Department of Electronic Engineering
N.E.D. University of Engineering & Technology

PRACTICAL WORK BOOK

For the course

INDUSTRIAL ELECTRONICS (EL-301)

For T.E (EL)

Instructors name:______________________________
Student Name: ________________________________
Roll no.:_________________ Batch: _____________
Semester :______________ Year:________________
Department: ___________________________________

LABORATORY WORK BOOK
FOR THE COURSE

INDUSTRIAL ELECTRONICS (EL-301)

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Reviewed By:

Dr.Riaz Un Nabi

Approved By:

The Board of Studies of Department of Electronic Engineering

Industrial Electronics Laboratory

CONTENTS

LAB EXPERIMENT 01

Objective:

To establish characteristics of Resistive Temperature Detector (RTD) temperature sensor.

Equipment Required:

- Base unit for the IPES system.
- Experiment module MCM14/EV.
- Digital millimeters, breadboards/Vero board
- Power supply Mod. PSUIEV (+12V & -12V)

Theory:

RTD

To measure the temperature, RTD exploits the "Resistance Variation" of an electrical conductor, at variation of the same temperature.
The relation between resistance and temperature is approximately the following:

$$R_T = R_o \times (1 + \alpha \Delta T)$$

Ro = resistance at 0° Celsius= 100Ω

Where the temperature coefficient **α** is given its average value in the measurement field. The RTD has the following main characteristics:

- Constance of the characteristics in time.
- Characteristics repeatability.
- Good variation of the resistance as function of temperature.

Two kinds of RTD's have been standardized:

- Nickel
- Platinum.

A platinum RTD is mounted in the module.
The platinum RTD has a coefficient of temperature $\alpha = 3.85 \times 10\text{-}3\ {}^{o}C^{-1}$.

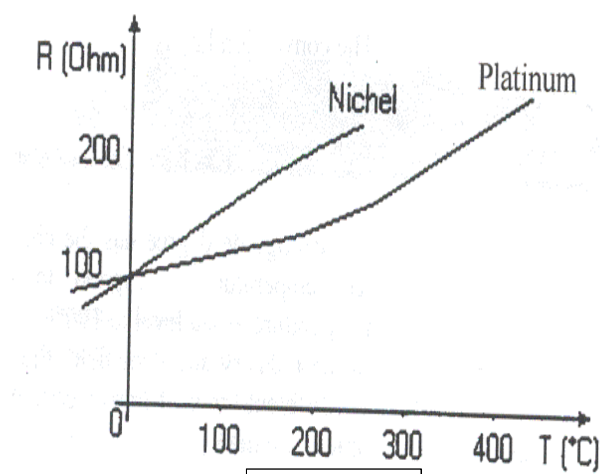

Figure 1-1

Reference: https://instrumentationtools.com/resistance-temperature-detectors-rtd-construction/

The characteristic curves of these two RTD's are shown in fig. 1-1.

Normally used RTD's have a resistance of 100 **Ω** at0°C and a tolerance of (+/-0.1)°C. They usually consist of a wire of the above materials wounded around a cylindrical insulating material or a plate resistant to high temperatures (ceramic, glass).
For their constitution, as they have a very high thermal constant, they are relatively slow in following the process temperature variations.

Heating source

The heat necessary to the tests on the temperature transducers is provided by two resistors in parallel. Two resistors heat the aluminum plate on which the transducers are inserted. The temperature range goes from ambient temperature to about 110^{O}C.

Range of RTD:

RTD has a resistance of 100 Ω at 0^{O}C and The RTD has a resistance of 138.5 Ω at 100°C. After calibration, voltage changes between 0V and 1 V from 0^{0}C to 100^{0}C. The Coefficient of 10 m V /^{0}C enables a direct temperature reading: e.g.450 mV correspond to 45^{0}C.

Procedure:

RTD signal conditioner settings:

The RTD has a resistance of 100 Ω at 0^{0}C and of 138.5 Ω at100°C.These resistance values are the two calibration points of the conditioner with two sample resistors to be inserted into the proper jumpers.

1. Disconnect all jumpers of the "TEMPERATURE RANSDUCERS" circuit.
2. Connect jumper J3
3. With J4 connect the 100-Ω resistance and with Potentiometer **RVI** adjust voltage so to obtain OV on point 7(OUT).
4. Disconnect jumper J4, with jumper J5 connect the 138.5-Ω resistance, and with Pot **RV2** adjust the voltage so to obtain 1 V of full scale on point7 (OUT)
5. Disconnect jumper J5.
6. Connect jumper J2 to connect the RTD (keep jumper J3 inserted).
7. Activate the heating element with the I1/HEATER switch.
8. Measure the voltage and then the temperature between OUT (7) and ground.
9. Draw the graph

Observation:

Corresponding Temperature	Output Signal (mV)	RTD resistance measured (Ω)	Resistance $R_T=R_O(1+\alpha T)$
30			
35			
40			
45			
50			
55			
60			
65			
70			
75			

Interfacing RTD with self-designed circuit:

Interface RTD with your own circuit on breadboard/Vero board. Provide circuit diagram below and fill out observation table:

Corresponding Temperature	**Output Signal ($0 \leq Vo \leq 5$) Volts**	**RTD resistance measured (Ω)**	**Resistance $R_T=R_O(1+\alpha T)$**
30			
35			
40			
45			
50			
55			
60			
65			
70			
75			

Result:

RTD's temperature versus resistance graph indicates good variation of resistance as the function of temperature.

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Department of Electronic Engineering

F /OBEM 01/05/00

Laboratory Session #___1_____ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 02

Objective:

To imitate characteristics of NTC & PTC Thermistor. Also, initiate the characteristic of Thermocouple.

Equipment Required:

- Base unit for the IPES system.
- Experiment module MCM14/EV.
- Digital Multimeters, breadboards/Vero board
- Power supply Mod. PSUIEV (+/-12V).

Theory:

NTC and PTC:

These semiconductor transducers exploit high sensibility of semiconductor materials toward temperature.

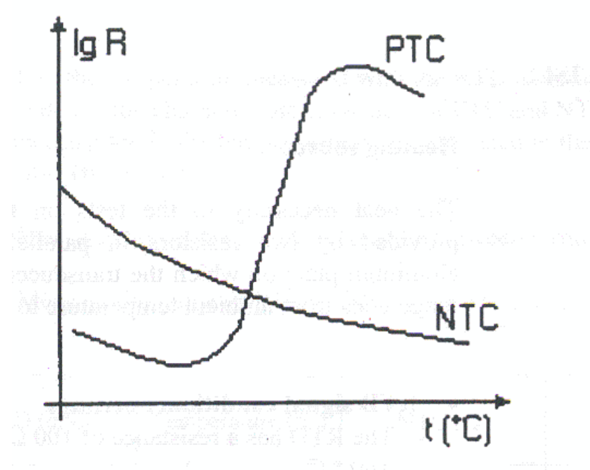
The coefficient of temperature is much higher than the one of RTD and is much cheaper but it has a temperature range which is narrower and with less linearity. The law for the variation of the resistance as function of Temperature, with a first approximation, is the following:

$$R_T = R_0 \times (1 + \alpha \Delta T)$$

Although this formula is equal to the one found for RTD, the error in this approximation is much greater.

The transducers of semi-conductor kind analyzed with module MCM14 are **NTC** and **PTC.**

NTC (**Negative Temperature Coefficient) Thermistor** drops its resistance when the temperature increases. PTC **(Positive Temperature Coefficient)** Thermistor increases its resistance when the temperature increases in Figure 2-1 At constructive level, the difference between the two transducers is determined during the semiconductor realization.



Curves of thermistors PTC and NTC

Figure 2-1

Reference:https://www.researchgate.net/figure/The-thermistor-temperature-characteristic-curve

Thermocouples:

A thermocouple consists of two dissimilar conductors in contact, which produces a voltage when heated. The voltage produced is dependent on the difference of temperature of the junction to other parts of the circuit. Thermocouples are a widely used type of temperature sensor for measurement and control and can also be used to convert a temperature gradient into electricity. Commercial thermocouples are inexpensive, interchangeable, are supplied with standard connectors, and can measure a wide range of temperatures. In contrast to most other methods of temperature measurement, thermocouples are self-powered and require no external form of excitation. The main limitation with thermocouples is accuracy; system errors of less than one degree Celsius (°C) can be difficult to achieve Figure 2-2 .

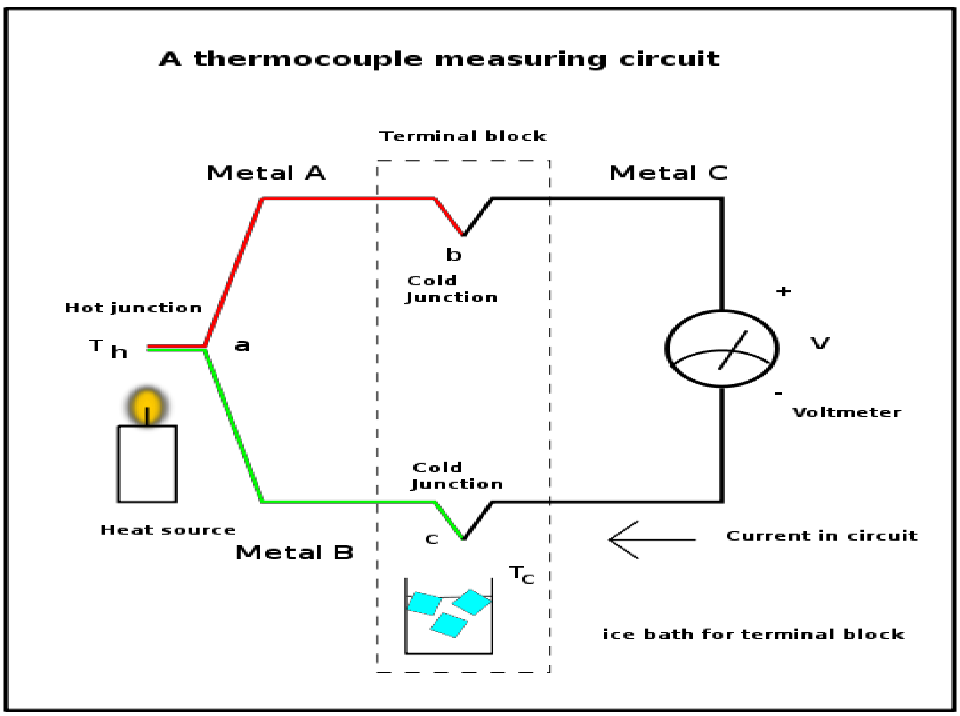


Figure 2-2

Reference: https://www.castlegroup.co.uk/what-do-we-mean-by-type-k-and-type-t-thermocouples/

Procedure:

RTD signal conditioner settings:

RTD has a resistance of 100 **Ω** at 0^0C and of 138.5 **Ω** at100°C.These resistance values are the two calibration points of the conditioner with two sample resistors to be inserted into the proper jumpers.

1. Disconnect all jumpers of the "TEMPERATURE TRANSDUCERS" circuit.
2. Connect jumper J3.
3. With J4 connect the 100-Ω resistance and with the potentiometer **RVI** adjust the voltage so to obtain OV on point 7(OUT).
4. Disconnect jumper J4, with jumper J5 connect the 138.5-Ω resistance, with the Potentiometer **RV2** adjust the voltage so to obtain 1 V of full scale on point 7 (OUT).
5. Measure the voltage and then the temperature between OUT (7) and ground.
6. Disconnect jumper J5.
7. Connect jumper J2 to connect the RTD (keep jumper J3 inserted).
8. Activate the heating element with the I1/HEATER switch.
9. Measure the voltage and then the temperature between OUT (7) and ground.
10. Use the temperature measured with the RTD as sample variable to detect the characteristic resistance of PTC and NTC Thermistor, in the temperature range.
11. Measure the value of NTC resistance between terminals 1-2.
12. Measure the value of PTC resistance between terminals 3-4.

