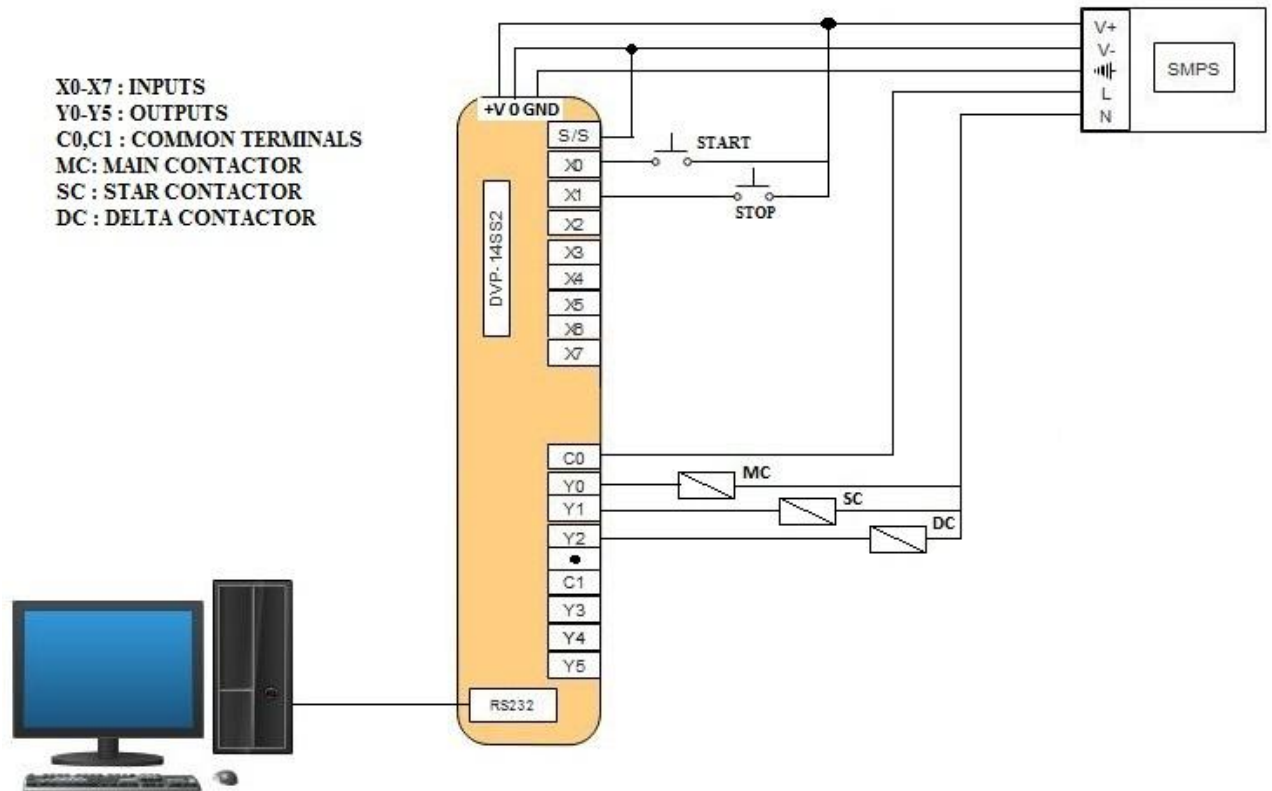


Figure: 2.2 PLC connection diagram

2.6 LADDER PROGRAMMING:

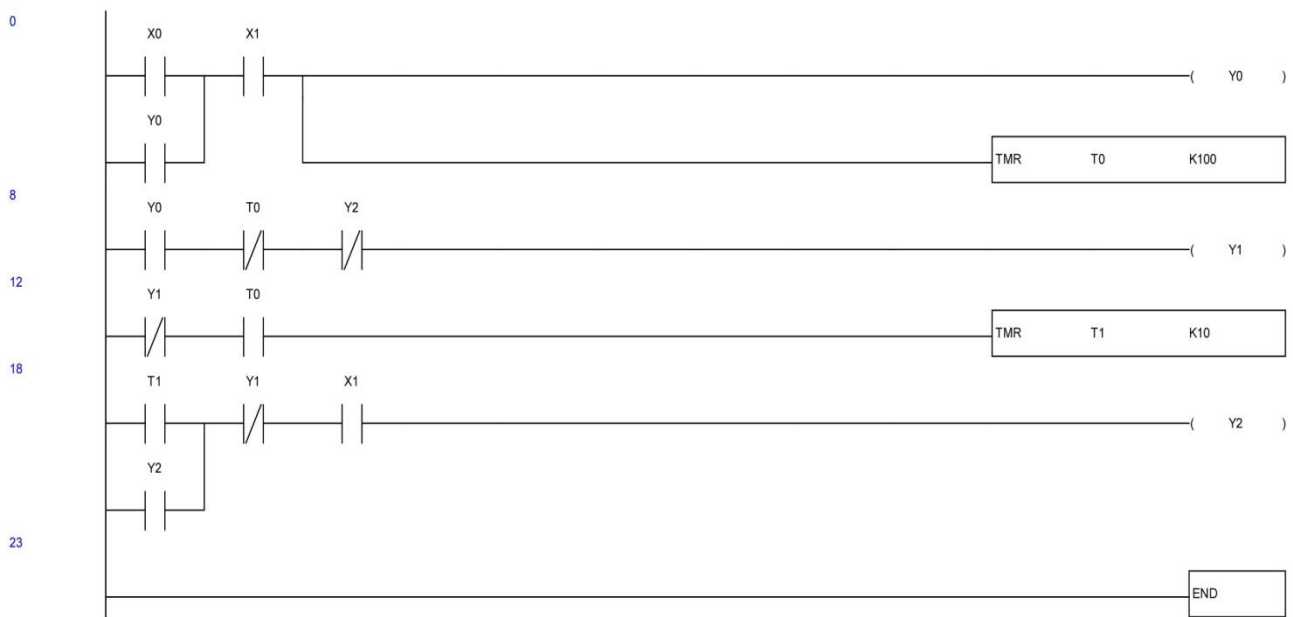


Figure: 2.3 PLC Ladder Programming

2.7 PROCEDURE:

1. Connect the power circuit cables of the motor.
2. Then, connect the control circuit cables for an easy set-up and do not forget to connect the PE (ground) connections!
3. Connect the 24 V DC SMPS to the Three-Phase supply unit and connect a multi-meter to measure the line current.
4. Connect the contactors to the stator windings of the induction motor. The windings connections can be plugged to the connection box on the induction motor. The stator must be WYE connected.
5. Connect the tacho-generator to the breaker control unit.
6. Make sure that the torque knob in the brake unit is at minimum, i.e., rotate all the way to the CCW direction.
7. Connect the NO and NC switches to the digital input module of the PLC. For each switch, connect one end to 24 V of SMPS, and connect other end to the corresponding input sockets on PLC Basic Unit.
8. Connect the PLC output from the PLC Basic Unit to the Contactor outputs of three contactors are Y0, Y1, Y2. Connect A2- end of Main contactor to zero volt on SMPS.
9. Open the STEP 7 software to program the PLC:

10. Make an online connection between the PLC and the software by running the command from “File/Connect Online”.
11. Create a new project. Then, in “Program/OB1” write your code in FBD/LD or STL. Right Click on OB1 and choose “Download to CPU” command.
12. When file transfer is finished, switch PLC to RUN mode.

2.8 RESULT:

2.9 PRE LAB VIVA QUESTIONS:

1. What is the principle of three phase induction motor?
2. What is the need of a starter in three phase induction motor?
3. What are the different types of starters available for three phase induction motor?
4. How star delta starters differ from a direct online starter?
5. Describe the operation of a PLC.

2.10 POST LAB VIVA QUESTIONS:

1. What is the function of star delta starter?
2. What are the advantages of star delta starter?
3. What are the disadvantages of star delta starter?
4. What are the input and output devices connected to PLC in Star delta Starter?
5. What is the function of a contactor?

EXPERIMENT – 3

AUTOMATIC FORWARD AND REVERSE CONTROL OF THREE PHASE INDUCTION MOTOR

3.1 AIM:

To operate three phase slip ring induction motor in forward and reverse direction continuously using PLC.

3.2 APPARATUS:

S. No	Name of the equipment	Quantity
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	2
4	Push Buttons (NO)	2
5	Contactors	2
6	MCB	1
7	3phase slip ring Induction motor	1
8	Relay Module	1
9	Personnel computer with Wplsoft V2.41	1

3.3 THEORY:

3-phase induction motor is the motor of the most popular or the most widely used in the propulsion, blowers etc. It was probably due to the induction motor by the motors of other types, such as; simple, durable, easy to maintain, and have a high efficiency. The direction of rotation of 3-phase induction motor is reversed by reversing the polarity of one of the incoming voltage to the motor.

