Subject Code	Subject Name	Period per Week		Credit
26875	Automation Engineering and PLC	T	P	C
		3	3	4

Rationale	Industrial Automation and Programmable Logic Controllers (PLCs) are essential component of modern manufacturing and industrial processes. It allows greater flexibility in production processes that increases efficiency, productivity and reduces operational costs, manual intervention. PLCs can be easily reprogrammed and adapted to accommodate changes in production requirements or new product designs. It includes safety features that can shut down processes in emergencies or when abnormal conditions are detected. As industries move towards IR 4.0 (characterized by smart manufacturing and IoT integration), PLCs play a pivotal role in connecting machinery and systems to the internet for advanced monitoring and control. There is a growing global demand for professionals' skill in industrial automation and PLC programming. Manufacturing industries, Automotive industries, Pharmaceuticals, Food processing industries etc. needs more competent personnel to design, install, maintain, and troubleshoot their systems. Learning about industrial automation and PLCs opens up diverse career opportunities in engineering, maintenance, project management and consultancy across various industries worldwide.
Learning Outcome (Theoretical)	**After Completing the subject, students will be able to:** 1. Explain Basic Control Systems. 2. State the Principles of Sensor. 3. Elucidate Switches and Relays. 4. Illustrate Electric, Hydraulic and Pneumatic Actuators. 5. Illustrate Programmable Logic Controller (PLC). 6. Interpret Relay Logic Control. 7. Explain PLC Ladder Diagram Programming. 8. Explain Jump, Call and Comparator. 9. Illustrate Timer and Counter in PLC. 10. Explain Automatic Motor Control system. 11. Interpret Hydro Pneumatic Booster System (HYPN). 12. Interpret Human Machine Interfacing (HMI). 13. Analyze Supervisory Control and Data Acquisition (SCADA). 14. State 4th IR Technologies.
Learning Outcome (Practical)	**After undergoing the subject, students will be able to:** 1. Measure the temperature by Resistance Thermometer. 2. Determine the temperature coefficient of Thermistor. 3. Measure the temperature by Thermocouple. 4. Install the PLC software. 5. Observe the simulation of ladder programming for Logic functions, latching and multiple outputs 6. Maintain temperature Control System/Oven Using PLC. 7. Develop and test a program for automatic Traffic light control using PLC. 8. Develop and test a program for control DC motor using PLC. 9. Develop and test a program for automatic Star-Delta starter for a three-phase induction

	motor using PLC. 10. Develop and test a program for automatic forward-reverse of a three-phase induction motor using PLC. 11. Develop and test a program of water pump controlling by VFD. 12. Perform Sorting of Objects for Packaging Using PLC Based Control. 13. Perform connection diagram of HMI with PLC.

Detailed Syllabus (Theory)

UNIT	TOPICS WITH CONTENTS	CLASS (1 PERIOD)	FINAL MARKS
1	**Control System** 1.1 Define Control System. 1.2 Explain the different types of Control System. 1.3 Describe working principle of control systems. 1.4 Distinguish between open-loop and closed-loop control systems. 1.5 Describe control system with block diagram. 1.6 Differentiate between analog and digital control systems.	3	6
2	**Sensor** 2.1 Define Sensor. 2.2 Describe Potentiometers and linear variable differential transformers. 2.3 State the Proximity sensors including limit switches, optical proximity switches and Hall-effect switches. 2.4 Describe bonded-wire strain gauge and semi-Conductor strain gauge load sensors. 2.5 Discuss Pressure sensors including Bourdon tubes, bellows, and Semiconductor pressure sensors. 2.6 Explain Thermo-couples, Resistance Temperature Detectors and Thermistor temperature sensors. 2.7 Interpret discrete and continuous types of Liquid-level sensors. 2.8 Discuss the Principle of Light Dependent Resistor (LDR), Motion sensor, Gas or Smoke Sensor.	5	9
3	**Switches and Relays** 3.1 Explain the operation of Transistors as Switch. 3.2 Classify Mechanical switch 3.3 Describe the types and operation of Electromechanical relays. 3.4 Explain the characteristics of solid-state relays. 3.5 State the advantages and disadvantages of solid-state relays compared with Electromechanical relays.	3	6
4	**Electric, Hydraulic and Pneumatic Actuators** 4.1 Define linear actuators. 4.2 Discuss operation and characteristics of Solenoid. 4.3 Explain the Linear Electric motor operation. 4.4 Describe the components and working procedure of a Basic Hydraulic system. 4.5 Describe the components and working procedure of a Basic Pneumatic system. 4.6 Discuss the Basic control-valve operation.	3	6