Observation:

RTD (mV)	Temperature (^{o}C) T	NTC R2(Ω)	PTC R1(Ω)	Log R1	Log R2

Interfacing Thermistor with self-designed circuit:

Interface Thermistor with your own circuit on breadboard/Vero board. Provide circuit diagram below and fill out observation table:

Corresponding Temperature	Output Signal (V) ($0 \leq Vo \leq 5$)	Thermistor resistance measured (Ω)	Resistance $R_T = R_o(1+\alpha T)$
30			
35			
40			
45			
50			
55			
60			
65			
70			
75			

Interfacing thermocouple with self-designed circuit:

Interface thermocouple with your own circuit on breadboard/Vero board. Provide circuit diagram below and fill out observation table:

Corresponding Temperature (^oC)	Output Signal (V) ($0 \leq Vo \leq 5$)	Thermocouple output (mV)
30		
35		
40		
45		
50		
55		
60		
65		
70		
75		

Results:

The characteristic curves of NTC and PTC Thermistor are successfully studied and Verified through graphs

The characteristics of thermocouples are studied and verified

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Laboratory Session #___2_____ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
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	0	1	2	3	4
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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 03

Objective:

To practice and ensure the principle of Piezo resistive force transducers.

Equipments Required :

- Basic unit for IPES system, module holder frame Mod.MUIEV,
- Individual control unit mod. SIS3.
- Power supply Mod.PSUIEV.
- Experiment module mod. MCMl4IEV
- Digital Multimeter, breadboards/Vero board

Theory:

Piezoelectricity:

Many electromechanical transducers use piezoelectric ceramics which can change their geometrical dimensions as function of the electrical field applied to them.
Inversely, these piezoelectric ceramics can be a source of electrical signal if under mechanical stresses. This propriety is used in force transducers as the one in module MCMl4/EV.

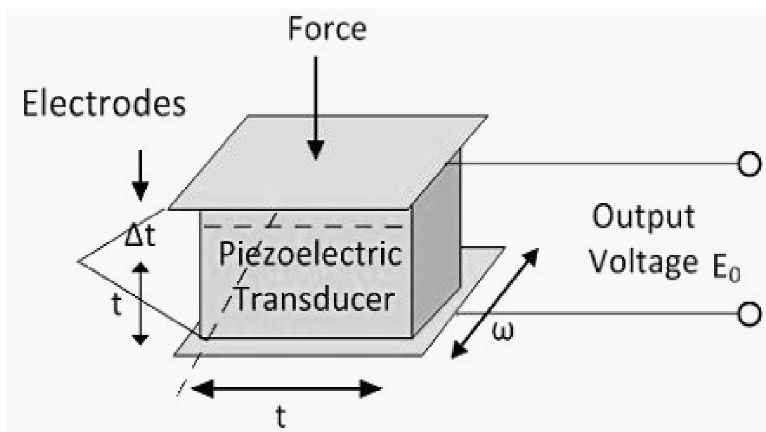

Figure 3-1: Piezo Resistive Force Transducer

Reference: https://circuitglobe.com/piezo-electric-transducer.html

The ceramic piece cut in the shape of a disk, has an inner structure composed by electrical dipoles at random and results in the electrically neutral unit.

Applying an intense electrical field to the ceramic disk (high temperature), the electrical dipoles set preferentially in the direction of the electrical field.
Making the temperature and the electrical field drop, the dipoles keep their preferential orientation and the totally neutral electrical state. The ceramic becomes permanentlyPiezoelectric.
Metal contacts are deposited on the surfaces of the ceramic transducer disk in order to apply and measure signals.
For this kind ceramic-piezoelectric transducer, a mechanical stress deforming the surface causes a loads shift, causing a measurable electrical voltage.

Characteristisc Parameter:

The force sensor set in the module MCM14/EV, has the following characteristics:
The Piezo resistive sensor is inserted into a Wheatstone bridge in Figure 3-2 enabling a stable output (Millivolt) for a range of 0 to 1500 grams.

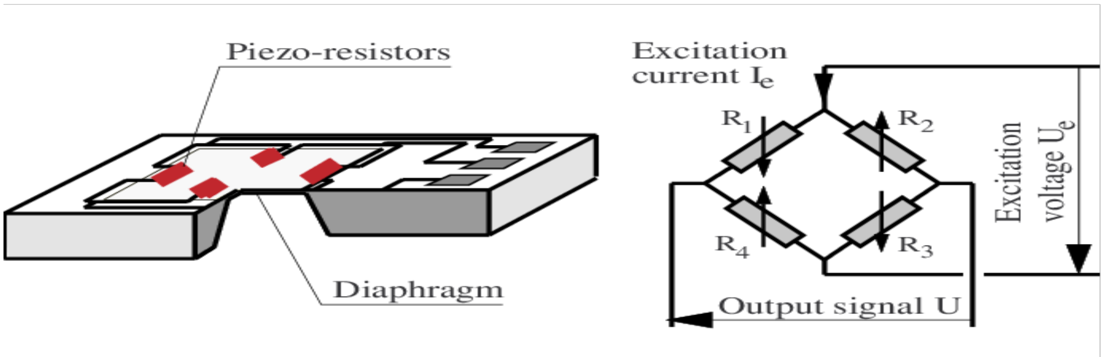

Figure 3-2: Piezo-Resistive inserted In Wheat stone bridge

Reference: https://www.researchgate.net/figure/Miniature-piezoresistive-pressure-sensor-chip-Wheatstone-bridge-circuit_fig2_305850597

Procedure:

- Disconnect all jumpers.
- Turn all switches OFF.

Calibrationoftheforcesensorconditioner

1. The reference voltage of the sensor is about + 10V dc, to be measured on the pins of the regulation diode.
2. The amplifier IC3 carries out an impedance matching.
3. The amplifier IC4 fixes the output variation range OUT (9).
4. The potentiometer RV3 is used to calibrate the 0 V= 0 gr.
5. The potentiometer RV 4 is used to calibrate the full scale 250m V = 250 gr (with sample weight)
6. The coefficient of the conditioner is 1 mV/gr.

- Set the weight supplied with the module on the weighting support and measure the value across the output OUT(9).
- Center the load on the measurement support.
- Check the measured weight corresponds to 250 mV, on the contrary proceed with the calibration.

Fault:

1. The voltage at the Terminal 9 is change.
2. The voltage at the Terminal 9 is zero.

Observation:

The sensibility of the sensor is 0.24mV/g. The voltage at the Terminal 9 was changed because the regulation diode is faulty. The voltage at the Terminal 9 was zero because IC 4 input is short-circuited to the ground.

Interfacing Commercially Available Sensor with Self-Designed Circuit:

Interface commercially available force/load sensor with your own circuit on breadboard or Vero board. Provide circuit diagram below and fill out observation table:

Load (g)	Output Signal (mV)	Measured error (g)

Result:

The principle of the Piezo-resistive Force transducer is successfully studied and its characteristic parameters are experimentally verified

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Department of Electronic Engineering

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Laboratory Session #______3_________ Dated ______________

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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 04

Objective:

To demonstrate the principle of Ultrasonic sensors and its application as range sensor.

Equipment Required:

- Base unit for the IPES system.
- Individual control unit mod. SIS3.
- Experiment module MCM14/EV.
- Digital multimeter, breadboard/Vero board
- Power supply MOD.PSUIEV.

Theory:

Characteristics of the Ultrasonic Components:

- These components are made with ceramic piezoelectric materials (piezoelectricity), which can operate as generators and as ultrasonic wave's receivers, especially for measuring the systems or for alarm systems.

- The ultrasonic vibrations **(>20 KHz)** sent by the transmitter, controlled by an oscillator, propagate in axial mode.

- Across the receiver you can detect a voltage which amplitude depends on the intensity of the waves radiated by the transmitter. The received voltage signal amplitude ranges between 10^{-6} V and 0.1 V.

- A short ultrasonic pulse is transmitted by a transducer, and it is received by another after a time T = L/v, where v is the sound speed (in the air = 334 m/s) which is supposed to be constant at variation of the distance L between the two transducers, it is easy to calculate L measuring the transit time T.Fig.4-1

- In Module MCM 14/EV an ultrasonic emitter (TX) and receiver (RX) are used.

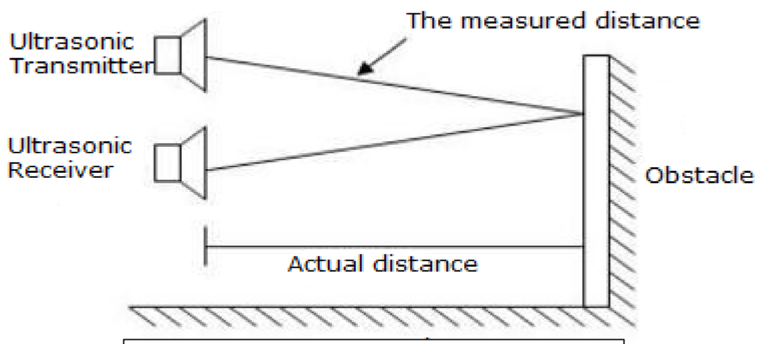

Figure 4-1: Ultrasonic Distance Sensor

Reference: https://www.cuidevices.com/blog/the-basics-of-ultrasonic-sensors

1. Disconnect all the jumpers.
2. Turn all switches OFF.
3. Turn on the power supply.
4. With the oscilloscope measure the signal on the base of T1.
5. With the oscilloscope, measure the control frequency of the transmitter (TX) on the resistor R31.
6. Vary the frequency and note the amplitude of the signal at transmitter at different frequencies.
7. Set jumper J7 to connect the buzzer.
8. Set your hand or a sheet of paper over the transmitter and the receiver so to Point out the ultrasonic wave reception.
9. Determine the reception pulse at different frequencies by connecting the Oscilloscope at the base of the transistor T2 and also determine the time of reception.

Using method	Receiver and Transmitter (dual use) type
Nominal frequency (kHz)	40
Sound Pressure (dB)	120±3 (20Pa)
Directivity (deg)	80
Detectable range (m)	0.2 – 4
Dimension (mm)	9.9φ x 7.1 height
Input voltage (Vp-p)	20 (40kHz) continuous signal

The frequency of the Transmitter (TX) is found to be___________KHz.
The time of transmission = T= _______µs.

The distance between the transmitter and receiver is L = V*T = ______m. V = velocity of sound in air = 334m/s.

T = time between transmission and reception.

Sr.No	**Frequency (KHz)**	**Amplitude (V)**
1		
2		
3		

Interfacing commercially available sensor with self-designed circuit:

Interface commercially available ultrasonic sensor with your own circuit on breadboard or Vero board. Provide circuit diagram below and fill out observation table:

Actual Range (cm)	Output Signal (mV)	Measured error (cm)

Result:

- The principle of the Ultrasonic Sensors is successfully studied and the characteristic of ultrasonic emitter and the receiver is verified through experiments.

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Department of Electronic Engineering

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Laboratory Session #______4_______ Dated _____________

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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 05

Objective:

To execute two and three input logic gates in Siemens Simatic Step 7 *Software*.