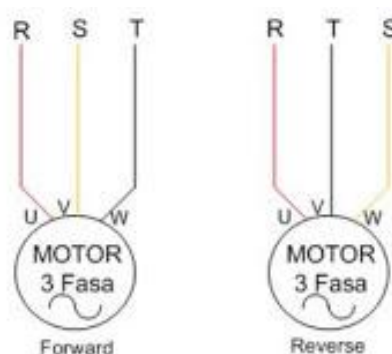


Figure: 3.1 Three phase induction motor terminals

3.4 CONNECTION DIAGRAM:

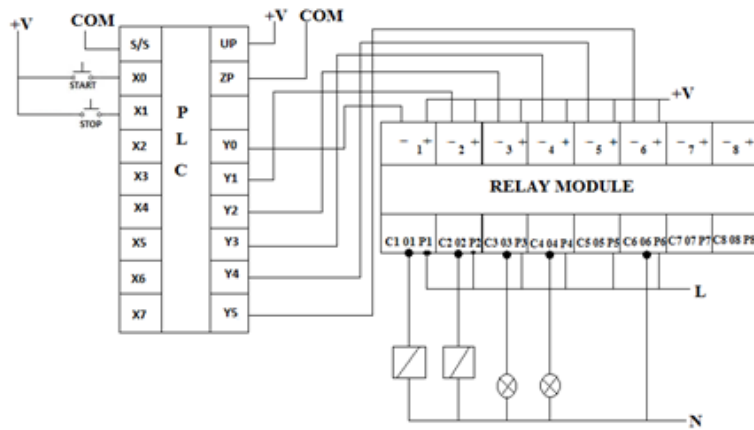


Figure: 3.2 PLC Connection diagram

3.5 LADDER PROGRAMMING:

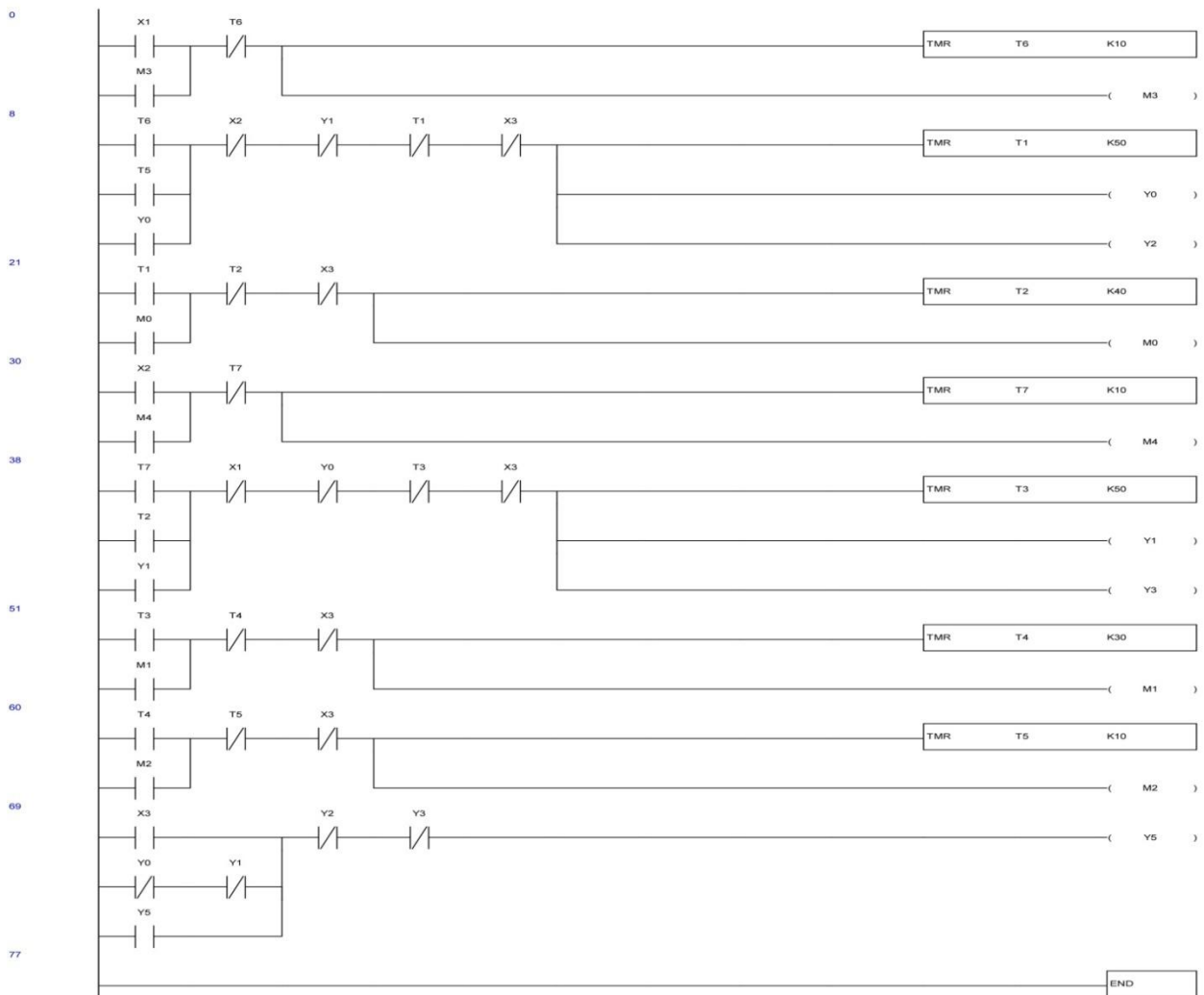


Figure: 3.3 PLC Ladder Programming

3.6 PROCEDURE:

1. Connect the power circuit cables of the motor.
2. Then, connect the control circuit cables for an easy set-up and do not forget to connect the PE (ground) connections!
3. Connect the 24 V DC SMPS to the Three-Phase supply unit and connect a multi-meter to measure the line current.
4. Connect the contactors to the stator windings of the induction motor. The windings connections can be plugged to the connection box on the induction motor. The stator must be WYE connected.
5. Connect the tacho-generator to the breaker control unit.
6. Make sure that the torque knob in the brake unit is at minimum, i.e., rotate all the way to the CCW direction.
7. Connect the NO and NC switches to the digital input module of the PLC. For each switch, connect one end to 24 V of SMPS, and connect other end to the corresponding input sockets on PLC Basic Unit.
8. Connect the PLC output from the PLC Basic Unit to the Contactor outputs of three contactors are Y0, Y1, Y2. Connect A2- end of Main contactor to zero volt on SMPS.
9. Open the STEP 7 software to program the PLC:
10. Make an online connection between the PLC and the software by running the command from “File/Connect Online”.
11. Create a new project. Then, in “Program/OB1” write your code in FBD/LD or STL. Right Click on OB1 and choose “Download to CPU” command.
12. When file transfer is finished, switch PLC to RUN mode.

3.7 RESULT:

3.8 PRE LAB VIVA QUESTIONS:

1. What are the different methods for reversing the direction of induction motor?
2. What is the Principle of induction motor?
3. What is the need of reversing the motor?

3.9 POST LAB VIVA QUESTIONS:

1. What are the applications of in which reversing and forwarding of motor is required?
2. What is the advantage of using PLC in industries?
3. Explain the operation of PLC.

EXPERIMENT – 4

PLUGGING OF INDUCTION MOTOR USING PLC

4.1 AIM:

To apply the brake by plugging method for three phase induction motor using PLC.

4.2 APPARATUS:

S. No	Name of the equipment	Quantity
1	PLC	1
2	SMPS	1
3	MCB	1
4	Contactors	4
5	Indicating Bulbs	4
6	Push Buttons (NO)	4
7	3phase squirrel Induction motor	1
9	Personnel computer with Wplsoft V2.41	1