5	**Programmable logic Controller (PLC)** 5.1 Define PLC. 5.2 State the Importance of PLC. 5.3 Compare among PLC, Microcontroller and Computer. 5.4 List the components of a typical PLC. 5.5 Explain the Block diagram of a PLC. 5.6 Mention the configuration of a PLC. 5.7 Define I/O module. 5.8 Mention the functions of input and output module. 5.9 State Digital and Analog module.	3	6
6	**Relay Logic Control** 6.1 Define Relay. 6.2 Analyze the working principle of Electromechanical Relay. 6.3 State the concept of Relay in Control Process. 6.4 Describe the use of Relay to implement control logic AND, OR and Flip-Flop. 6.5 Explain Relay logic ladder diagram. 6.6 Mention the limitation of relay logic control. 6.7 State the advantages of PLC over relay logic in control process.	3	6
7	**PLC Ladder Diagram Programming** 7.1 Define ladder diagram. 7.2 List PLC languages based on International Electro-technical Commission (IEC). 7.3 Illustrate Functional Block diagram. 7.4 List the standard IEC symbols used for input and output devices. 7.5 Mention the notation used for I/O address. 7.6 Draw the ladder diagram for Logic functions, latching and multiple outputs.	4	7
8	**Jump, Call and Comparator in PLC** 8.1 Discuss the conditional jump in ladder diagram. 8.2 Describe Jump within jump. 8.3 Explain the use of subroutine in ladder diagram. 8.4 Discuss the comparator instruction in ladder diagram. 8.5 Mention the application of comparator instruction.	3	4
9	**Timer and Counter in PLC** 9.1 State the types of Timers with symbol 9.2 Describe the types of Counters with symbol 9.3 Discuss the ladder diagram of Blinking light 9.4 Discuss the ladder diagram of Automatic Traffic light control 9.5 Discuss the ladder diagram of Washing Machine control	4	7
10	**Automatic Motor Control system** 10.1 State the technique of motor starter by PLC. 10.2 Discuss the different methods of Motor Control. 10.3 Explain PLC Program and Wiring diagram for Star Delta Starter. 10.4 Differentiate between PLC and variable frequency drive (VFD). 10.5 Describe the Block Diagram of PLC Controlling and monitoring System of Fluid Level, Temperature and Pressure Using VFD.	4	7
11	**Hydro Pneumatic Booster System (HYPN)** 11.1 Define Booster System Control 11.2 State the principle of a Hydro Pneumatic system	4	8

	11.4 Explain the water pump controlling by VFD. 11.5 Discuss the advantages of hydro pneumatic water System.		
12	**Human Machine Interfacing (HMI)** 12.1 Define HMI. 12.2 List the Fields of Applications of HMI. 12.3 Describe the block diagram of HMI. 12.4 State connection diagram of HMI with PLC. 12.5 Mention the advantage of an HMI over a PLC alone.	3	6
13	**Supervisory Control and Data Acquisition (SCADA)** 13.1 Define SCADA. 13.2 Describe the Basic SCADA diagram. 13.3 Mention the Essential composing parts of SCADA. 13.4 List the Fields of applications of SCADA.	3	6
14	**4th IR Technologies** 14.1 State the necessity of realizing 4th Industrial revolution. 14.2 Mention the technological advancement of 4th IR. 14.3 Discuss the necessity of Robotics control in Automation. 14.4 Define Remote control system. 14.5 Discuss IoT. 14.6 Discuss AI.	3	6
	TOTAL	**48**	**90**