Learning Outcomes

To implement the operation of logic gates in Siemens Simatic Step 7

Introduction:

Simatic is a controller plus software developed by a German company. In Industrial Electronics labs, S300 PLCs with Step 7 (S7) software will be utilized.

Procedure:

1. Double click the Simatic Manager icon once to open S7
2. Once the S7 is launched, screen similar as shown below in Figure 5-1 will appear

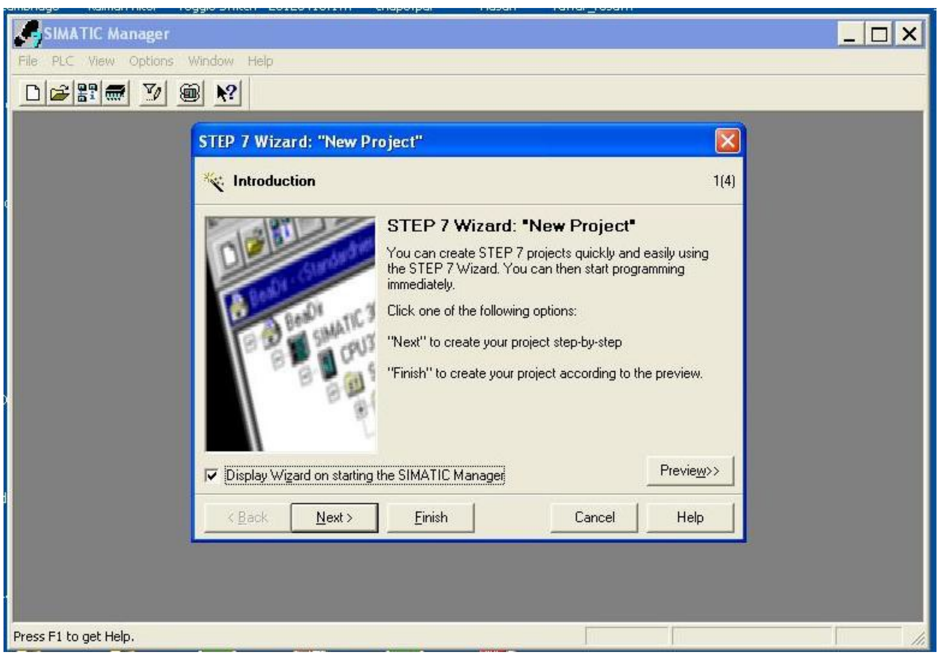


Figure 5-1: New Project Screen

3. Click Next. Select CPU314IFM in Figure :5-2.

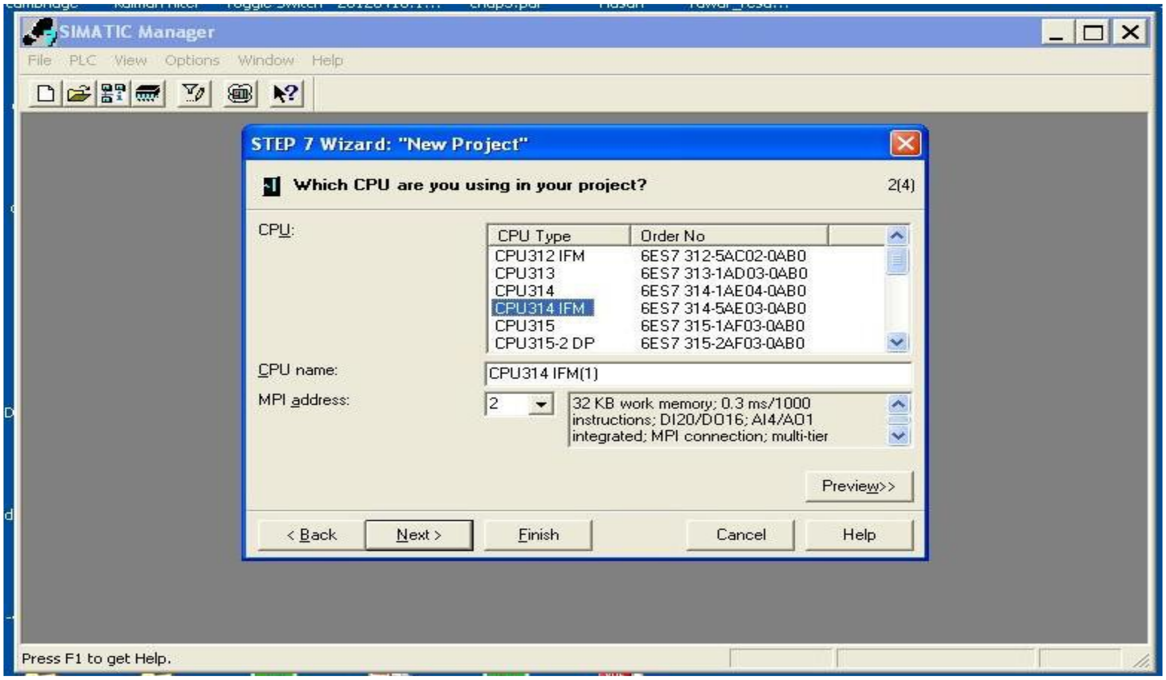


Figure 5-2

4. Click Next and select OB1 under Blocks. Select LAD as the language for selected blocks as in Figure 5-3

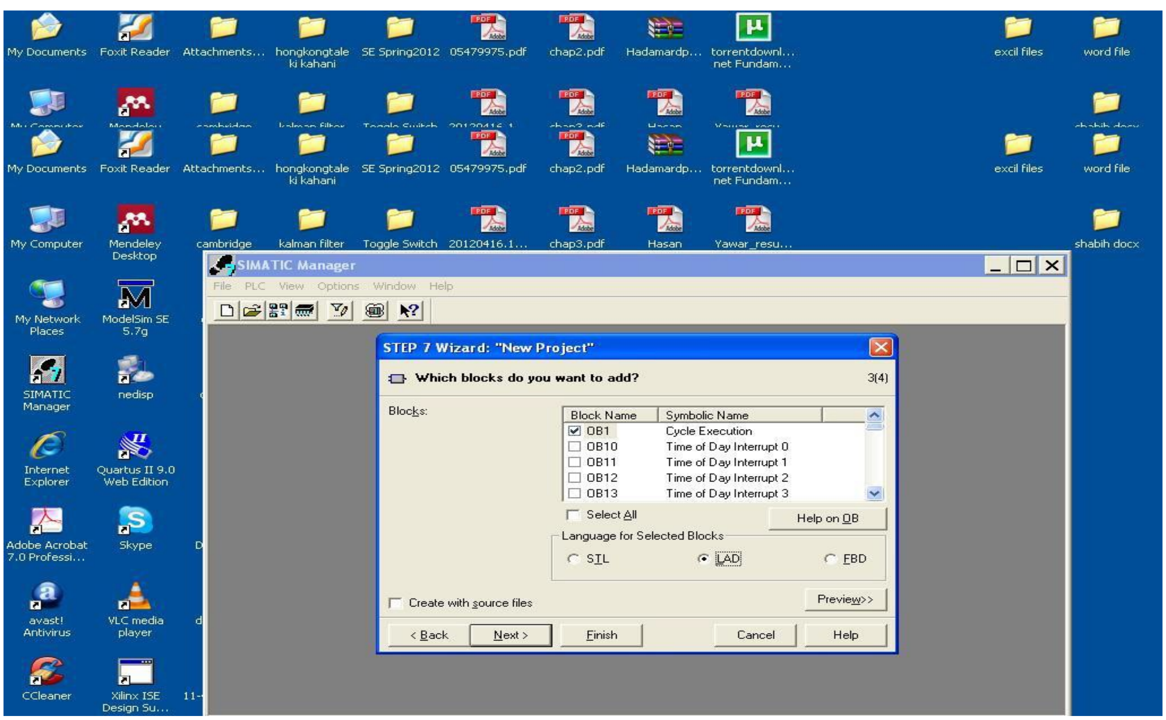


Figure 5-3

5. Click Next and name your project. Click Finish as in Figure 5-4 and Figure 5-5

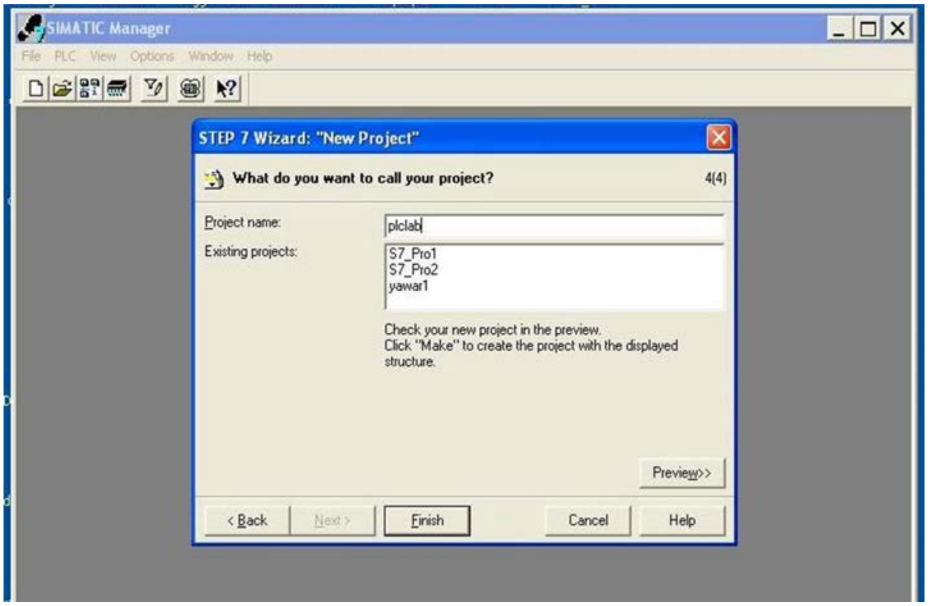


Figure 5-4

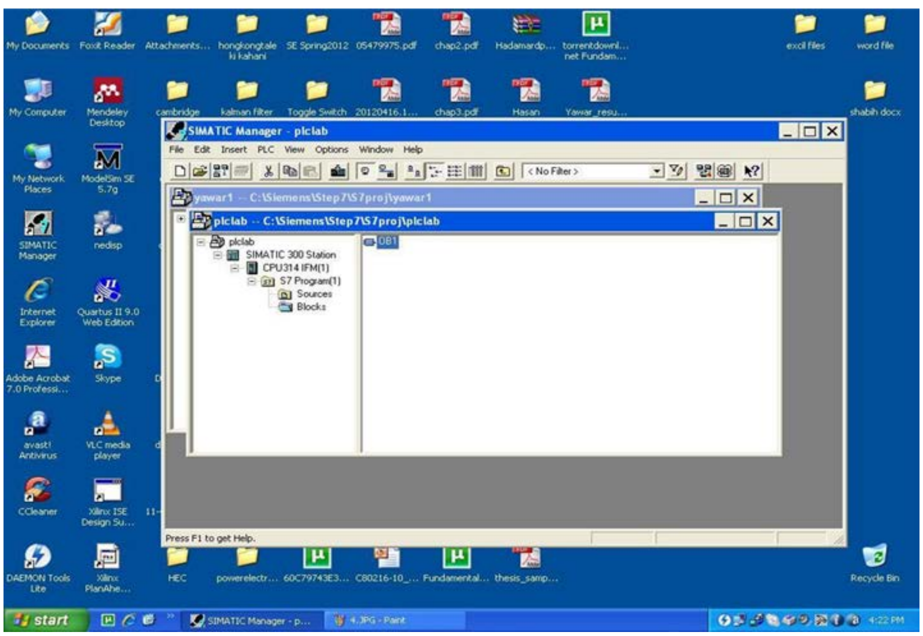


Figure 5-5

6 .Following project window will open as in Figure 5-6 and Figure 5-7