4.3 ELECTRICAL CIRCUIT DIAGRAM:

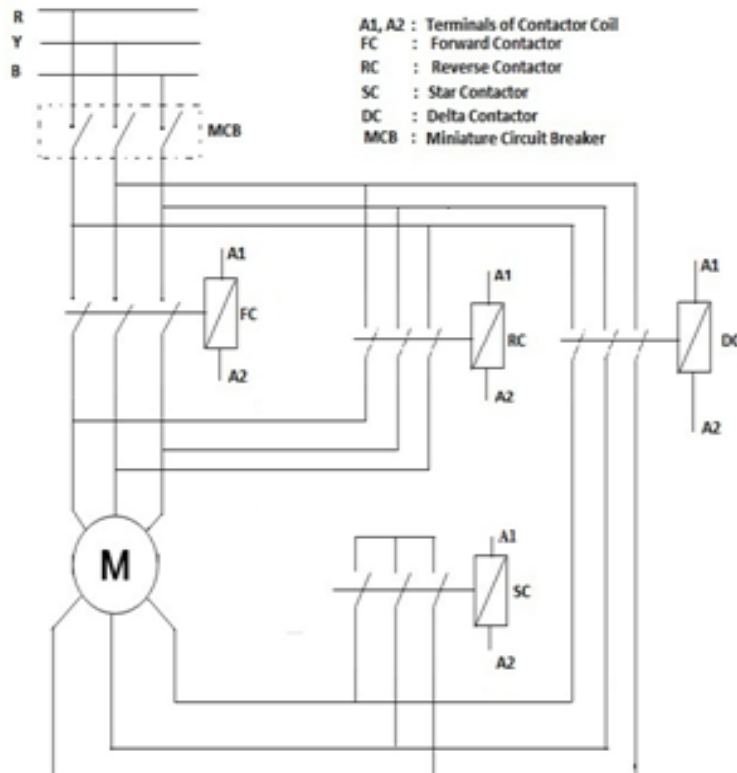


Figure: 2.3 Circuit Diagram Plugging of Induction Motor Using PLC

4.4 PLC CONNECTION DIAGRAM:

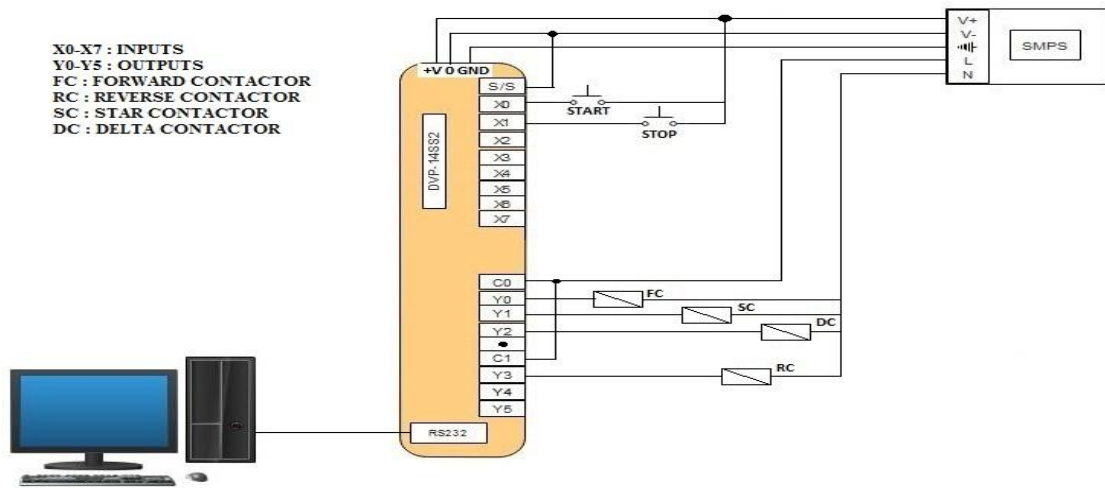


Figure: 2.4 PLC Connection diagram

4.5 LADDER PROGRAMMING:

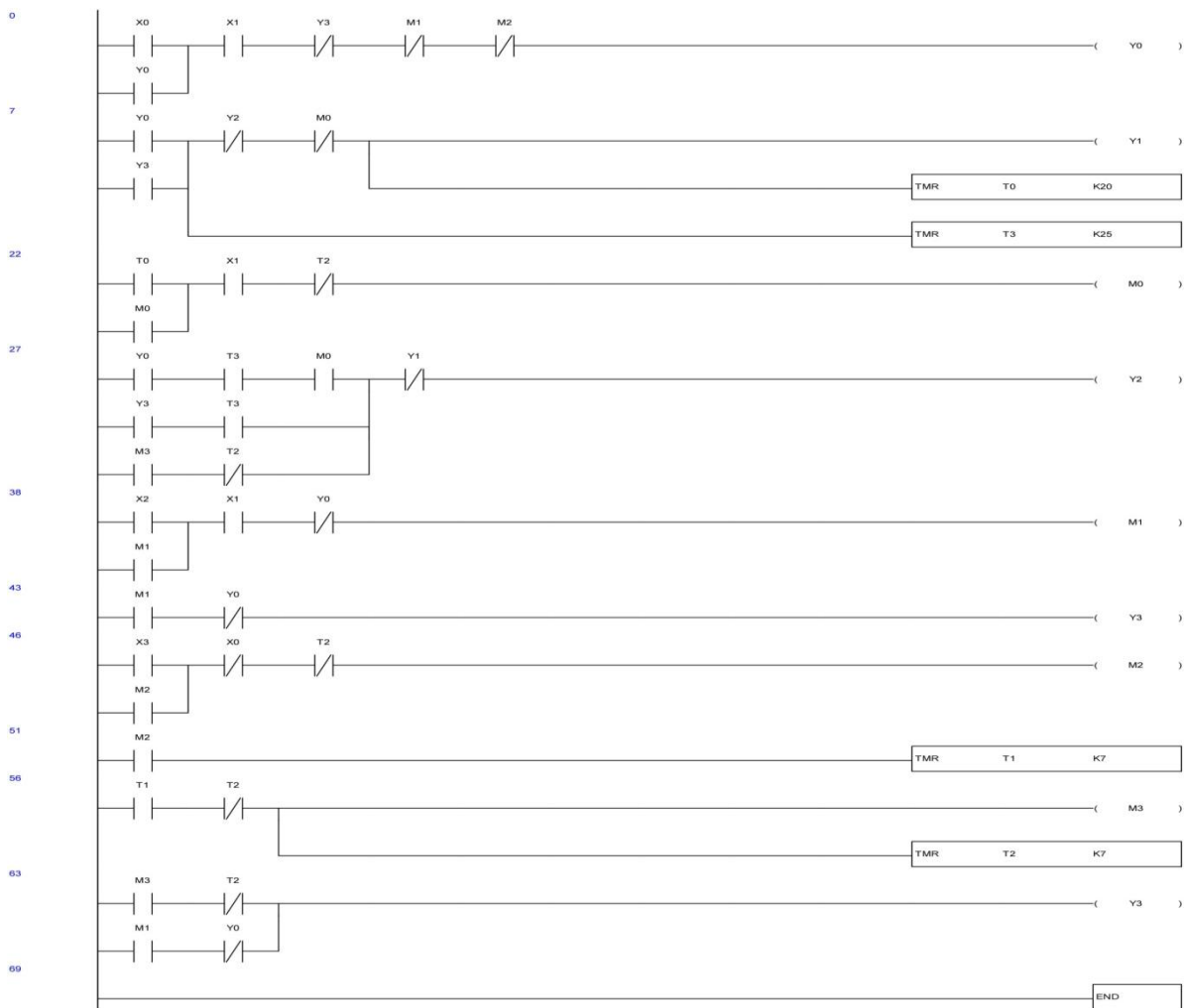


Figure: 4.3 PLC Ladder Programming

4.6 PROCEDURE

1. Connect the power circuit cables of the motor.
2. Then, connect the control circuit cables for an easy set-up and do not forget to connect the PE (ground) connections!
3. Connect the 24 V DC SMPS to the Three-Phase supply unit and connect a multi-meter to measure the line current.
4. Connect the contactors to the stator windings of the induction motor. The windings connections can be plugged to the connection box on the induction motor. The stator must be WYE connected.
5. Connect the tacho-generator to the breaker control unit.
6. Make sure that the torque knob in the brake unit is at minimum, i.e., rotate all the way to the CCW direction.
7. Connect the NO and NC switches to the digital input module of the PLC. For each switch, connect one end to 24 V of SMPS, and connect other end to the corresponding input sockets on PLC Basic Unit.
8. Connect the PLC output from the PLC Basic Unit to the Contactor outputs of three contactors are Y0, Y1, Y2. Connect A2- end of main contactor to zero volt on SMPS.
9. Open the STEP 7 software to program the PLC:
10. Make an online connection between the PLC and the software by running the command from “File/Connect Online”.
11. Create a new project. Then, in “Program/OB1” write your code in FBD/LD or STL. Right Click on OB1 and choose “Download to CPU” command.
12. When file transfer is finished, switch PLC to RUN mode.

4.7 RESULT:

4.8 PRE LAB VIVA QUESTIONS

1. Define is plugging?
2. Explain Regenerative braking method.
3. Explain the dynamic braking method.
4. Which method of braking is more used now a day?

4.9 POST LAB VIVA QUESTIONS

1. What are the advantages of plugging method?
2. What are the disadvantages of plugging?
3. How the plugging is applied to induction motor?
4. Which method of braking is advantageous?

EXPERIMENT – 5

SEQUENTIAL CONTROL OF THREE MOTORS

5.1 AIM:

To start the three motors using in an industry sequentially one after other using PLC

5.2 APPARATUS:

S. No	Name of the equipment	Quantity
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	2
4	Push Buttons (NO)	2
5	Contactors	3
6	MCB	3
7	3phase squirrel Induction motor	3
9	Personnel computer with Wplsoft V2.41	1

5.3 ELECTRICAL CIRCUIT DIAGRAM:

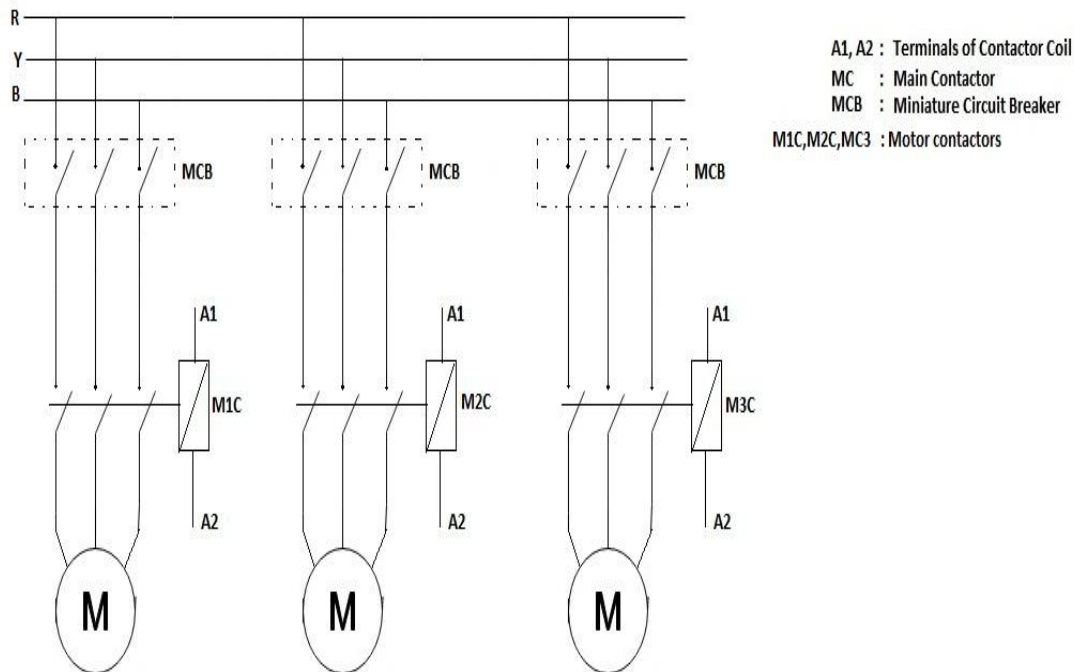


Figure: 5.1 Circuit Diagram Sequential Control of Three Motors

5.4 PLC CONNECTION DIAGRAM:

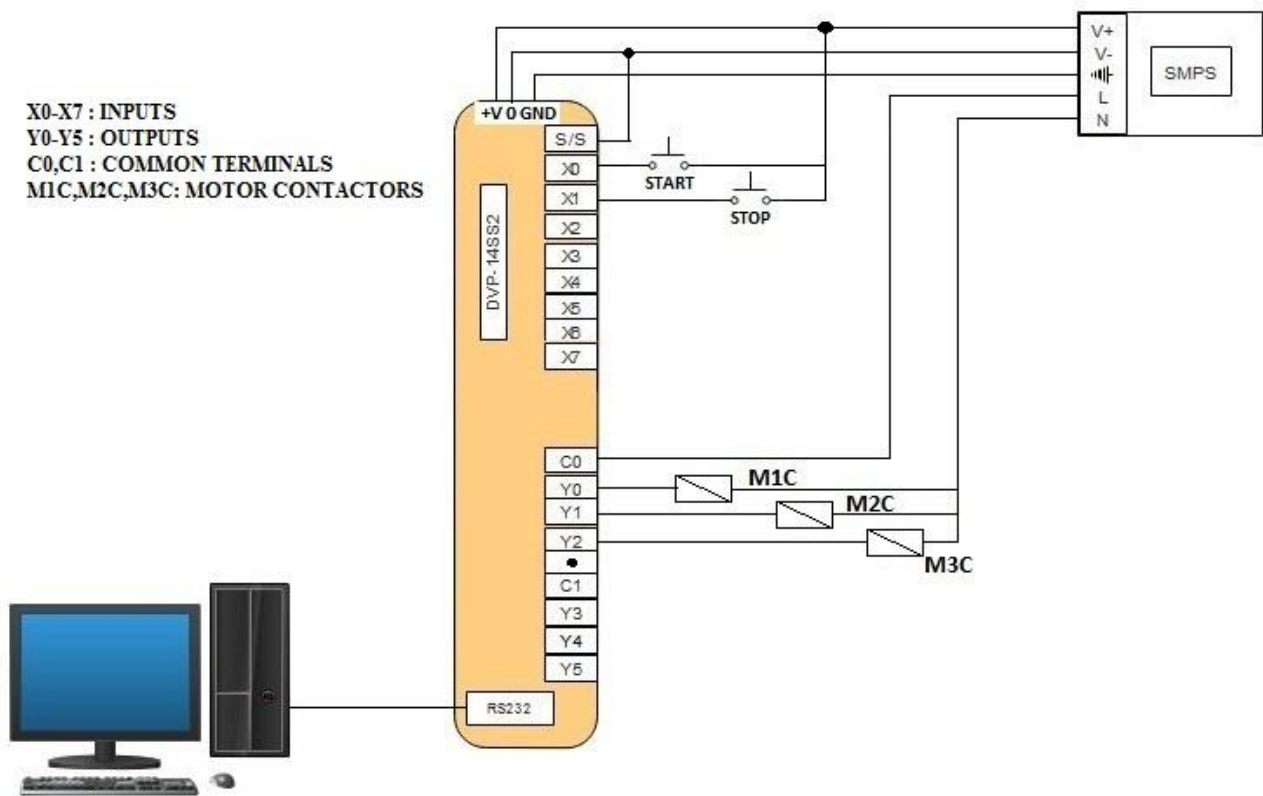


Figure: 5.2 PLC Connection Diagram

5.5 LADDER PROGRAMMING:



Figure: 5.3 PLC Ladder Programming

5.6 PROCEDURE:

1. Connect the motors to PLC as shown in the electrical circuit diagram.
2. Open the WPL soft and write the PLC program.

3. Dump the program to PLC
4. Push the start button and observe the operation of the motors the motors will start one after the other with the time delay given by the user.
5. Push the OFF button and turn off the Power.

5.7 RESULTS:

5.8 PRELAB QUESTIONS:

1. What do you mean by sequential operation?
2. What are the necessities of sequential operation?
3. What are the applications of sequential operation?

5.9 POSTLAB QUESTIONS:

1. How much is the voltage input to the PLC?
2. What is the meaning of S/S terminal in PLC?
3. Draw the PLC internal block diagram.

EXPERIMENT – 6

SPEED CONTROL OF DC MOTOR

6.1 AIM:

To control the speed of DC motor by armature voltage control method, and field control method using PLC.

6.2 APPRATUS:

S. No	Equipment	Quantity
1	PLC	1
2	SMPS	1
3	MCB	1
4	Contactora	1
5	Indicating Bulbs	2
6	Push Buttons (NO)	2
7	Plc Relays	5
8	Filament bulbs	5
9	DC Motor	1
10	Thyristor Converter	1
11	Personel Computer with wplsoft V2.42	1

6.3 THEORY:

There are many methods of designing an automatic lift control systems with relay control but all these methodologies require human assistance. In this project an automatic lift control system is designed using Programmable Logic Controller. The main difference from other computers is that PLCs operate in industrial environments and have multiple (I/O) terminals; those connect the PLC to sensors and actuators. PLCs measure, continuously varied analog input process variables (P, T), and outputs to positioning and vision systems. A modern programmable logic controller is usually programmed in any one of several languages, ranging from ladder logic to Basic or C. The programmable logic controller circuitry monitors the status of multiple sensor inputs, which control output. The design can be divided into several sections such as sensor section, power section, processing section. Figure 6.1 shows the block diagram of a PLC based Elevator control system. Supply is given to PLC as well as to the dc motor. This is connected with the elevator cabin and the

use of reed switch senses the position of the cabin and position of the floor. The indication of floor is done by using the push button.