Detailed Syllabus (Practical)

SL.	Experiment Name with Procedure	Class (3 Period)	Continuous Marks
1	**Measure the temperature by resistance thermometer.** 1.1 Select a resistance thermometer (such as platinum resistance thermometer) and a heat source with mounting facility and required tools & materials. 1.2 Measure the thermometer resistance at room temperature. 1.3 Record the temperature of heat source. 1.4 Make the temperature of the source steady. 1.5 Measure the resistance of the thermometer. 1.6 Calculate the temperature using appropriate formula. 1.7 Maintain records of all work. 1.8 Clean and maintain equipment used after work.	1	2
2	**Determine the temperature coefficient of thermistor.** 2.1 Select a thermistor and required tools & equipment. 2.2 Connect the thermistor with measuring equipment. 2.3 Provide a temperature regulated heat source for the thermistor. 2.4 Increase the temperature and measure the corresponding resistance of the thermistor. 2.5 Plot the data for temperature verses resistance characteristics. 2.6 Observe the graph. 2.7 Maintain records of all work. 2.8 Clean and maintain equipment used after work.	1	2
3	**Measure the temperature by Thermocouple.**	1	2

	& materials. 3.2 Connect one end of the thermocouple to a voltmeter with proper arrangement. 3.3 Apply heat on the other end of the thermocouple in the fire. 3.4 Observe the reading of the meter. 3.5 Calibrate the meter for temperature. 3.6 Measure the temperature. 3.7 Maintain records of all work. 3.8 Clean and maintain equipment used after work.		
4	**Install PLCs software.** 4.1 Select and collect necessary machinery, equipment and materials. 4.2 Download Siemens Logo soft comfort software. 4.3 Unzip the folder. 4.4 Open the file and run the setup.exe file. 4.5 Click the Agree License button. 4.6 Click Next then Install button. 4.7 Run Logo soft comfort software. 4.8 Save the installation process by screenshot. 4.9 Maintain records of all work. 4.10 Clean and maintain equipment used after work.	2	2
5	**Observe the simulation of ladder programming for Logic functions, latching and multiple outputs** 5.1 Draw the ladder diagram. 5.2 Sketch a connection diagram with PLC and I/O devices. 5.3 Upload the program in PLC. 5.4 Test the program. 5.5 Maintain records of all work. 5.6 Clean and maintain equipment used after work.	1	2
6	**Maintain temperature Control System of Oven Using PLC.** 6.1 Select a PLC 6.2 Identify the I/O address 6.3 Connect thermometer with analog module. 6.4 Draw the ladder diagram. 6.5 Connect PLC with PC 6.6 Load program to PLC 6.7 Run the Program 6.8 Observe the result 6.9 Maintain records of all work. 6.10 Clean and maintain equipment used after work.	1	2
7	**Develop and test a program for automatic traffic light control using PLC.** 7.1 Draw the ladder diagram. 7.2 Sketch the connection diagram with PLC and I/O devices. 7.3 Upload the program in PLC. 7.4 Test the program. 7.5 Maintain records of all work. 7.6 Clean and maintain equipment used after work.	1	2
8	**Control DC motor Using PLC.**	1	2