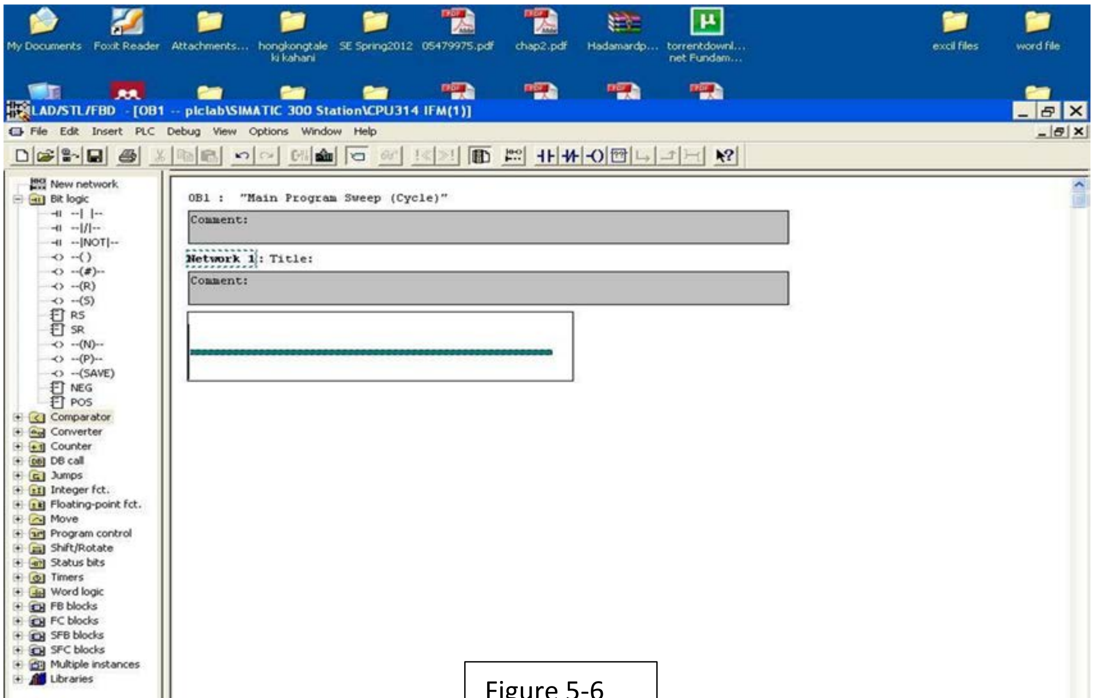


Figure 5-6

7. Draw AND gate as follows

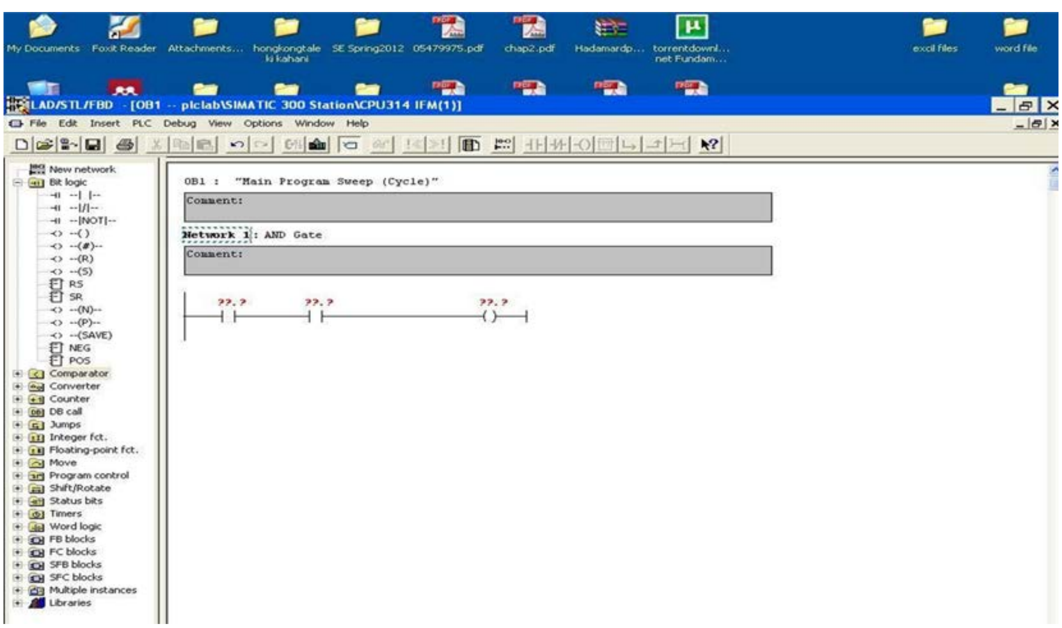


Figure 5-7

8. For Soft simulation turn Simulator ON from the Simatic manager window as follows in Figure 5-8

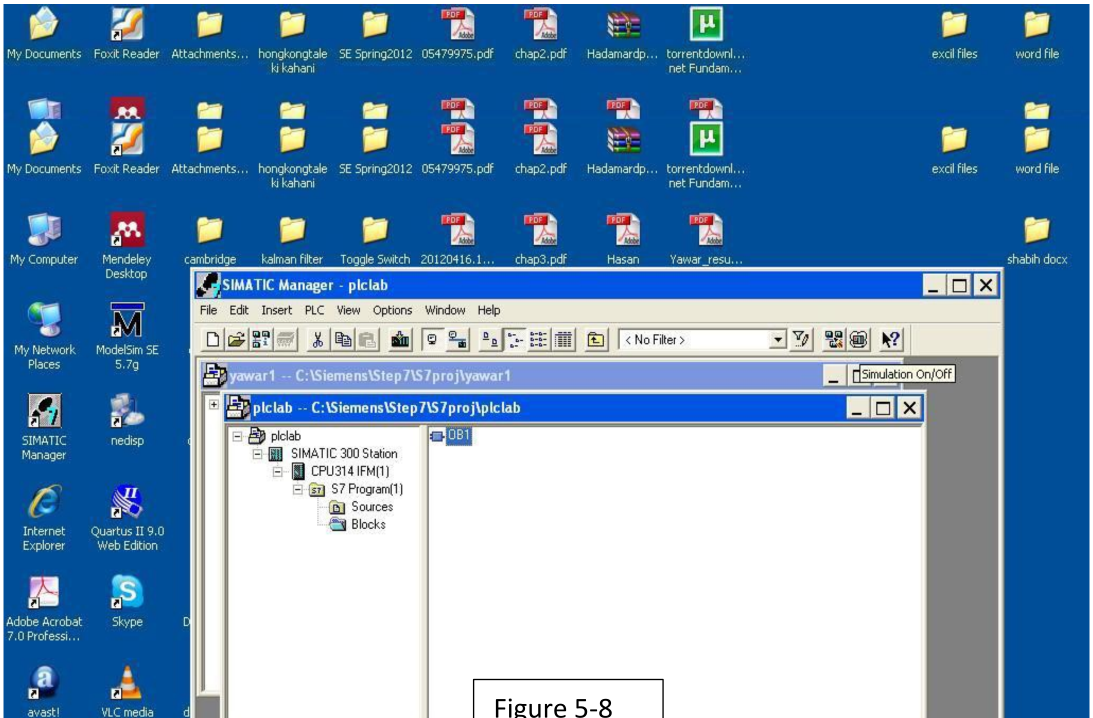


Figure 5-8

9. Add input and output variable shown in Figure 5-9

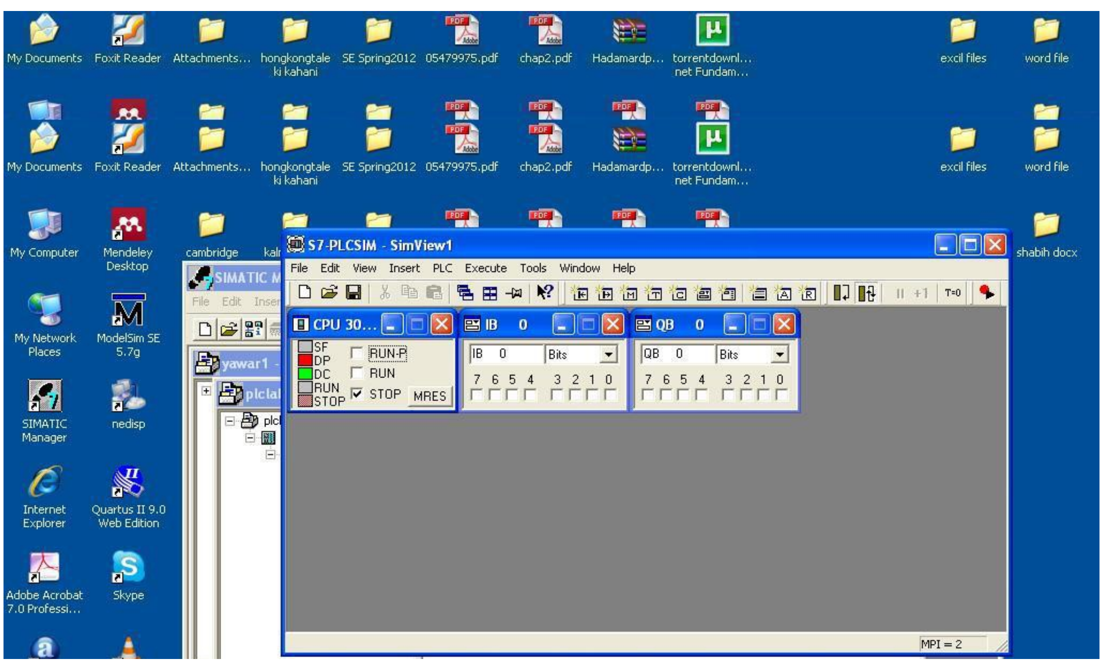


Figure 5-9

10. Assign addresses to the input and output as in Figure 5-10

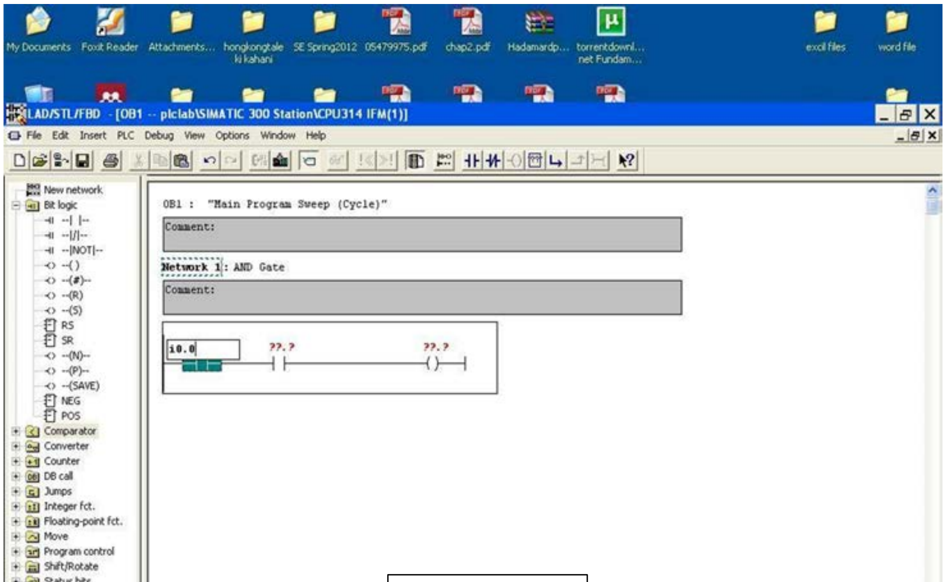


Figure 5-10

11. Click Download as in Figure 5-11

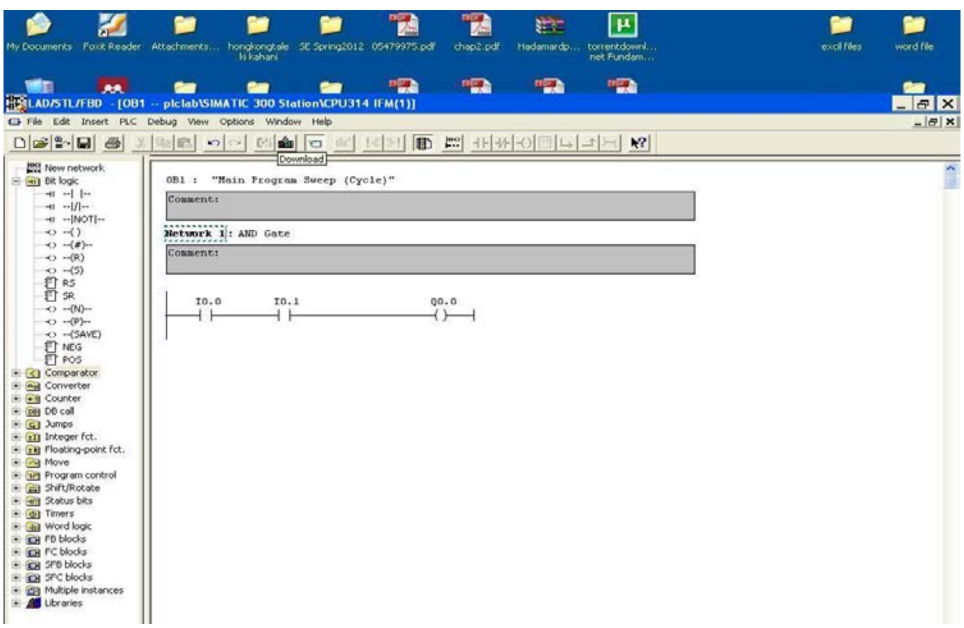


Figure 5-11

12. Click Monitor as in Figure 5-12

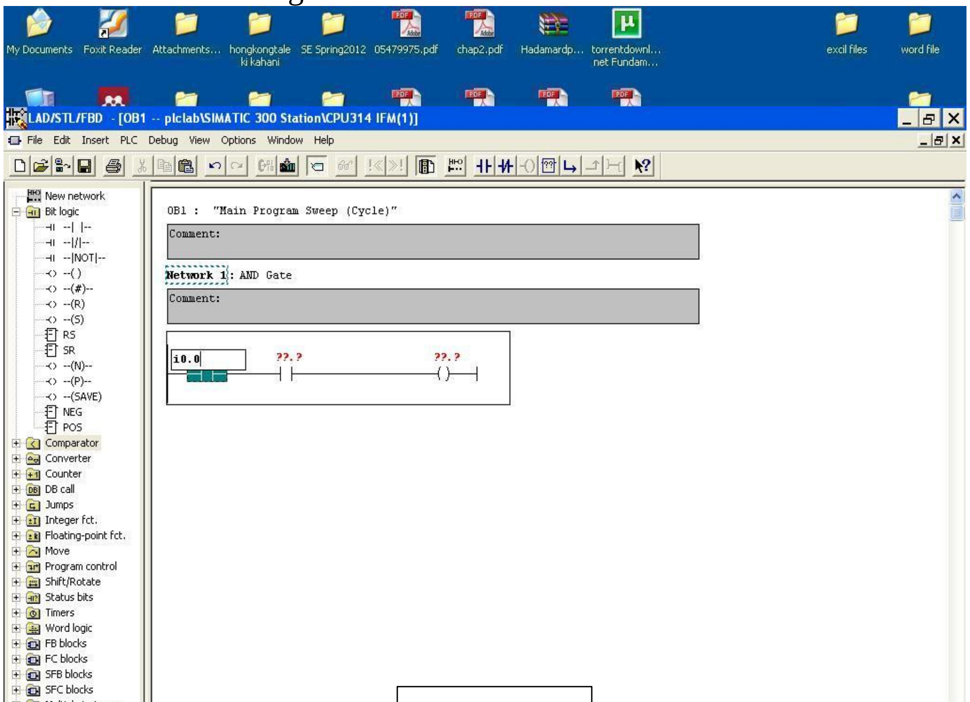


Figure 5-12

13. Select Run in the simulator window as in Figure 5-13

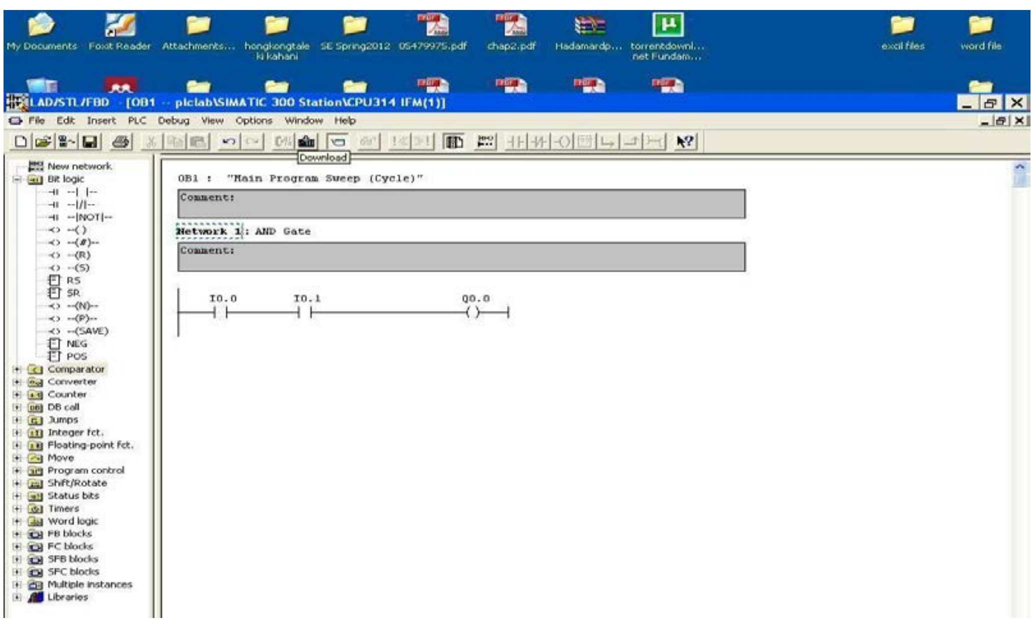


Figure 5-13

14. Select bit for Logic 1 and unselect for Logic 0. Verify the AND logic as Figure 5-14.

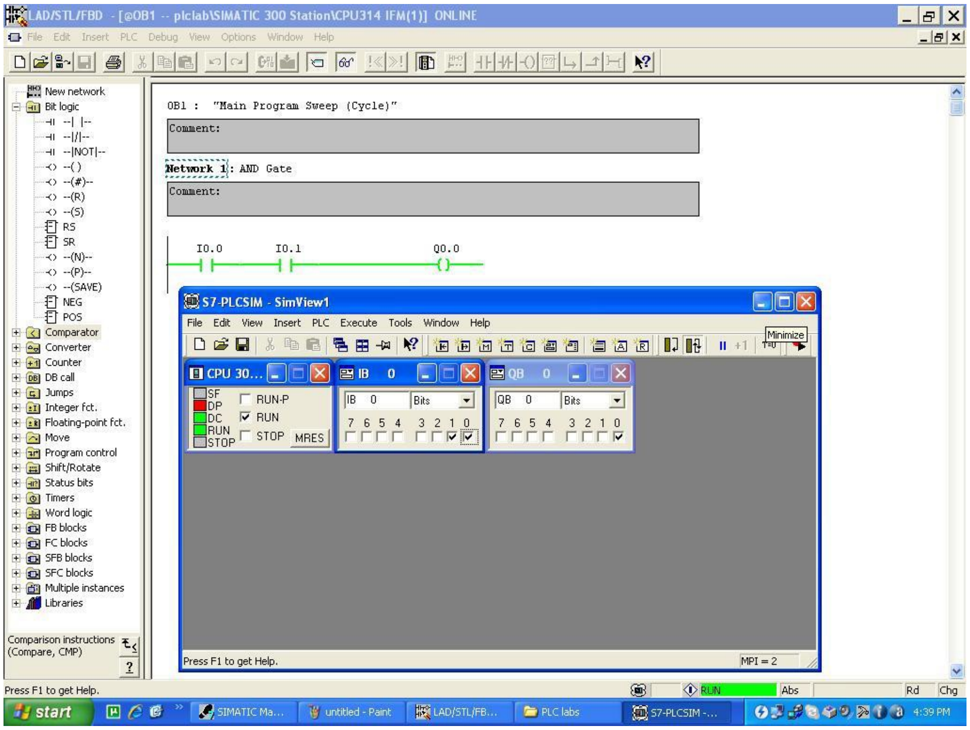


Figure 5-14

<u>Task:</u>