6.4 ELECTRICAL CIRCUIT DIAGRAM:

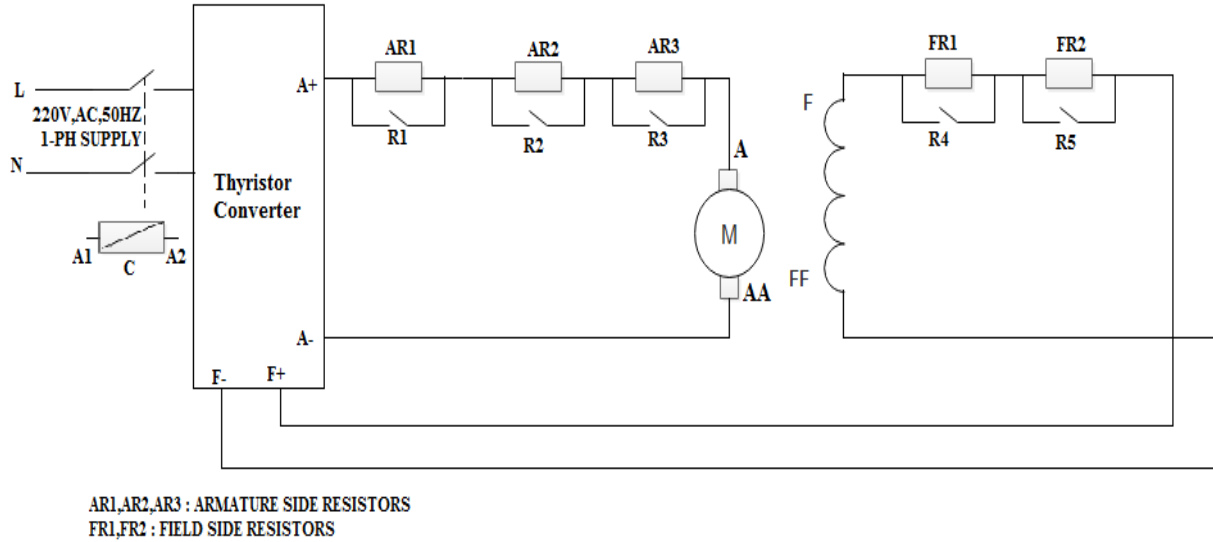


Figure: 6.1 Circuit Diagram for Speed Control of DC Motor using PLC

6.5 PLC CONNECTION DIAGRAM:

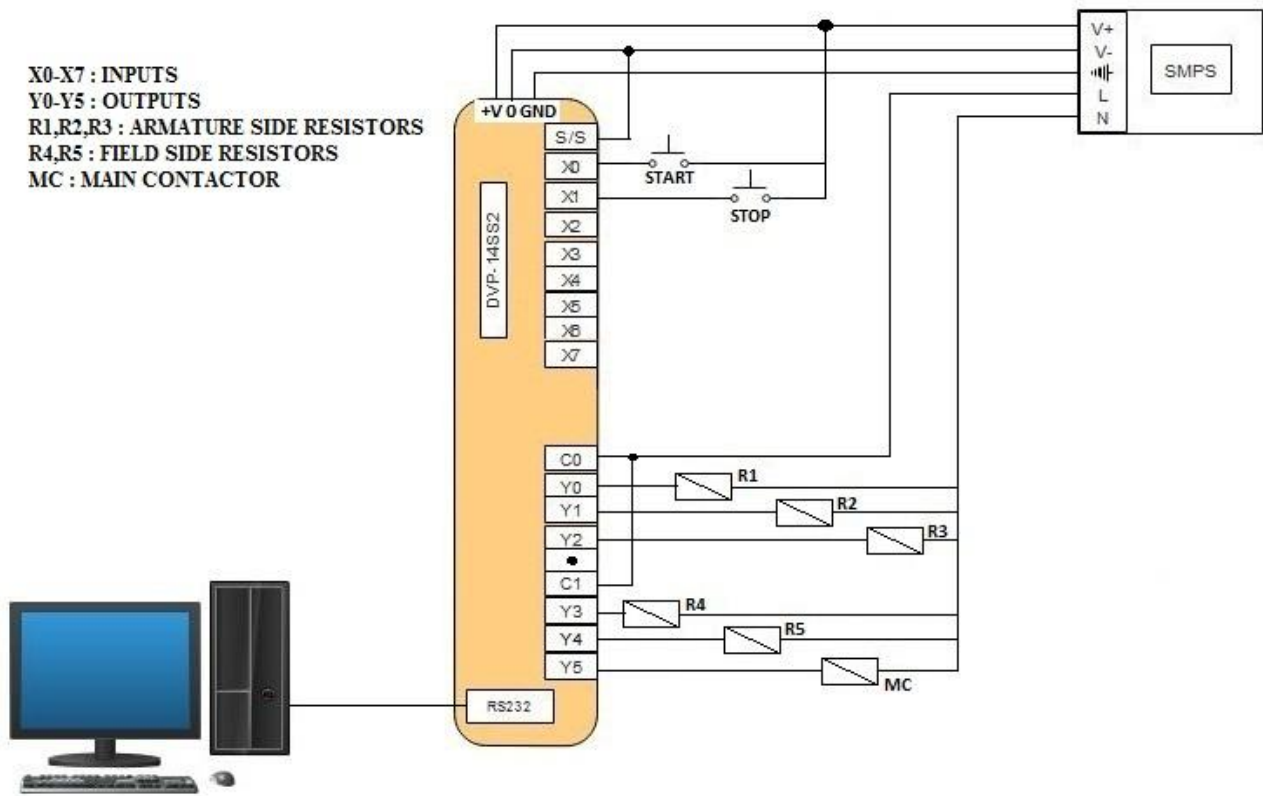


Fig: 6.2 PLC Connection Diagram

6.6 LADDER PROGRAMMING:

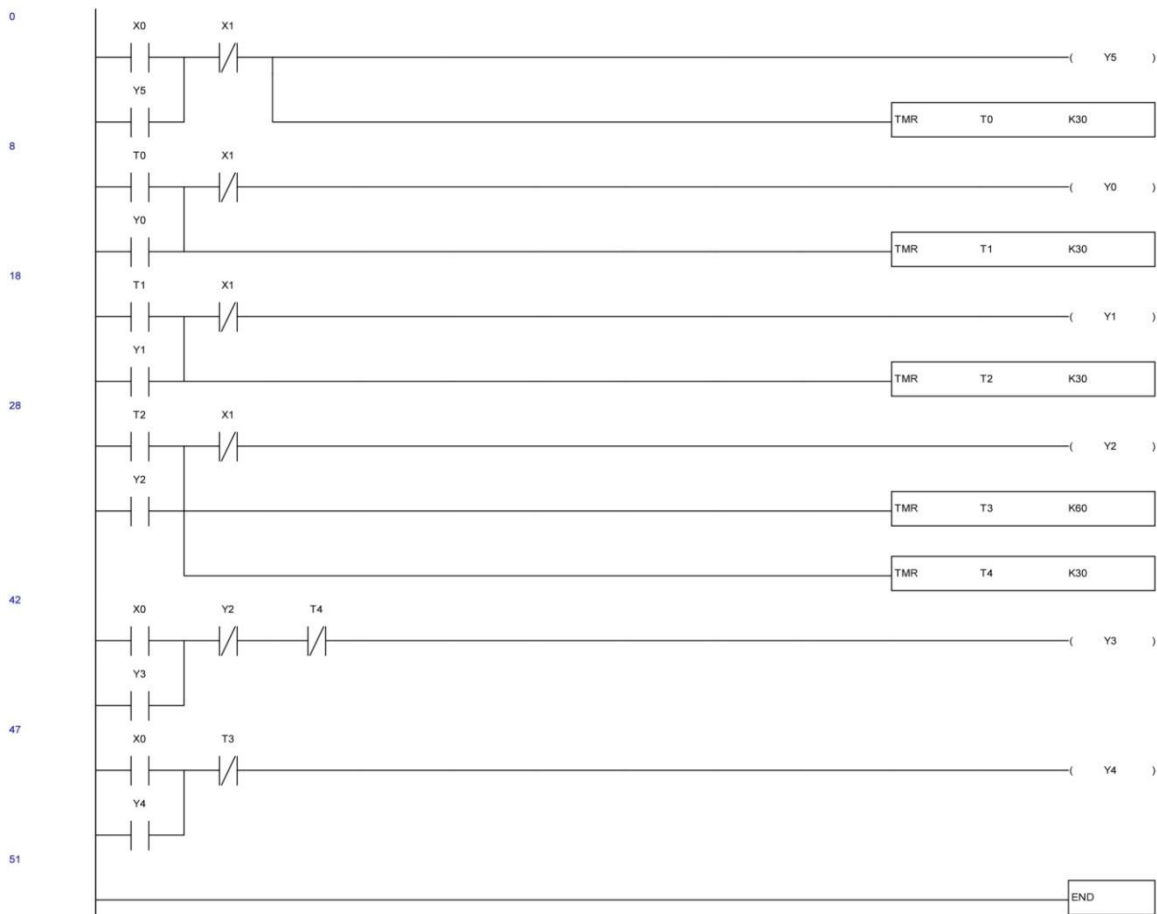


Figure: 6.3 PLC Ladder Programming

6.7 PROCEDURE:

- 1 Click on the WPL soft
- 2 After the 'RUN' operation what operated next is the WPL window will show up.
- 3 After WPL soft is activated we are to undertake the creating of new documents.
- 4 After the setting is completed, three windows will show up: one is the ladder diagram mode window, the other is the command mode window and the third one is the SFC editing mode.
- 5 Users are to choose the editing mode of their interests to proceed with the program editing.
- 6 The ladder diagram mode :(after the diagram is edited , convert the ladder diagram to the command mode and the SFC diagram through compiling)
- 7 The command mode (after the command is edited, convert it to the ladder and the SFC diagram through compiling)
- 8 The SFC mode: (after the SFC diagram is edited convert it to the command code through compiling and to convert it to the ladder diagram, users have to go through the command code compiling in order to achieve the ladder diagram conversion).

- 9 When WPL soft is activated, the first image to show up is; there are five selections on the function panel: File (F), communication(C), option (o), window (W), Help (H).
- 10 Click on 'New' under 'File', and the following image will show up; there will be some other selections listed on the function panel: Edit (E), Compile (P), Comment (L), Search(S), View (V).

6.8 RESULT:

6.9 PRE LAB QUESTIONS:

1. What are the different speed control methods for DC motor?
2. How to control the speed of a dc motor above its rated speed?
3. How to control the speed of a dc motor below its rated speed?

6.10 POST LAB QUESTIONS:

1. What is the function of thyristor drive?
2. Which type of DC motor speed you are going to control?
3. Why speed control of DC motor is required?
4. What are the advantages of using PLC for speed control?

