

Programmable Logic Controller (PLC Using SIMATICs)

Course Objectives	<ul style="list-style-type: none">• To introduce students to the concepts and fundamentals of Programmable Logic Controllers (PLC) in automation systems.• To familiarize students with the programming languages used in PLC systems, particularly focusing on Siemens S7-1200 CPU and hardware.• To provide hands-on experience in PLC communication using the TIA portal, including wiring, addressing, and commissioning tasks.• To enable students to implement bit logic instructions and structured programming using function blocks (FB), function calls (FC), and data blocks (DB).• To explore analog signal processing and provide practical exercises for students to apply their knowledge
Course Outcomes	<ul style="list-style-type: none">• Configure the PLC Siemens S7-1200 CPU and Hardware.• Working with Digital IOs.• Interfacing Digital Sensors and actuators.• Competent in wiring, addressing, and commissioning tasks using the TIA portal for PLC communication.• Implement bit logic instructions and utilizing structured programming elements like FB, FC, and DB.• Process analog signals and applying their knowledge to real-world scenarios.

Course Duration: 45 Hours

Course Curriculum:

Unit 1: Introduction to PLC

Introduction and Classification of Automation- Introduction of PLC and Programming Languages- Introduction of Siemens S71200-CPU & Hardware.

Unit 2: TIA Portal

PLC wiring and addressing- TIA portal ad different views- Commissioning of S7-1200, and practical task

Unit 3: PLC Communication Using TIA portal

bit logic instruction and hands-on practice- Structured Programming using FB, FC and DB- Analog signal processing and hands-on Practice.

Unit 4: HMI Interfacing

Introduction, Commissioning and Interfacing of HMI- Interfacing of PLC Program with HMI using Tags- Alarms- Recipe- User Administration.

Unit 5: SCADA & PLC

Introduction of SCADA and Commissioning- Interfacing of SCADA with PLC using Tags- Screen Management

Test Projects:

Use Cases:

1. Conveyor Control System:

Task 1: Program a PLC to control the speed and direction of a conveyor belt.

Task 2: Interface an HMI with the PLC to monitor and control the conveyor system.

Task 3: Implement fault detection and alarm systems for efficient operation.

Task 4: Configure SCADA to visualize and analyse conveyor performance.

Task 5: Optimize the conveyor control system for maximum throughput and energy efficiency.

2. Traffic Light Control:

Task 1: Develop a PLC program to control the sequencing and timing of traffic lights.

Task 2: Design an HMI interface for monitoring and manual control of traffic lights.

Task 3: Implement communication between the PLC and HMI to display real- time traffic data.

Task 4: Integrate SCADA to monitor traffic flow and adjust signal timing based on traffic conditions.

Task 5: Evaluate the effectiveness of the traffic light control system in improving traffic efficiency and safety.

3. Water Treatment Plant Automation:

Task 1: Program a PLC to monitor and control water treatment processes, such as filtration and disinfection.

Task 2: Design an HMI interface for operators to visualize and control the water treatment plant.

Task 3: Implement communication between PLCs for interlocking and data exchange.

Task 4: Configure SCADA for remote monitoring and data analysis of water treatment parameters.

Task 5: Optimize the automation system to ensure efficient water treatment and quality compliance.

4. Packaging Line Automation:

Task 1: Develop PLC programs to control various stages of a packaging line, including filling, sealing, and labelling.

Task 2: Create an HMI interface for operators to monitor and control the packaging process.

Task 3: Implement communication between PLCs for synchronization and error handling.

Task 4: Configure SCADA to track production rates, reject rates, and overall equipment effectiveness (OEE).

Task 5: Improve the packaging line automation system for increased productivity and reduced downtime.

5. Elevator Control System:

Task 1: Program a PLC to control the operation of an elevator, including floor selection and door control.

Task 2: Design an HMI interface for users to interact with the elevator system.

Task 3: Implement communication between PLCs for multi-elevator coordination and fault handling.

Task 4: Integrate SCADA to monitor elevator performance, track usage patterns, and optimize energy consumption.

Task 5: Evaluate the elevator control system for reliability, efficiency, and

passenger safety.

6. Temperature Control in HVAC:

Task 1: Develop a PLC program to control temperature setpoints, fan speed, and damper positions in an HVAC system.

Task 2: Create an HMI interface for operators to monitor and adjust HVAC parameters.

Task 3: Implement communication between the PLC and HMI for real-time data exchange.

Task 4: Configure SCADA to visualize temperature trends, energy consumption, and system alarms.

Task 5: Optimize the HVAC control system for energy efficiency and occupant comfort.

7. Pump Control in Water Distribution:

Task 1: Program a PLC to control the operation of pumps in a water distribution system based on demand.

Task 2: Design an HMI interface for operators to monitor pump status, flow rates, and pressure.

Task 3: Implement communication between PLCs for pump sequencing and fault handling.

Task 4: Configure SCADA to visualize water distribution parameters and detect anomalies.

Task 5: Improve the pump control system for efficient water management and reduced energy consumption.

8. Batch Process Automation:

Task 1: Develop PLC programs to control batch processes, such as mixing, heating, and cooling.

Task 2: Create an HMI interface for operators to monitor and control batch parameters.

Task 3: Implement communication between PLCs for recipe management and data exchange.

Task 4: Configure SCADA to track batch progress, process variables, and quality metrics.

Task 5: Optimize the batch automation system for consistent product quality and reduced cycle times.

9. Boiler Control System:

Task 1: Program a PLC to control the operation of a boiler, including temperature, pressure, and fuel flow.

Task 2: Design an HMI interface for operators to monitor boiler parameters and alarms.