Draw and soft simulate the ladder logic of following gates:

OR Gate
NOR Gate
NAND Gate
XOR Gate
NOT Gate
XNOR Gate

Objective:

To implement two and three input logic gates in Siemens S7-300 *PLC.*

LearningOutcomes:

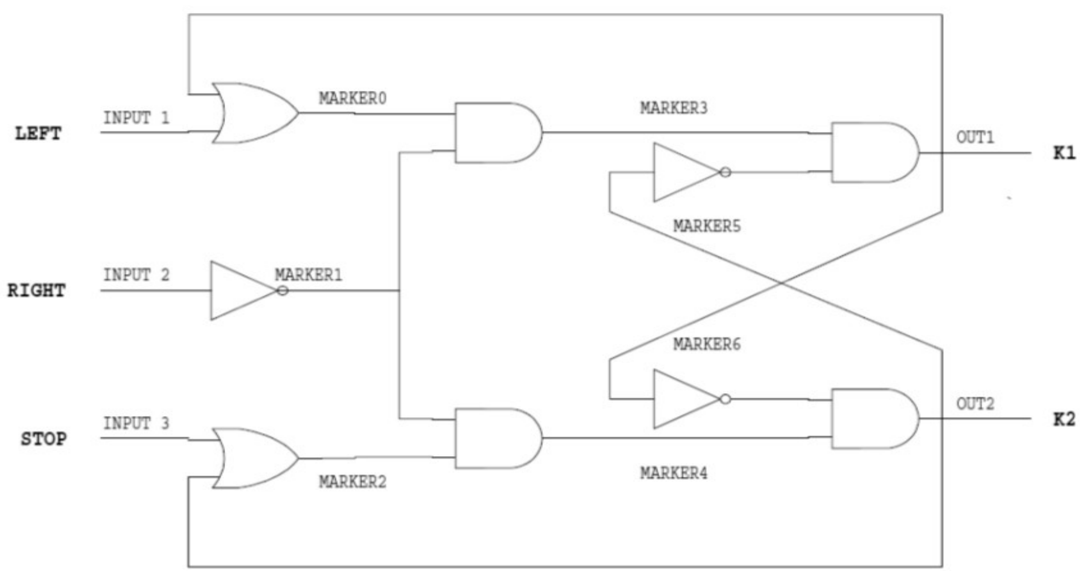
To learn how to download a program in a PLC
To understand operation of Siemens S7-300 PLC

Procedure:

1. Draw AND logic gate in software as described in lab 3.
2. Be careful in addressing the input and output. Byte address can be seen on the PLC (e.g.: I 124.0 and Q 124.0).
3. Turn on the PLC and click Download in software. This will download the program in the PLC. Do NOT turn the simulator on as in Lab 3; else the program will download in it and not the PLC. Click Monitor.
4. Now turn the knob on PLC from Stop to Run.
5. Change input logic with the help of switches on the PLC. An LED will turn on for logic 1 and will turn off for logic 0. Observe the output.
6. Repeat the procedure for OR, NOR, NAND, XOR and XNOR gates.