EXPERIMENT – 7

CONTROL OF LIFT USING PLC

7.1 AIM:

To control the lift using programmable logic controller

7.2 APPARATUS:

S. No	Equipment	Quantity
1	PLC	1
2	SMPS	1
3	MCB	1
4	Relays	2
5	Push buttons	3
6	Read switches	3
7	Small DC motor	1
8	Bridge Rectifier	1
9	1phase transformer	1
11	Personnel Computer with wplsoft V2.42	1

7.3 ELECTRICAL CIRCUIT DIAGRAM:

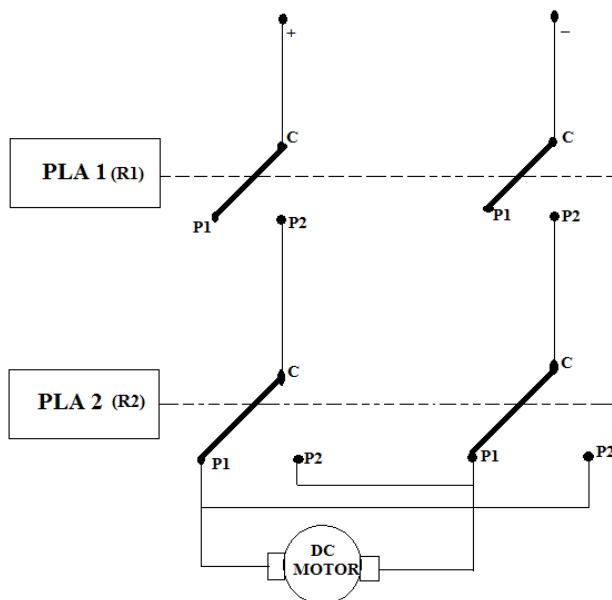


Figure: 7.1 Circuit Diagram for Control of Lift Using PLC

7.4 PLC CONNECTION DIAGRAM:

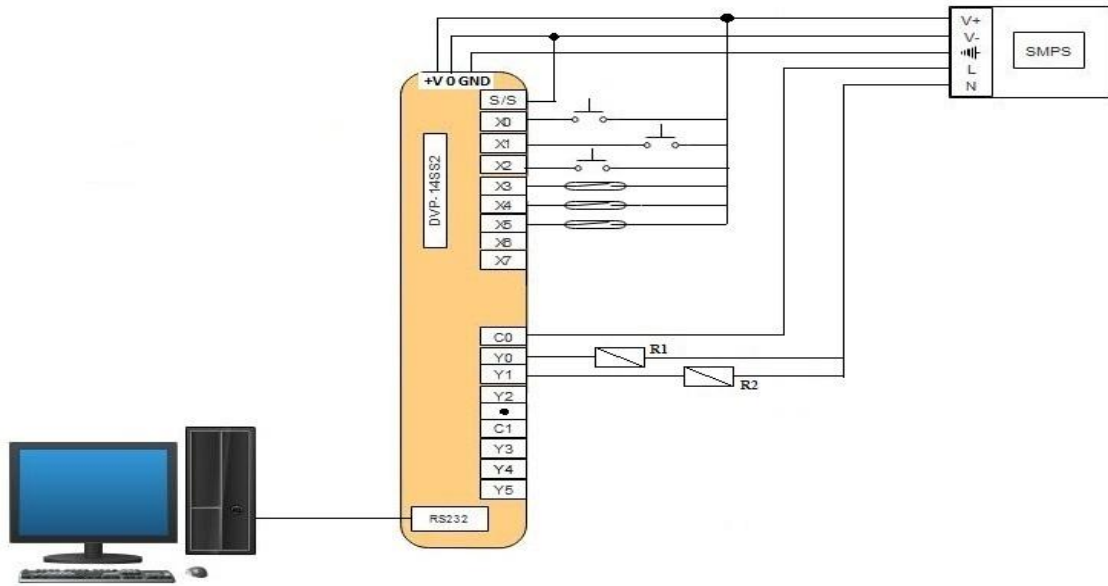


Figure: 7.2 PLC Connection Diagram

7.5 LADDER PROGRAMMING:

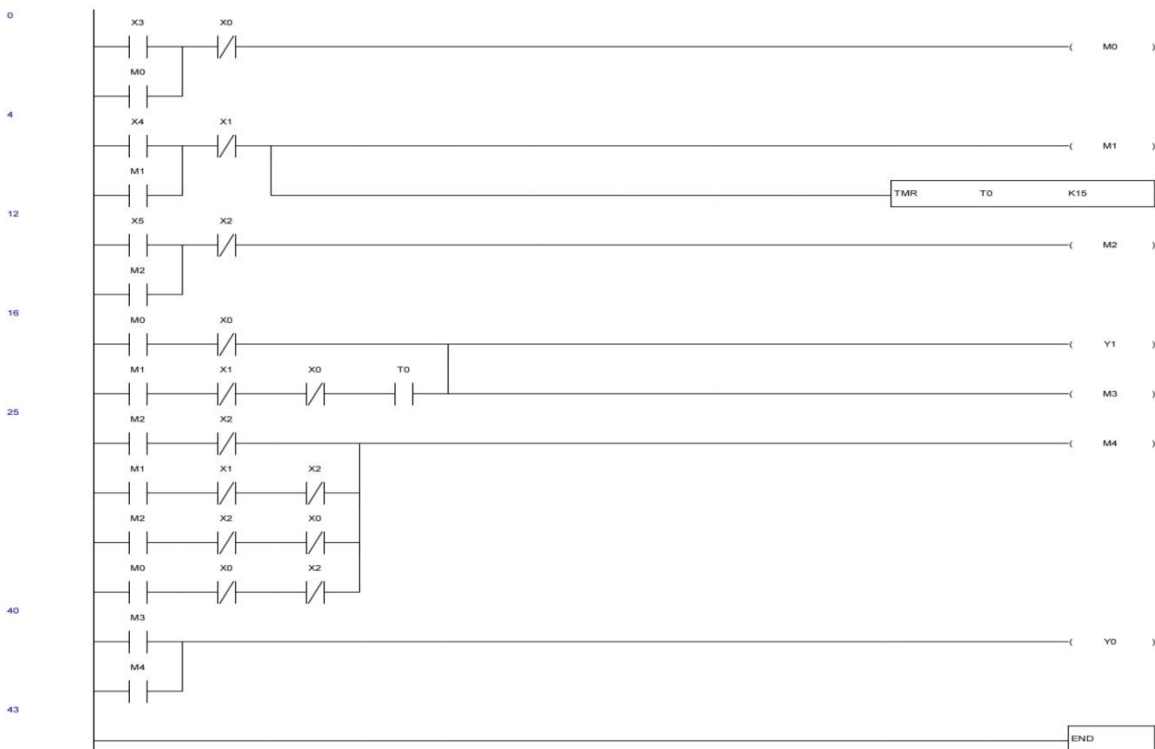


Figure: 7.3 PLC Ladder Programming

7.6 PROCEDURE:

1. Check the connections of motor and PLC
2. If the connections are given properly, switch ON the power supply to PLC and motor.
3. Open WPLsoft software and write the PLC ladder program.
4. Dump the program to PLC using RS232 cable.
5. Now, push the different switches which are given on different floors.
6. Observe the movement of the lift and ensure that it works properly and stops in a desired floor.

7.7 RESULT:

7.8 PRE LAB VIVA QUESTIONS

1. What are the different types of motors used for lifts?
2. How will be the torque of the motor used for lifts?
3. Name the DC motor which has the high starting torque.
4. Name the AC motor which has the high starting torque.

7.9 POST LAB VIVA QUESTIONS

1. What are the different technologies used for control of lift?
2. What are the advantages of using PLC for lift control?
3. How the direction of motor will be reversed?
4. What are the different sensors used in lift control?

EXPERIMENT – 8

FAULT ANNUNCIATION SYSTEM

8.1 AIM:

To implement the fault annunciation system using PLC

8.2 APPRATUS:

S. No.	Equipments	QUANTITY
1	PLC	1
2	SMPS	1
3	3phase squirrel Induction motor	1
4	Lamp Loads (60W, 100W)	2each, 4total
5	Electronic Buzzer	1
6	Plc Relays	3
7	Toggle switches	4
8	Push Buttons	2
9	Read switches	2
10	Personnel computer with wplsoft V2.42	1