Task 3: Implement communication between the PLC and HMI for real-time data visualization.

Task 4: Configure SCADA to track boiler efficiency, emissions, and safety interlocks.

Task 5: Improve the boiler control system for optimized fuel consumption and compliance with regulations.

10. Energy Monitoring and Management:

Task 1: Develop PLC programs to monitor and log energy consumption of different equipment and processes.

Task 2: Create an HMI interface for operators to visualize energy usage and identify areas of improvement.

Task 3: Implement communication between PLCs for centralized energy data collection and analysis.

Task 4: Configure SCADA to generate energy reports, set alarms for abnormal consumption, and support energy optimization strategies.

Task 5: Evaluate the energy monitoring and management system for energy savings and cost reduction.

11. Material Handling Automation:

Task 1: Program a PLC to control material handling equipment, such as conveyors, robots, and lifts.

Task 2: Design an HMI interface for operators to monitor and control material flow and equipment status.

Task 3: Implement communication between PLCs for seamless integration of different material handling systems.

Task 4: Configure SCADA to track material throughput, equipment utilization, and maintenance schedules.

Task 5: Optimize the material handling automation system for efficient production flow and reduced manual intervention.

12. Renewable Energy System Monitoring:

Task 1: Develop PLC programs to monitor and control renewable energy sources, such as solar panels and wind turbines.

Task 2: Create an HMI interface for operators to visualize real-time energy production and system performance.

Task 3: Implement communication between PLCs for data aggregation and synchronization.

Task 4: Configure SCADA to analyse renewable energy generation, track system efficiency, and detect faults.

Task 5: Improve the renewable energy system monitoring for enhanced energy utilization and maintenance planning.

13.Inventory Management:

Task 1: Program a PLC to monitor and control inventory levels in a warehouse or manufacturing facility.

Task 2: Design an HMI interface for operators to track inventory status, receive alerts, and manage stock movements.

Task 3: Implement communication between PLCs for real-time inventory data synchronization.

Task 4: Configure SCADA to visualize inventory levels, analyse consumption patterns, and generate inventory reports.

Task 5: Optimize the inventory management system for accurate stock control, reduced waste, and improved order fulfilment.

14.Waste Management and Recycling:

Task 1: Develop PLC programs to automate waste management processes, such as sorting, compaction, and recycling.

Task 2: Create an HMI interface for operators to monitor waste levels, equipment status, and recycling targets.

Task 3: Implement communication between PLCs for optimized waste routing and tracking.

Task 4: Configure SCADA to monitor waste generation rates, recycling efficiency, and environmental metrics.

Task 5: Improve the waste management system for effective recycling and waste reduction strategies.

15.Power Distribution Monitoring and Control:

Task 1: Program a PLC to monitor and control power distribution systems, including switchgear, transformers, and distribution panels.

Task 2: Design an HMI interface for operators to monitor power status, load balance, and fault conditions.

Task 3: Implement communication between PLCs for coordinated power

distribution and protection.

Task 4: Configure SCADA to visualize power flow, monitor energy demand, and detect abnormalities.

Task 5: Optimize the power distribution system for efficient energy delivery, load shedding, and predictive maintenance.

16. Automated Material Testing:

Task 1: Develop PLC programs to automate material testing procedures, such as tensile testing or hardness testing.

Task 2: Create an HMI interface for operators to configure test parameters, monitor test progress, and visualize results.

Task 3: Implement communication between PLCs and testing equipment for synchronized test control and data acquisition.

Task 4: Configure SCADA to track test data, analyze test results, and generate test reports.

Task 5: Improve the automated material testing system for increased testing efficiency, accuracy, and data traceability.

17. Remote Monitoring and Control:

Task 1: Program a PLC for remote monitoring and control of industrial processes or equipment.

Task 2: Design an HMI interface for remote operators to visualize process parameters, receive alarms, and send control commands.

Task 3: Implement secure communication protocols for remote access and data transmission.

Task 4: Configure SCADA for remote data logging, trend analysis, and performance monitoring.

Task 5: Evaluate the reliability and responsiveness of the remote monitoring and control system under different network conditions.

18. Food and Beverage Production Automation:

Task 1: Develop PLC programs to automate food and beverage production processes, such as mixing, filling, and packaging.

Task 2: Create an HMI interface for operators to monitor production lines, set recipe parameters, and manage quality control.

Task 3: Implement communication between PLCs for seamless integration of different production stages.

Task 4: Configure SCADA to track production rates, material usage, and compliance with food safety standards.

Task 5: Optimize the food and beverage production automation system for increased productivity, product consistency, and reduced waste.

19. Pharmaceutical Manufacturing Automation:

Task 1: Program a PLC to automate pharmaceutical manufacturing processes, including blending, granulation, and tablet compression.

Task 2: Design an HMI interface for operators to monitor critical process parameters, track batch progress, and manage recipe changes.

Task 3: Implement communication between PLCs for recipe management and real-time data exchange.

Task 4: Configure SCADA to monitor equipment performance, track quality metrics, and comply with regulatory requirements.

Task 5: Improve the pharmaceutical manufacturing automation system for enhanced process control, product traceability, and compliance with good manufacturing practices (GMP).

20. Building Automation and Energy Management:

Task 1: Develop PLC programs to control and monitor building systems, including HVAC, lighting, and access control.

Task 2: Create an HMI interface for facility managers to visualize and adjust building parameters for occupant comfort and energy efficiency.

Task 3: Implement communication between PLCs for coordinated building system operation and energy optimization.

Task 4: Configure SCADA to analyze energy consumption, detect anomalies, and generate reports for energy management.

Task 5: Optimize the building automation system for energy savings, occupant comfort, and predictive maintenance.