Task:

Design ladder logic for the following circuit:



NED University of Engineering & Technology

Department of Electronic Engineering

F /OBEM 01/05/00

Laboratory Session #______5a&5b___ Dated ______________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
O bser v a t io n's U se ***Displays*** skills to perform related mathematical calculations using the observations from lab work.	Not able to use lab work observations into mathematical calculations.	Able to slightly use lab work observations into mathematical calculations.	Able to somewhat use lab work observations into mathematical calculations.	Able to moderately use lab work observations into mathematical calculations.	Able to fully use lab work observations into mathematical calculations.
Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group based lab work.	Never participate s.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 06

Objective:

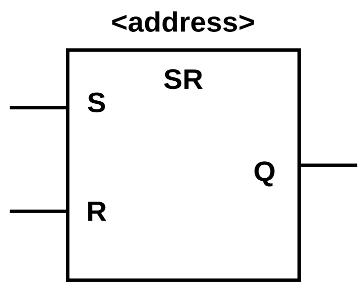
To design and perform operation and application of SR and RS Flip Flops in Siemens S7-300 PLC.

LearningOutcomes:

To understand the logical operation of PLC
To implement the operation and application of SR & RS Flip flops
To simulate their behavior in software Step 7 and implement in Siemens S7-300 PLC

SR(Set-Reset)FlipFlop:

Symbol

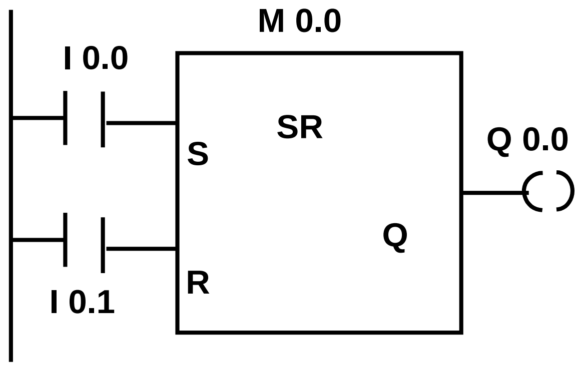


Parameter	Data Type	Memory Area	Description
<address>	BOOL	I,Q,M,L,D	Set or reset bit
S	BOOL	I,Q,M,L,D	Enabled set instruction
R	BOOL	I,Q,M,L,D	Enabled reset instruction
Q	BOOL	I,Q,M,L,D	Signal state of <address>

Description:

SR (Set-Reset Flip Flop) is set if the signal state is "1" at the S input, and "0" at the R input. Otherwise, if the signal state is "0" at the S input and "1" at the R input, the flip flop is reset. If the RLO (result of logic operation) is "1" at both inputs, the order is of primary importance. The SR flip flop executes first the set instruction then the reset instruction at the specified <address>, so that this address remains reset for the remainder of program scanning. The S (Set) and R (Reset) instructions are executed only when the RLO is "1". RLO "0" has no effect on these instructions and the address specified in the instruction remains unchanged.

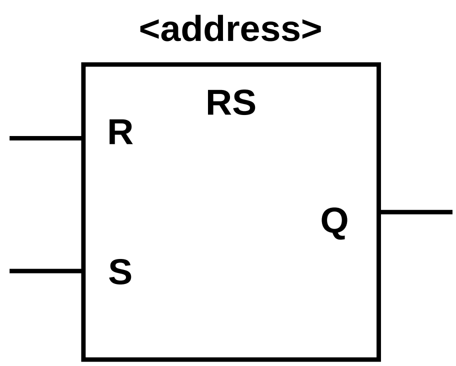
Example:



If the signal state is "1" at input I0.0 and "0" at I0.1, memory bit M0.0 is set and output Q0.0 is "1". Otherwise, if the signal state at input I0.0 is "0" and at I0.1 is "1", memory bit M0.0 is reset and output Q0.0 is "0". If both signal states are "0", nothing is changed. If both signal states are "1", the reset instruction dominates because of the order; M0.0 is reset and Q0.0 is "0".

RS (Reset-Set) Flip Flop:

Symbol

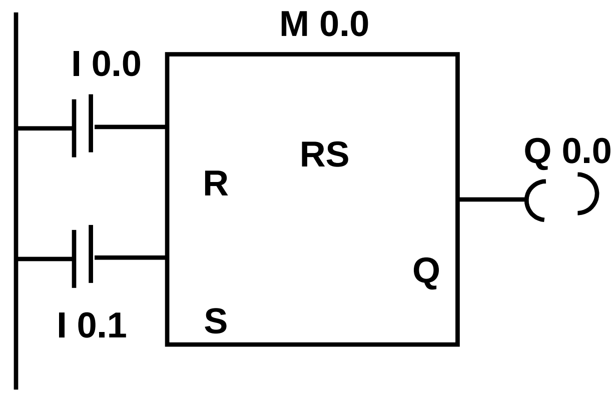


Parameter	**Data Type**	**Memory Area**	**Description**
<address>	BOOL	I,Q,M,L,D	Set or reset bit
S	BOOL	I,Q,M,L,D	Enabled set instruction
R	BOOL	I,Q,M,L,D	Enabled reset instruction
Q	BOOL	I,Q,M,L,D	Signal state of <address>

Description:

RS (Reset-Set Flip Flop) is reset if the signal state is "1" at the R input, and "0" at the S input. Otherwise, if the signal state is "0" at the R input and "1" at the S input, the flip flop is set. If the RLO is "1" at both inputs, the order is of primary importance. The RS flip flop executes first the reset instruction then the set instruction at the specified <address>, so that this address remains set for the remainder of program scanning. The S (Set) and R (Reset) instructions are executed only when the RLO is "1". RLO "0" has no effect on these instructions and the address specified in the instruction remains unchanged.

Example:



If the signal state is "1" at input I0.0 and "0" at I0.1, memory bit M0.0 is set and output Q0.0 is "0". Otherwise, if the signal state at input I0.0 is "0" and at I0.1 is "1", memory bit M0.0 is reset and output Q0.0 is "1". If both signal states are "0", nothing is changed. If both signal states are "1", the set instruction dominates because of the order; M0.0 is set and Q0.0 is "1".

<u>Task:</u>

Design a control system for a refrigerator using one input 'A' such that its light 'L' is turned off when the door is closed and turns on when it is open. Use SR or RS flip flop to implement the logic.

Please attach flowchart of your program indicating inputs and outputs (ladder diagram code must also be included).

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Department of Electronic Engineering

F /OBEM 01/05/00

Laboratory Session #______6___ Dated ______________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
Observation's Use ***Displays*** skills to perform related mathematical calculations using the observations from lab work.	Not able to use lab work observations into mathematical calculations.	Able to slightly use lab work observations into mathematical calculations.	Able to somewhat use lab work observations into mathematical calculations.	Able to moderately use lab work observations into mathematical calculations.	Able to fully use lab work observations into mathematical calculations.
Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group based lab work.	Never participate s.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 07

Objective:

To originate and accomplish the operation and application of various timers in Siemens S7-300 PLC.

Learning Outcomes:

To implement the operation and application of timers

To simulate their behavior in software Step 7 and implement in Siemens S7-300 PLC

Timers in Siemens S7-300:

The following timer instructions are available:

S_PULSE	Pulse S5 Timer
S_PEXT	Extended Pulse S5 Timer
S_ODT	On-Delay S5 Timer
S_ODTS	Retentive On-Delay S5 Timer
S_OFFDT	Off-Delay S5 Timer

Time Value

Bits 0 through 9 of the timer word contain the time value in binary code. The time value specifies a number of units. Time updating decrements the time value by one unit at an interval designated by the time base. Decrementing continues until the time value is equal to zero. The time range is from 0 to 9,990 seconds.

You can pre-load a time value using either of the following formats:

W#16#wxyz

– Where w = the time base (that is, the time interval or resolution)
– Where xyz = the time value in binary coded decimal format

S5T# aH_bbM_ccS_ddMS

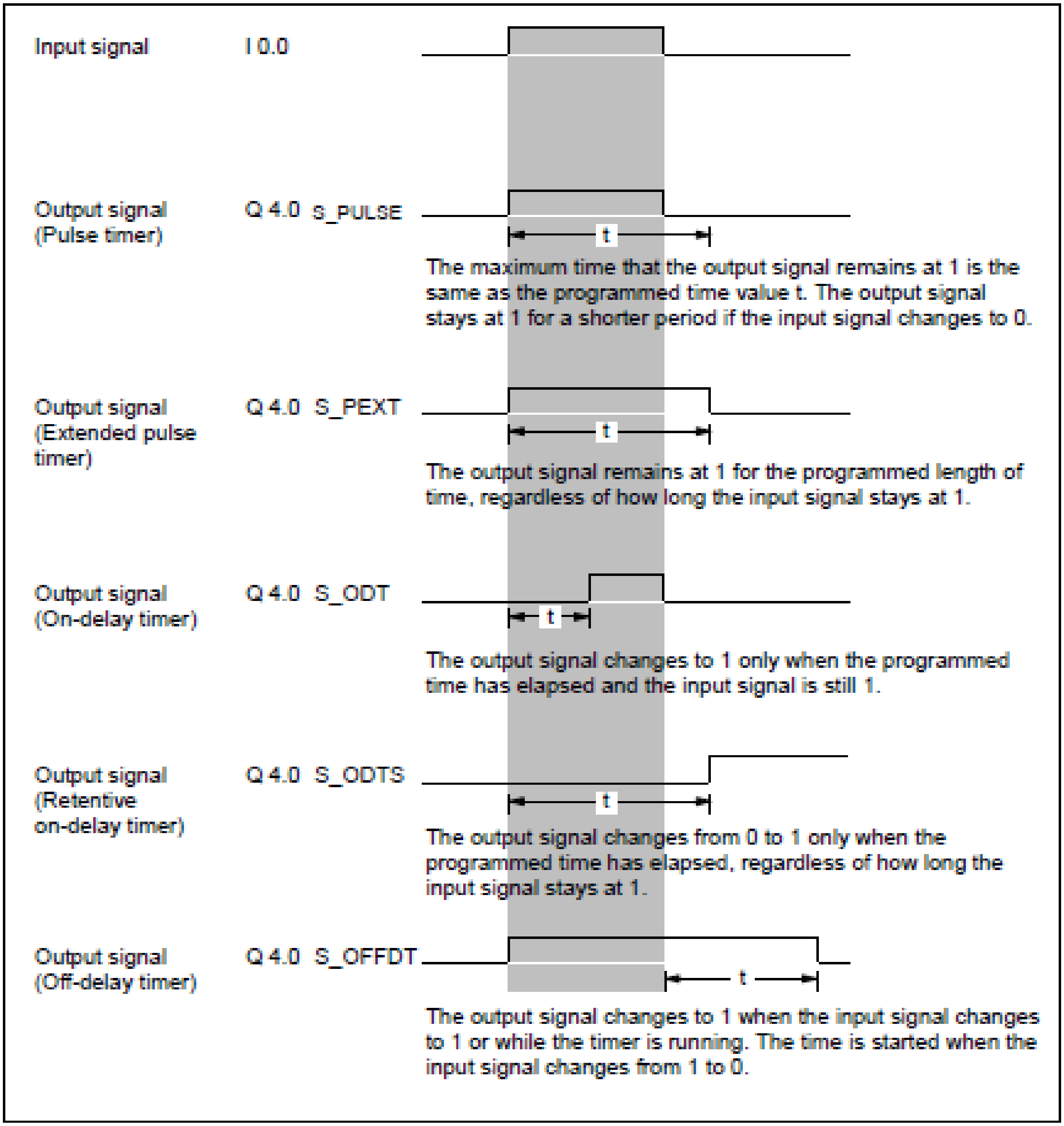
– Where a = hours, bb = minutes, cc = seconds, and dd = milliseconds