8.3 CIRCUIT DIAGRAM:

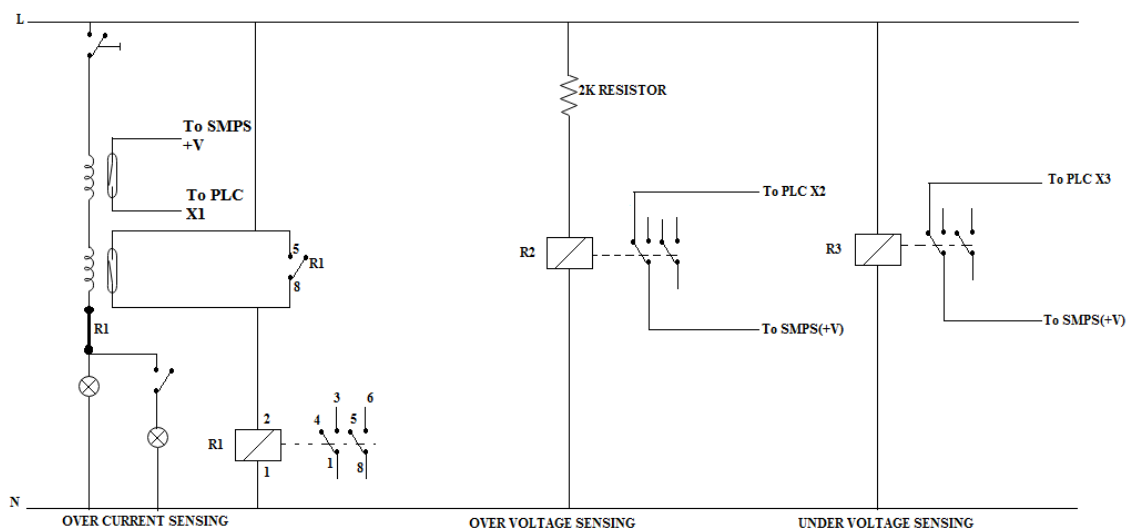


Figure: 8.1 Circuit Diagram for Fault Annunciation System

8.4 PLC CONNECTION DIAGRAM:

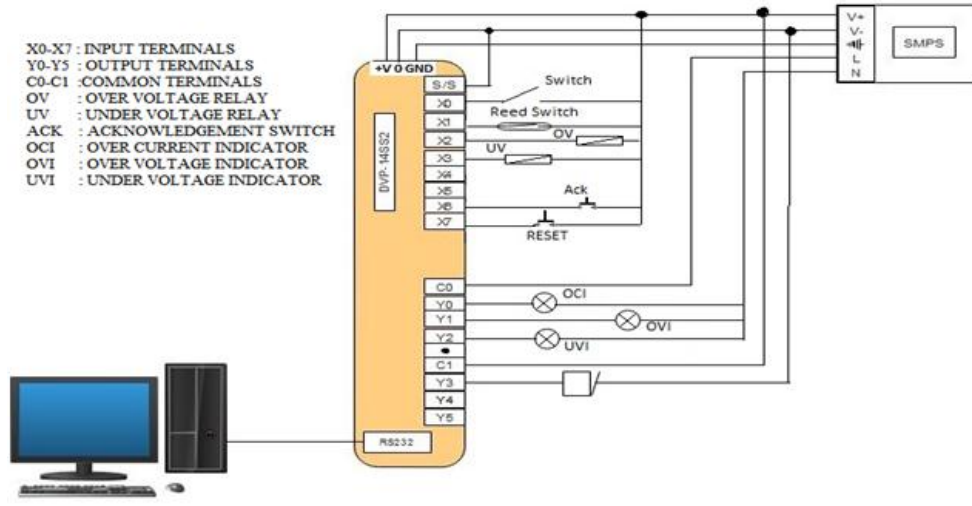


Figure: 8.2 PLC Connection Diagram

8.5 LADDER LOGIC DIAGRAM:

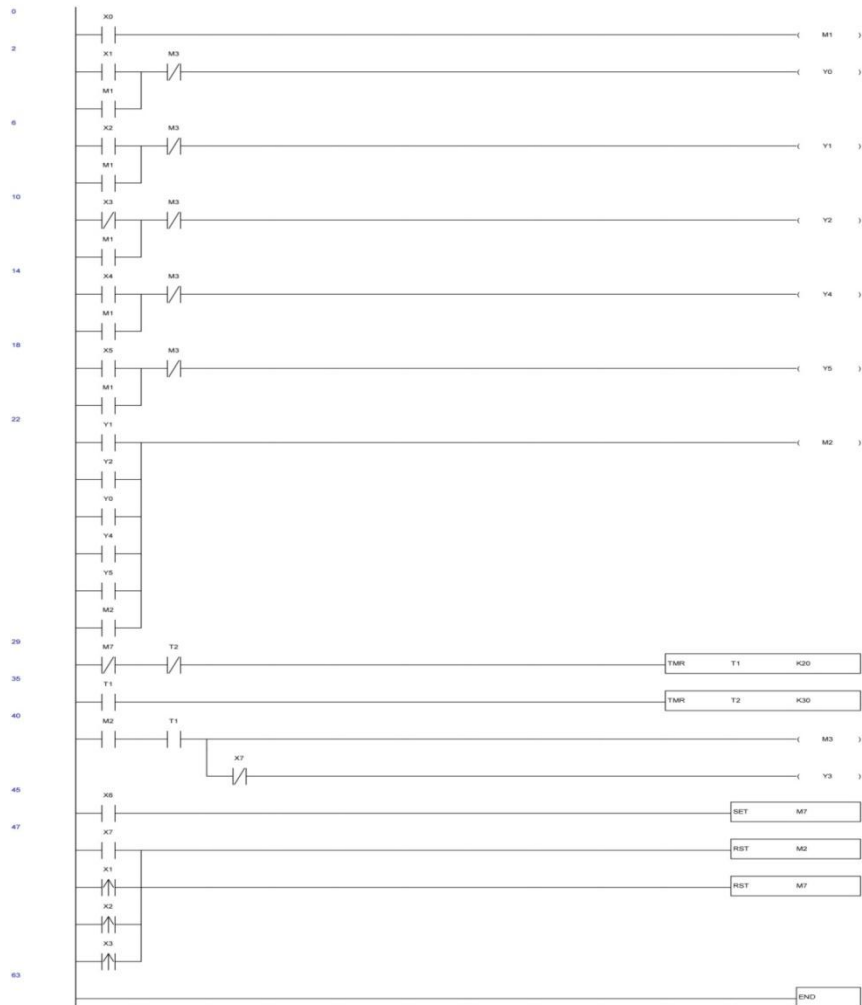


Figure: 8.3 PLC Ladder Programming

8.6 PROCEDURE:

1. Connect the wires as shown in the circuit diagram and PLC connection diagram.
2. Open wplsoft on PC and write the PLC Ladder program.
3. Dump the Program to the PLC using RS232 cable.
4. Switch ON the Supply to the PLC and check for different faults.
5. Initially apply a 230V single phase supply to the circuit and switch on the two loads so that over current will flow. Then the relay senses the current and give the alarm and blinks the over current indicator bulb. The operator has to press the ACK button to stop blinking of over current indicator.
6. Next, apply an under voltage to the circuit by varying the auto transformer and observe that under voltage indicator will blink. Again press ACK button to stop the blinking of under voltage indicator.
7. Next, apply an over voltage to the circuit by varying the auto transformer and observe that over voltage indicator will blink. Again press ACK button to stop the blinking of over voltage indicator.
8. Turn OFF the power supply.

8.7 RESULT:

8.8 PRE LAB VIVA QUESTIONS

1. What are the different faults in a power system?
2. When over current will flow in a system?
3. What are the reasons for under voltage and over voltages?

8.9 POST LAB VIVA QUESTIONS

1. What is the function of a Read switch?
2. How to generate over voltages and under voltages in Laboratory?
3. What are the advantages of PLC?

EXPERIMENT – 9

TRAFFIC SIGNAL CONTROL USING PROGRAMMABLE LOGIC CONTROLLER

9.1 AIM:

To control the traffic signals using PLC

9.2 APPRATUS:

S. No.	Equipments	QUANTITY
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	6 (R-2, G-2, Y-2)
4	Push Buttons (NO)	2
5	Personnel computer with wplsoft V2.42	1

9.3 TRAFFIC CONTROL SYSTEM BLOCK DIAGRAM:

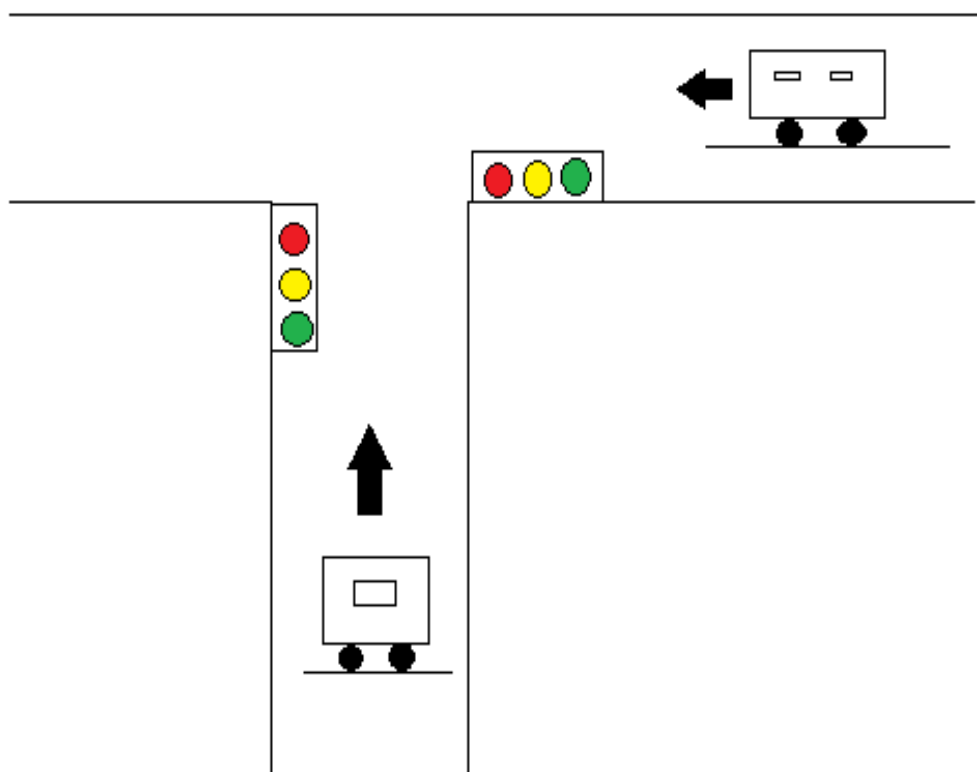


Figure: 9.1 Block diagram for Traffic Control System

9.4 PLC CONNECTION DIAGRAM:

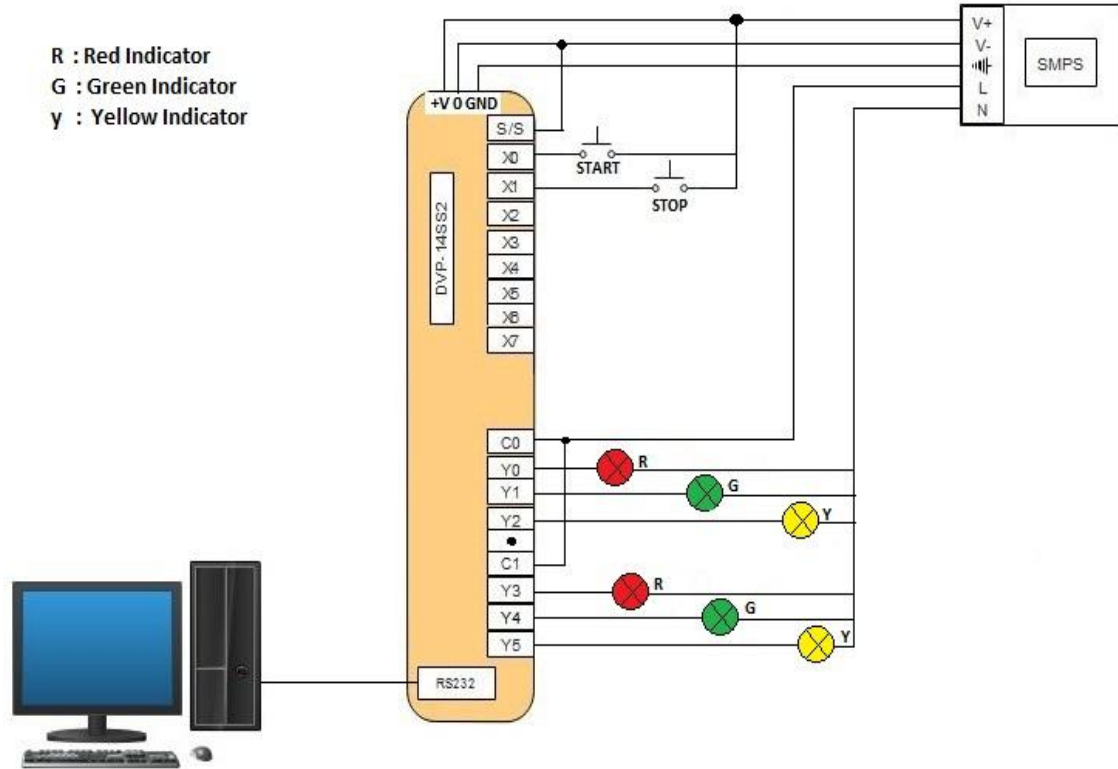


Figure: 9.2 PLC Connection diagram

9.5 LADDER PROGRAMMING:

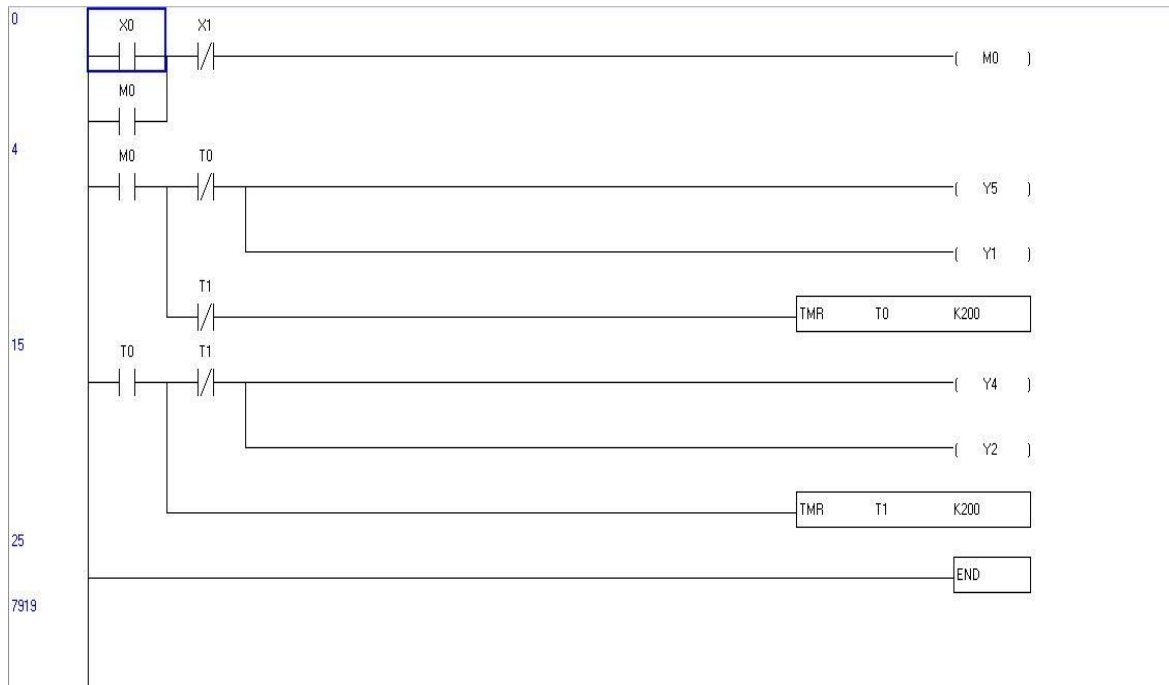


Figure: 9.3 PLC Ladder Programming

9.6 PROCEDURE:

1. Connect the traffic control indicators as shown in the PLC connection diagram.
2. Open the wplsoft software on PC and write the PLC ladder Program.
3. Dump the Program to the PLC using RS232 Cable.
4. Switch on the power supply and push the START button.
5. The traffic signal indicators will blink one by one depending on the timings given by the user.
6. If a RED signal is blinking in one way, then in the other way the GREEN signal indicator will blink.
7. Push the STOP button and turn OFF the power supply.