	8.1 Select a PLC. 8.2 Identify the I/O address. 8.3 Connect the switches and DC Motor with driver circuit. 8.4 Draw the ladder diagram. 8.5 Connect PLC with PC. 8.6 Load program to PLC 8.7 Run the Program 8.8 Observe the result 8.9 Maintain records of all work. 8.10 Clean and maintain equipment used after work.		
9	**Develop and test a program for automatic Star-Delta starter for a three-phase induction motor using PLC.** 9.1 Draw the ladder diagram. 9.2 Sketch a connection diagram with PLC and I/O devices. 9.3 Upload the program in PLC. 9.4 Test the program. 9.5 Maintain records of all work. 9.6 Clean and maintain equipment used after work.	2	2
10	**Develop and test a program for automatic forward-reverse of a three-phase induction motor using PLC.** 10.1 Select and collect necessary machinery, equipment and materials. 10.2 Draw the connection diagram. 10.3 Connect input push switch to PLC as per diagram. 10.4 Connect the motor to the PLC as per diagram. 10.5 Draw a ladder diagram through soft comfort software. 10.6 Connect PLC to computer through PLC cable or UTP cable. 10.7 Upload the program to the PLC. 10.8 Monitor the operation of forward-reverse of a three-phase induction motor by pressing the input switch. 10.9 Maintain records of all work. 10.10 Clean and maintain equipment used after work.	2	2
11	**Develop and test a program of water Pump controlling by VFD** 11.1 Draw the ladder diagram. 11.2 Sketch the connection diagram with PLC, VFD and I/O devices. 11.3 Upload the program in PLC. 11.4 Test the program. 11.5 Monitor the operation changing value of VFD. 11.6 Maintain records of all work. 11.7 Clean and maintain equipment used after work.	1	2
12	**Perform sorting of objects for Packaging Using PLC Based Control.** 12.1 Select a PLC. 12.2 Identify the I/O address. 12.3 Arrange the system and connect to PLC. 12.4 Draw the ladder diagram. 12.5 Connect PLC with PC. 12.6 Load program to PLC.	1	2

	12.8 Observe the result 12.9 Maintain records of all work. 12.10 Clean and maintain equipment used after work.		
13	**Perform connection diagram of HMI with PLC.** 13.1 Select a PLC 13.2 Identify the I/O address 13.3 Arrange the system and connect to PLC & HMI. 13.4 Draw the ladder diagram. 13.5 Connect PLC with PC 13.6 Load program to PLC 13.7 Run the Program. 13.8 Observe the result controlling by HMI. 13.9 Maintain records of all work. 13.10 Clean and maintain equipment used after work.	1	1
	Total	**16**	**25**

Resources (Tools, equipment, Materials and Machineries):

Sl	Item Name	Quantity
01	Soldering Iron, Push Switch, Pressure switch, Float switch, Limit Switch,	Each item 10 nos.
02	Multi-meter, Water Flow meter, LVDT, Actuator (Electric, Hydraulic and Pneumatic), Magnetic contractor, Solenoid Valve, Relay	Each item 10 nos.
03	Resistance thermometer Graph paper, thermistor, Thermocouple, Pressure Gauge, Strain Gauge, Motion sensor, Liquid-level sensors, Gas or Smoke Sensor, Pressure gauge, Connecting Wire, Proximity sensor, Light Dependent Resistor (LDR), Transistor, Lamp, Toy Car, Timer, control switch	Each item 10 nos.
04	Power supply 24V DC, Power supply 220V AC, Different type of PLC (Different Brand), PLC software, HMI, VFD, SCADA, Desktop computer, Laptop, Oven, Washing Machine, Water Pump.	10 Sets

Reference books:

Sl.	Book Name	Writer Name	Publisher Name & Edition
01	Modern Control Technology: Components and Systems	Kilian	EBIN Publication 2nd Edition
02	Programmable Logic Controllers.	W. Bolton	***Elsevier Ltd publication*** ***Sixth Edition***
03	Programmable Logic Controllers: Programming Methods and Applications.	John R. Hackworth Frederick D. Hackworth, Jr.	Pearson College Div Publication January 1, 2003
04	Basic Instrumentation System & Programmable Logic Controller.	Umesh Rathore.	S.K.KATARIA & SONS ***Educational Publisher*** 2nd Edition