For example:

- S5TIME#4S = 4 seconds
- s5t#2h_15m = 2 hours and 15 minutes
- S5T#1H_12M_18S = 1 hour, 12 minutes, and 18 seconds

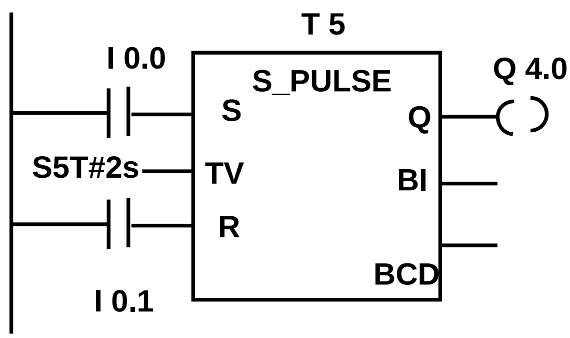
– The time base is selected automatically, and the value is rounded to the next lower number with that time base.
The maximum time value that you can enter is 9,990 seconds, or 2H_46M_30S.

Choosing the Right Timer
This overview is intended to help you choose the right timer for your timing job.



Parameter	Data Type	Memory Area	Description
T no.	TIMER	T	Timer identification number; range depends on CPU
S	BOOL	I, Q, M, L, D	Start input
TV	S5TIME	I, Q, M, L, D	Preset time value
R	BOOL	I, Q, M, L, D	Reset input
BI	WORD	I, Q, M, L, D	Remaining time value, integer format
BCD	WORD	I, Q, M, L, D	Remaining time value, BCD format
Q	BOOL	I, Q, M, L, D	Status of the timer

Example:



If the signal state of input I0.0 changes from "0" to "1" (positive edge in RLO), the timer T5 will be started. The timer will continue to run for the specified time of two seconds (2 s) as long as I0.0 is "1". If the signal state of I0.0 changes from "1" to "0" before the timer has expired, the timer will be stopped. If the signal state of input I0.1 changes from "0" to "1" while the timer is running, the time is reset. The output Q4.0 is logic "1" as long as the timer is running and "0" if the time has elapsed or was reset.

Task:

Draw ladder diagram for the following:

1. If the signal state of input I0.0 changes from "0" to "1" (positive edge in RLO), the timer T5 will be started. The timer will continue to run for the specified time of two seconds (2 s) without being affected by a negative edge at input S. If the signal state of I0.0 changes from "0" to "1" before the timer has expired the timer will be re-triggered. The output Q4.0 is logic "1" as long as the timer is running.

2. If the signal state of I0.0 changes from "0" to "1" (positive edge in RLO), the timer T5 will be started. If the time of two seconds elapses and the signal state at input I0.0 is still "1", the output Q4.0 will be "1". If the signal state of I0.0 changes from "1" to "0", the timer is stopped and Q4.0 will be "0" (if the signal state of I0.1 changes from "0" to "1", the time is reset regardless of whether the timer is running or not).
3. If the signal state of I0.0 changes from "1" to "0", the timer is started. Q4.0 is "1" when I0.0 is "1" or the timer is running. (if the signal state at I0.1 changes from "0" to "1" while the time is running, the timer is reset).
4. If the signal state of I0.0 changes from "0" to "1" (positive edge in RLO), the timer T5 will be started. The timer runs without regard to a signal change at I0.0 from "1" to "0". If the signal state at I0.0 changes from "0" to "1" before the timer has expired, the timer will be re-triggered. The output Q4.0 will be "1" if the timer elapsed. (If the signal state of input I0.1 changes from "0" to "1", the time will be reset irrespective of the RLO at S.).

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Laboratory Session #____7___ Dated ______________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
Observation's Use ***Displays*** skills to perform related mathematical calculations using the observations from lab work.	Not able to use lab work observations into mathematical calculations.	Able to slightly use lab work observations into mathematical calculations.	Able to somewhat use lab work observations into mathematical calculations.	Able to moderately use lab work observations into mathematical calculations.	Able to fully use lab work observations into mathematical calculations.
Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group based lab work.	Never participates.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 08

Objective:

To draft and review the operation and application of different counters in Siemens S7-300 PLC.

LearningOutcomes:

To implement the operation and application of counters

To simulate their behavior in software Step 7 and implement in Siemens S7-300 PLC

Counters in Siemens S7-300:

The following counter instructions are available:

Up Counter

Down Counter

Up-Down Counter

Count Value

Bits 0 through 9 of the counter word contain the count value in binary code. The count value is moved to the counter word when a counter is set. The range of the count value is 0 to 999. You can vary the count value within this range by using the Up-Down Counter, Up Counter, and Down Counter instructions.

Bit Configuration in the Counter

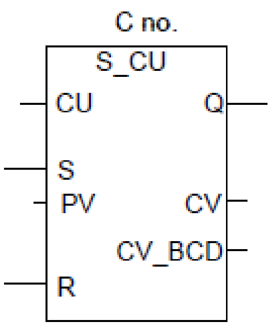
You provide a counter with a preset value by entering a number from 0 to 999, for example 127, in the following format:

C#127

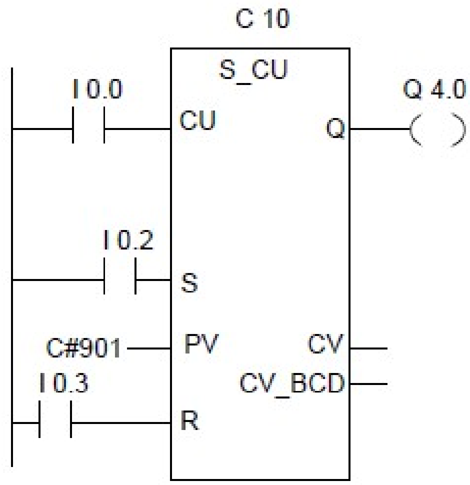
The C# stands for binary coded decimal format (BCD format: each set of four bits contains the binary code for one decimal value).

Up Counter:

A positive edge (i.e. a change in signal state from 0 to 1) at input S of the Up Counter instruction sets the counter with the value at the Preset Value (PV) input. With a positive edge, the counter is reset at input R. The resetting of the counter sets the count value to 0. With a positive edge, the value of the counter at input CU is increased by 1 when the count value is less than 999. A signal state check for 1 at output Q produces a result of 1 when the count is greater than 0; the check produces a result of 0 when the count is equal to 0.

LAD Box	Parameter	Data Type	Memory Area	Description
	no.	COUNTER	C	Counter identification number. The range depends on the CPU.
	CU	BOOL	I, Q, M, D, L	Count up input CU
	S	BOOL	I, Q, M, D, L	Set input for presetting counter
	PV	WORD	I, Q, M, D, L	Value in the range of 0 to 999 for presetting counter (entered as C#<value> to indicate BCD format)
	R	BOOL	I, Q, M, D, L	Reset input
	Q	BOOL	I, Q, M, D, L	Status of the counter
	CV	WORD	I, Q, M, D, L	Current counter value (integer format)
	CV_BCD	WORD	I, Q, M, D, L	Current counter value (BCD format)

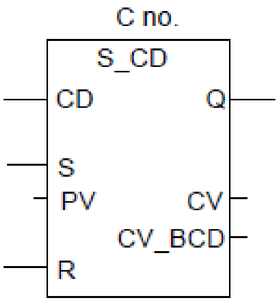
Example



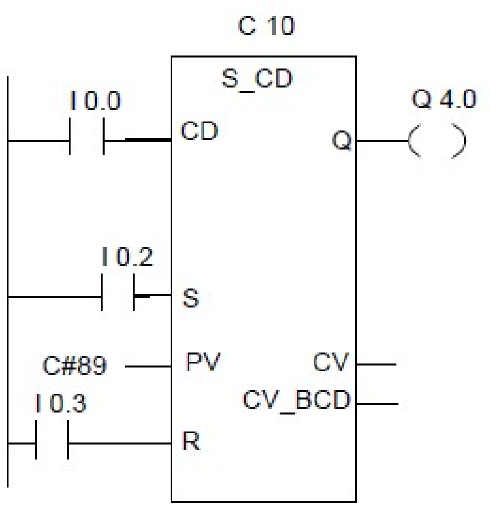
A change in signal state from 0 to 1 at input I 0.2 sets counter C 10 with the value 901 in binary coded decimal format. If the signal state of I 0.0 changes from 0 to 1, the value of counter C 10 is increased by 1, unless the value of C 10 is equal to 999. If I 0.3 changes from 0 to 1, the value of C 10 is set to 0. The signal state of output Q 4.0 is 1 if C 10 is not equal to 0.

Down Counter:

A positive edge (that is, a change in signal state from 0 to 1) at input S of the Down Counter instruction sets the counter with the value at the Preset Value (PV) input. With a positive edge, the counter is reset at input R. The resetting of the counter sets the count value to 0. With a positive edge, the value of the counter at the input is reduced by 1 when the count value is greater than 0. A signal state check for 1 at output Q produces a result of 1 when the count is greater than 0; the check produces a result of 0 when the count is equal to 0.

LAD Box	Parameter	Data Type	Memory Area	Description
	no.	COUNTER	C	Counter identification number. The range depends on the CPU.
	CD	BOOL	I, Q, M, D, L	Count down input CD
	S	BOOL	I, Q, M, D, L	Set input for presetting counter
	PV	WORD	I, Q, M, D, L	Value in the range of 0 to 999 for presetting counter (entered as C#<value> to indicate BCD format)
	R	BOOL	I, Q, M, D, L	Reset input
	Q	BOOL	I, Q, M, D, L	Status of the counter
	CV	WORD	I, Q, M, D, L	Current counter value (integer format)
	CV_BCD	WORD	I, Q, M, D, L	Current counter value (BCD format)

Example:

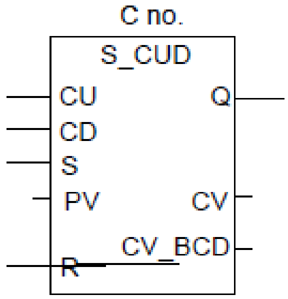


A change in signal state from 0 to 1 at input I 0.2 sets counter C 10 with the value 89 in binary coded decimal format. If the signal state of input I 0.0 changes from 0 to 1, the value of counter C 10 is decreased by 1, unless the value of counter C 10 is equal to 0. The signal state of output Q 4.0 is 1 if counter C 10 is not equal to 0. If I 0.3 changes from 0 to 1, the value of C 10 is set to 0.