9.7 RESULT:

9.8 PRE LAB QUESTIONS:

1. Why traffic signals are needed?
2. What the Red, green and yellow signals will indicate?
3. What are the different methods used to control traffic?

9.9 POST LAB QUESTIONS:

1. What are the advantages of using PLC?
2. Draw plc block diagram of a PLC.
3. How to give the delay for blinking indicators using PLC?

EXPERIMENT – 10

UP-DOWN COUNTER USING PROGRAMMABLE LOGIC CONTROLLER

10.1 AIM:

To implement the up down counter using PLC

10.2 APPARATUS:

S. No.	Equipments	QUANTITY
1	PLC	1
2	SMPS	1
3	Indicating Bulbs	2
4	Push Buttons (NO)	4
5	Personnel computer with wplsoft V2.42	1

10.3 LADDER PROGRAMMING:

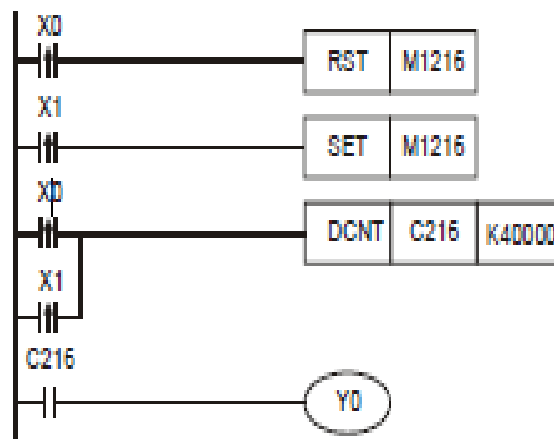


Fig - 10.1 PLC Ladder Diagram of Up-Down Counter Using in PLC

DEVICES:

Devices	Function
X0	Photoelectric sensors for monitoring incoming goods. X0=ON when incoming detected.
X1	Photoelectric sensors for monitoring outgoing goods. X1=ON when incoming detected.
M1216	Counting mode of C216(ON: counting down)
C216	32-bit counting up/down counter
Y0	Alarm

10.4 PROCEDURE:

- 1 Click on the WPL soft
- 2 After the 'RUN' operation what operated next is the WPL window will show up.
- 3 After WPL soft is activated we are to undertake the creating of new documents.
- 4 After the setting is completed, three windows will show up: one is the ladder diagram mode window, the other is the command mode window and the third one is the SFC editing mode.
- 5 Users are to choose the editing mode of their interests to proceed with the program editing.
- 6 The ladder diagram mode :(after the diagram is edited , convert the ladder diagram to the command mode and the SFC diagram through compiling).
- 7 The command mode (after the command is edited, convert it to the ladder and the SFC diagram through compiling).
- 8 The SFC mode: (after the SFC diagram is edited convert it to the command code through compiling and to convert it to the ladder diagram, users have to go through the command code compiling in order to achieve the ladder diagram conversion).
- 9 When WPL soft is activated, the first image to show up is; there are five selections on the function panel: File (F), communication(C), option (o), window (W), Help (H).
- 10 Click on 'New' under 'File', and the following image will show up; there will be some other selections listed on the function panel: Edit (E), Compile (P), Comment (L), Search(S), View (V).

10.5 RESULT:

10.6 PRE LAB VIVA QUESTIONS:

1. What is PLC?
2. Write down two advantages of PLC.
3. Differentiate between normally ON and normally OFF switch.
4. Distinguish between Timers and counters.
5. What is Latches?

10.7 POST LAB VIVA QUESTIONS:

1. What is the function of MCR (Master Control Relay)?
2. Where in the PLC memory is each timer storing its data?
3. How does the operation of an OFF -delay timer differ from that of an on-delay timer?
4. How does each type of timer get reset back to zero?
5. How long of a time period can a timer time? What is the maximum "count" value for a timer?

EXPERIMENT – 11

IMPLEMENTATION OF TIMERS USING PROGRAMMABLE LOGIC CONTROLLER

11.1 AIM:

To implement OFF delay and ON delay timers using PLC

11.2 APPRATUS:

S. No.	Equipments	Quantity
1	PLC	1
2	SMPS	1
3	Push buttons	6
4	Indicating bulbs	6
5	Personnel computer with wplsoft V2.42	1

11.3 LADDER PROGRAMMING:

OFF Delay Timer:

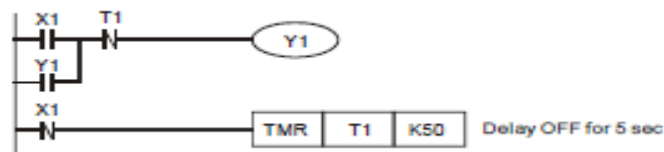


Fig. 11.1 PLC Ladder Diagram for OFF Delay Timer

DEVICES:

Devices	Functions
X1	X1=OFF when the switch is turned off
C1	5 sec timer, Timer base=100ms
C2	Output indicator

ON Delay Timer:

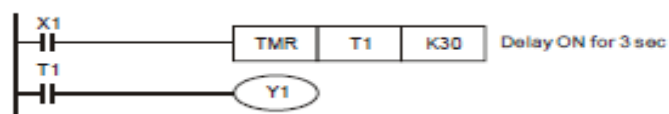


Fig. 11.2 PLC Ladder Diagram for ON Delay Timer

DEVICES:

Devices	Functions
X1	X1=ON when the switch is turned on
T1	3 sec timer, Timer base=100ms
Y1	Output indicator

11.4 PROCEDURE FOR OFF DELAY TIMER:

1. X1 = ON when the switch is turned on. The NC (Normally Closed) contact X1 will be activated, and TMR instruction will not be executed. Coil T1 will be OFF and so will the NC contact T1. Because X1 = ON, the indicator Y1 will be ON and latched.
2. X1 = OFF when the switch is turned off. The NC contact X1 will not be activated, which makes TMR instruction executed. Indicator Y1 will remain ON by the latched circuit until T1 reaches its set value.
3. When timer T1 reaches its set value of 5 seconds, coil T1 will be ON. The NC contact T1 will be activated, which makes the indicator Y1 OFF.
4. Delay OFF function can also be performed by using API 65 STMR instruction.

PROCEDURE FOR ON DELAY TIMER:

1. When X1 = ON, TMR instruction will be executed. Timer T1 will be ON and start counting for 3 sec. When T1 reaches its set value, the NO (Normally Open) contact T1 will be activated and indicator YI will be ON.
2. When X1 = OFF, TMR instruction will not be executed. Timer T1 will be OFF and so will NO contact T1. Therefore, the indicator Y1 will be OFF.

11.5 RESULT:

11.6 PRE LAB VIVA QUESTIONS

1. What is the purpose of blinking lights in various electrical equipments?
2. How blinking lights are implemented in PLC.
3. Can you suggest method to implement blinking lights?

11.7 POST LAB VIVA QUESTIONS

1. Can we apply this experiment for implementing traffic lights?
2. What do you understand by complements?
3. What are various types of timers?

EXPERIMENT – 12

IMPLEMENTATION OF DIGITAL CLOCK USING PROGRAMMABLE LOGIC CONTROLLER

12.1 AIM:

To implement the digital clock using PLC

12.2 APPARATUS:

S. No.	Equipments	QUANTITY
1	Delta PLC	1
2	HMI	1
3	SMPS	1
5	Personnel computer with wplsoft V2.42	1

12.3 LADDER PROGRAMMING:

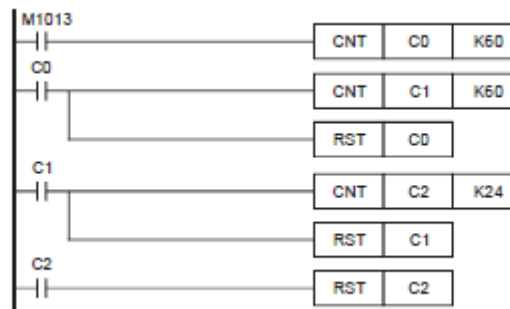


Fig - 12.1 PLC Ladder diagram for implementation of Digital Clock DEVICES:

Devices	Functions
C0	Count per second
C1	Count per minute
C2	Count per hour
M1013	1s clock pulse

12.4 PROCEDURE/PROGRAM DESCRIPTION:

1. Click on the WPL soft
2. After the 'RUN' operation what operated next is the WPL window will show up.
3. After WPL soft is activated we are to undertake the creating of new documents.

4. After the setting is completed, three windows will show up: one is the ladder diagram mode window, the other is the command mode window and the third one is the SFC editing mode.
5. Users are to choose the editing mode of their interests to proceed with the program editing.
6. The ladder diagram mode :(after the diagram is edited , convert the ladder diagram to the command mode and the SFC diagram through compiling)
7. The command mode (after the command is edited, convert it to the ladder and the SFC diagram through compiling)
8. The SFC mode: (after the SFC diagram is edited convert it to the command code through compiling and to convert it to the ladder diagram, users have to go through the command code compiling in order to achieve the ladder diagram conversion.)
9. When WPL soft is activated, the first image to show up is; there are five selections on the function panel: File (F), communication(C), option (o), window (W), Help (H).
10. Click on 'New' under 'File'', and the following image will show up; there will be some other selections listed on the function panel: Edit (E), Compile (P), Comment (L), Search(S), View (V).
11. The key of operating a 24-hour clock is to use M1013 (1s clock pulse). When the program is executed, C0 will count once per second. When the counted number reaches 60(1 minute),C0 = ON. C1 will count once, and C0 will be reset at the same time; similarly, when the counted number in C1 reaches 60(1 hour), C1 = ON. C2 will count once, and C1 will be reset at the same time. Furthermore, when the present value in C2 reaches 24, C2 will be reset, and the 24-hour counting process will start again.
12. The 24-hour clock operates by using C0 to count "second", C1 to count "minute" and C2 to count "hour." In this clock, the value of "second", "minute" and "hour" can be read by C0, C1 and C2 correspondingly. When the set value of C2 is 12, the clock will be a 12-hour clock.

12.5 RESULT:

12.6 PRE LAB QUESTIONS:

1. Describe the function of timer in PLC Program
2. What are the advantages of PLC?
3. Draw the block diagram of PLC.

12.7 POST LAB QUESTIONS:

1. What are the applications of digital clocks?
2. What is the advantage of using PLC for implementation of clock?
3. What is the function of HMI.

EXPERIMENT – 13
TEMPERATURE CONTROL SYSTEM

13.1 AIM:

To control the temperature of a system using PLC

13.2 APPRATUS:

S. No.	Equipments	Quantity
1	DELTA PLC	1
2	PT100	1
3	PT100-10V Converter	2
4	Contactator	1
5	PLA relay	1
6	Immersion type Heater	1
7	Arduino	1
8	Pt100-5V converter	1
9	LCD display	1
10	SMPS	1
11	Personnel computer with wplsoft V2.42	1

13.3 BLOCK DIAGAM:

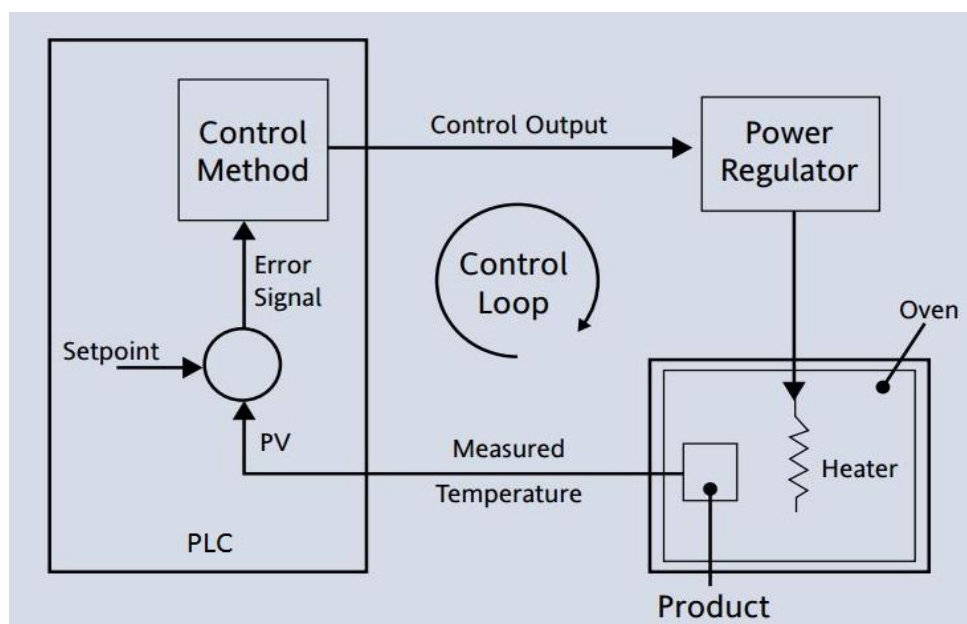


Figure: 13.1 Block Diagram of Temperature Control System

13.4 LADDER PROGRAMMING:

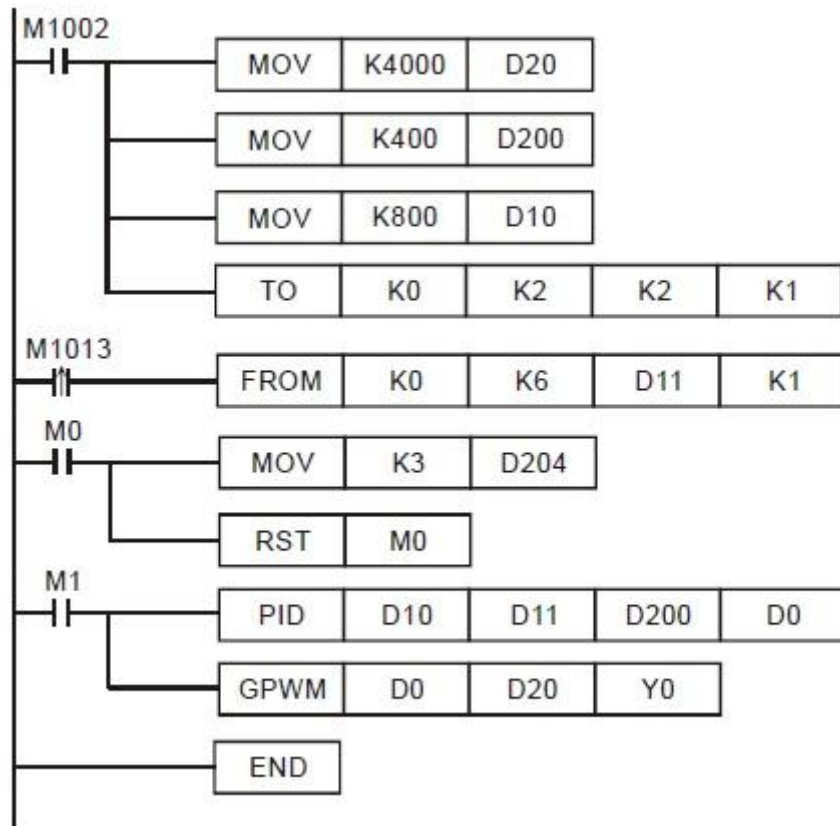


Figure: 13.2 PLC Ladder Programming

13.5 PROCEDURE:

1. Open the wplsoft in PC and write the PLC ladder program.
2. Dump the Program to the PLC using RS232 cable.
3. Turn on the power supply to the PLC and run it.
4. The plc senses the temperature of water using PT100 and gives a proportional voltage to the PLC analog input.
5. This voltage is converter to temperature and compared with the desired temperature in PLC.
6. If the temperature is not match with the desired temperature PLC will give a signal to switch off or switch on the heater.
7. Thus the desired temperature is maintained in the system.

13.6 RESULT:

13.7 PRE LAB QUESTIONS:

1. Write any two applications where temperature control is required?
2. What is the necessity of using PLC for temperature control?
3. What are the advantages of using PLC?

3.8 POST LAB QUESTIONS:

1. What is the principle of operation of PT100?
2. What is the use of HMI?
3. What are the different elements used for control of temperature with PLC?

EXPERIMENT – 14

SOLAR TRACKING USING PROGRAMMABLE LOGIC CONTROLLER

14.1 AIM:

Implantation of single axis solar tracking system using PLC

14.2 APPRATUS:

S. No.	Equipments	Quantity
1	VFD	1
2	Induction motor with brake	1
3	Contactora with 400V coil	1
4	PLC	1
5	Smps	1
6	Personnel computer with wplsoft V2.42	1

14.3 THEORY

Solar Trackers direct solar panels or modules toward the sun. These devices change their orientation throughout the day to follow the sun's path to maximize energy capture. In photovoltaic systems, trackers help minimize the angle of incidence (the angle that a ray of light makes with a line perpendicular to the surface) between the incoming light and the panel, which increases the amount of energy the installation produces. Concentrated solar photovoltaic and concentrated solar thermal have optics that directly accept sunlight, so solar trackers must be angled correctly to collect energy. All concentrated solar systems have trackers because the systems do not produce energy unless directed correctly toward the sun.

Single-axis solar trackers rotate on one axis moving back and forth in a single direction. Different types of single-axis trackers include horizontal, vertical, tilted, and polar aligned, which rotate as the names imply. Dual-axis trackers continually face the sun because they can move in two different directions. Types include tip-tilt and azimuth-altitude. Dual-axis tracking is typically used to orient a mirror and redirect sunlight along a fixed axis towards a stationary receiver. Because these trackers follow the sun vertically and horizontally they help obtain maximum solar energy generation.

14.4 BLOCK DIAGRAM:

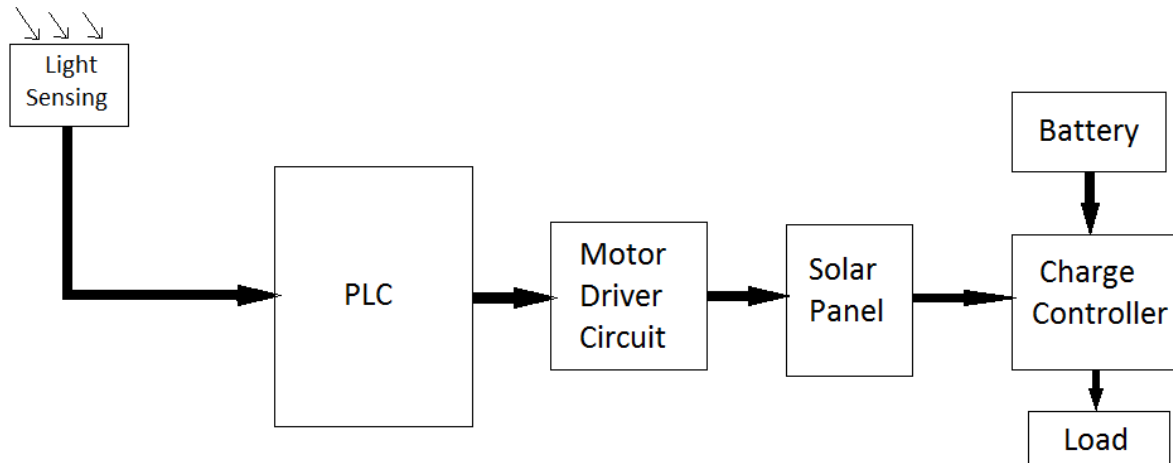


Figure: 14.1 Block Diagram of Solar Tracking System

4.5 LADDER PROGRAMMING:

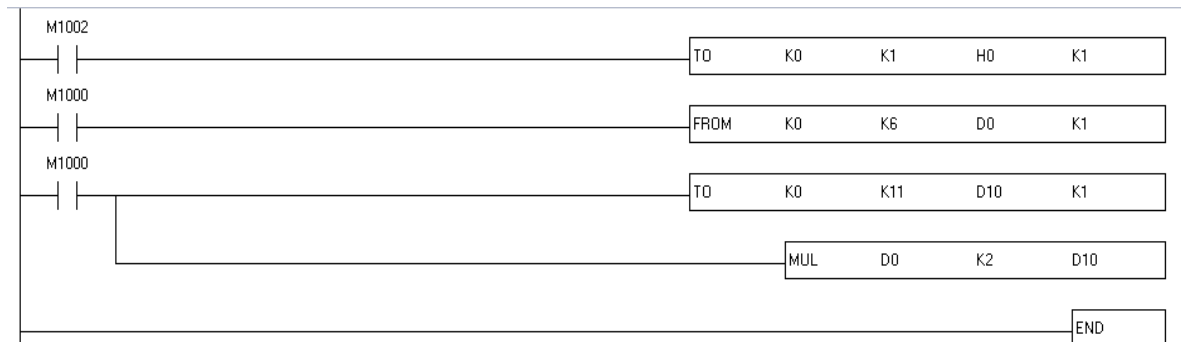


Figure: 14.2 PLC Ladder Programming

14.6 PROCEDURE:

1. Give the connection as per the requirement.
2. Open wplsoft on PC and write the PLC ladder program.
3. Turn on the PLC power supply.
4. Dump the program to the PLC using RS232 cable.
5. Press the start push button to start working.
6. The PLC will sense the sun light and gives the command signal to the motor drive to drive the motor to track the path of the sun.
7. Observe this by placing the panel at different angles.

14.7 RESULT:

14.8 PRE LAB QUESTIONS:

1. What is the need for tracking the sun?
2. What is the average sunshine radiation outside the atmosphere?
3. Define solar constant.

14.9 POST LAB QUESTIONS:

1. What are the different techniques available for racking the sun?
2. What do you mean by maximum power tracking?
3. Define solar cell, solar array and solar module.