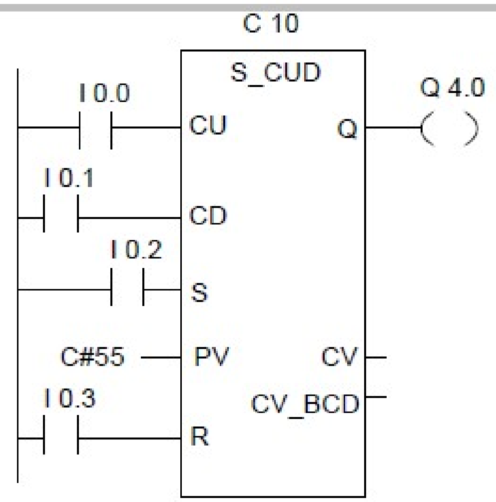
Up-Down Counter:

A positive edge (i.e. a change in signal state from 0 to 1) at input S of the Up-Down Counter instruction sets the counter with the value at the Preset Value (PV) input. A signal state of 1 at input R resets the counter. Resetting the counter places the value of the count at 0. The counter is incremented by 1 if the signal state at input CU changes from 0 to 1 (that is, there is a positive edge) and the value of the counter is less than 999. The counter is decremented by 1 if the signal state at input CD changes from 0 to 1 (that is, there is a positive edge) and the value of the counter is more than 0.

If there is a positive edge at both count inputs, both operations are executed and the count remains the same. A signal state check for 1 at output Q produces a result of 1 when the count is greater than 0; the check produces a result of 0 when the count is equal to 0.

LAD Box	Parameter	Data Type	Memory Area	Description
	no.	COUNTER	C	Counter identification number. The range depends on the CPU.
	CU	BOOL	I, Q, M, D, L	Count up input CU
	CD	BOOL	I, Q, M, D, L	Count down input CD
	S	BOOL	I, Q, M, D, L	Set input for presetting counter
	PV	WORD	I, Q, M, D, L	Value in the range of 0 to 999 for presetting counter (entered as C#<value> to indicate BCD format)
	R	BOOL	I, Q, M, D, L	Reset input
	Q	BOOL	I, Q, M, D, L	Status of the counter
	CV	WORD	I, Q, M, D, L	Current counter value (integer format)
	CV_BCD	WORD	I, Q, M, D, L	Current counter value (BCD format)

Example



A change in signal state from 0 to 1 at input I 0.2 sets counter C 10 with the value 55 in binary coded decimal format. If the signal state of input I 0.0 changes from 0 to 1, the value of counter C 10 is increased by 1, except when the value of counter C 10 is equal to 999. If input I 0.1 changes from 0 to 1, counter C 10 is decreased by 1, except when the value of counter C 10 is equal to 0. If I 0.3 changes from 0 to 1, the value of C 10 is set to 0. Q 4.0 is 1, when C 10 is not equal to "0".

Task:

Draw ladder diagram for the following:

1. Develop the ladder logic that will turn on a light, after switch A has been closed 10 times. Push button B will reset the counters.
2. A buffer can hold up to 10 parts. Parts enter the buffer on a conveyor controller by output conveyor. As parts arrive they trigger an input sensor *enter*. When a part is removed from the buffer they trigger the *exit* sensor. Write a program to stop the conveyor when the buffer is full. As normal, the system should also include a start and stop button

.

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Laboratory Session #_____08___ Dated ______________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
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Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group based lab work.	Never participate s.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 9

Objective:

To originate PLC Ladder Logic Diagram for controlling operation of an overhead tank.

Learning Outcomes:

- To put to practice the concepts learnt so far.
- To simulate the program in software Step 7 and implement in Siemens S7-300 PLC.

Task:

Consider an overhead tank. One pump is used to fill the tank and second pump is used to empty it. Mixer is used to mix the chemical in the tank. Design a PLC based ladder diagram to control the system by understanding the following conditions:

- System will be on if momentary main switch SW1 is pressed once and will be off if shutdown momentary switch SW2 is pressed once.
- Pump P1 will be on if level of chemical is going down from lower level sensor LS1 and will be off if level of chemical is going up from upper level sensor LS2.
- Mixer M1 will be on for 5 seconds if pump P1 is not activated and level of chemical is just above from LS1.
- Pump P2 will be on after stoppage of mixer M1 and will be off when level of LS1 is achieved.

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Department of Electronic Engineering

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Laboratory Session #______09___ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
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Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group based lab work.	Never participate s.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 10

Objective:

To develop PLC Ladder Logic Diagram for controlling operation of a conveyer belt.

LearningOutcomes:

-To put to practice the concepts learnt so far

-To simulate the program in software Step 7 and implement in Siemens S7-300 PLC

Task:

Design a Conveyor belt system which contains a DC motor, a limit switch, an optocoupler to count objects on the belt and Enable push switch to activate counting. Draw a PLC ladder diagram for this system such that:

Conveyor belt should not move if limit switch is activated and it should not move if count value of objects sensed by the optocoupler is reached to 40.
Counting of objects should be enabled by the Enable switch.

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Laboratory Session #_____10___ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 11

Objective:

To refine Ladder Logic Diagram for controlling operation of an industrial tank unit.

Task:

A collecting basin for waste water is emptied using two pumps. The system is started when ENABLE button E0 is pressed.

Pump P1:

Start: The pump is started either manually by pressing momentary contact push button S2 or automatically by float switch B1. When the water level is exceeded

STOP: if the water level falls below float switch B0, the pump switch off automatically at any time by pressing push button S1 or by thermal over current release F1

Pump P2:

Start: The pump is started either manually by pressing momentary contact push button S4 or automatically by float switch B4 when the water level is exceeded.

Stop: If the water level falls below float, switch B3, the pump switch off automatically at any time by pressing push button S3 or by thermal over current release F2.

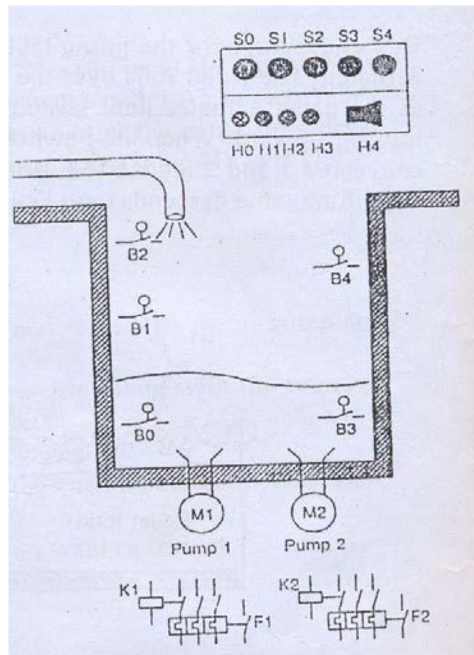

Figure 11-1 : Tank water levels

Lamp H0 to H3 indicates the operating state of the pumps. Whole of the system is shut down when stop push button S0 is pressed. Hooter H4 must sound when the water level reaches float switch B2 or when a pump fails because the associated thermal over current release has tripped.

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Laboratory Session #_____11___ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
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Group Work Contributes in a group based lab work.	Never participate s.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

LAB EXPERIMENT 12

Objective:

To elaborate the PLC Ladder Logic Diagram to interface and to control industrial actuator (AC/DC motors).

Task:

Build hardware and interfacing circuitry for the interfacing of given actuator
Build PLC logic to control given actuator

Interfacingcircuit:

Provide your interfacing circuitry diagram below:

PLCLogic:

Provide your PLC logic for given task:

Results:

Following results are observed:

NED University of Engineering & Technology

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F /OBEM 01/05/00

Laboratory Session #_____12___ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	

OPEN ENDED LAB

Objective:

To manipulate PLC Ladder Logic Diagram to drive an Induction motor on Star and delta connection.

Task:

- Build hardware and ladder logic
- Build PLC logic to control given motor connection

Comparison between Star and Delta Connections

Three phase system in electrical system use the term Star and Delta.

Star connection "Y": Star connection also called Y connection that is obtained by joining together similar ends of coils either "starting" or finishing. The other ends are joined to the line wires. The common point is called the Neutral or Star Point.

This Star connection (three-phase, 4-wires system) is used in power distribution, transformers and small scale domestic and residential applications.

Delta or Mesh Connection "Δ": Delta and Mesh connection is obtained by connecting the starting end of the first coil to the finishing end of the second coil and so on (for all three coils) which forms like a closed loop or mesh circuit.

Delta connection (three-phase, 3-wires system) is used in power transmission, transformers, and large-scale industrial and commercial applications.

STAR	DELTA
1. In "Y" Connection, the starting or finishing ends (similar ends) of three coils are connected together to form the neutral point in the shape of letter "Y". A common wire is taken out from the neutral point, which is known as the Neutral Wire.	In "Δ" Connection, the opposite ends of three coils are connected together, which forms the shape of Greek alphabet "Δ". In other words, the end of each coil is connected with the starting point of another coil, and the common joints form the three phase wires.
There is a Neutral or Star Point in this connection.	No Neutral Point in Delta Connection in this connection..
There are Four conductors in the star connection (3 Phase Wires + 1 Neutral Wire).	There are Three conductors in the delta connection (3 Phase Wires ; All are phases).

Line Current is Equal to the Phase Current. i • Line Current = Phase Current • $I_L = I_{PH}$	Line Current is √3 times of Phase Current. • Line Current = √3 × Phase Current • $I_L = \sqrt{3} \times I_{PH}$
Line Voltage is √3 times of Phase Voltage. i.e. • Line Voltage = √3 × Phase Voltage • $V_L = \sqrt{3} \times V_{PH}$ In Star Connection, the total Power supplied by three Phases could be found by: • $P = \sqrt{3} \times V_L \times I_L \times \cos\Phi$ … Or • $P = 3 \times V_{PH} \times I_{PH} \times \cos\Phi$ • $P = \sqrt{3} \times V \times I$	Line Voltage is Equal to the Phase Voltage. i.e. • Line Voltage = Phase Voltage • $V_L = V_{PH}$ In Delta Connection, the total Power of three phases could be found by: • $P = \sqrt{3} \times V_L \times I_L \times \cos\Phi$ … Or • $P = 3 \text{ x } V_{PH} \text{ x } I_{PH} \text{ x } \cos\Phi$ • $P = 3 \times V \times I$
The speeds of Star connected motors are slower as they receive 1/√3 voltage.	The speeds of Delta connected motors are high because each phase gets the total of line voltage.
Smooth starting and operation with nominal power and normal operation without overheating can be achieved in this connection.	Motor receives the highest power output in this connection.

Interfacing Circuit :

Provide your interfacing circuitry diagram below:

PLCLogic:

Provide your PLC logic for given task:

Results:

Following results are observed:

NED University of Engineering & Technology

Department of Electronic Engineering

F /OBEM 01/05/00

Laboratory Session #__open ended lab ___ Dated _____________

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
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Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
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Weighted CLO (Psychomotor	
Remarks	
Instructor's Signature with Date:	