# PLC, SCADA, and HMI Systems for Beginners

**Course Description:**
This integrated course provides a complete journey through industrial automation using Siemens technologies. Covering the programming of Siemens S7-1200 and S7-1500 PLCs with TIA Portal, the configuration and administration of SCADA systems using WinCC Advanced, and best practices in Human-Machine Interface (HMI) design and implementation, the program combines theory with extensive hands-on practice. Participants will gain skills to confidently design, implement, and troubleshoot real-world automation systems across factory, process, and machine automation environments.

**Audience Profile:**
This course is designed for:

- Engineering students seeking applied knowledge in PLCs, SCADA, and HMI systems.

- Automation engineers, system integrators, and maintenance technicians.

- Electricians and technical staff transitioning into Siemens-based systems.

- IT professionals supporting industrial automation projects.

- Anyone aiming to master practical Siemens industrial automation technologies.

**Prerequisite Knowledge/Skills:**

- Basic understanding of electrical circuits and industrial automation principles.

- Familiarity with programming concepts (not mandatory but beneficial).

- General awareness of industrial networks and controllers.

**Course Objectives:**
After completing this course, participants will be able to:

- Explain industrial automation concepts and different types of control systems.

- Program Siemens S7-1200 and S7-1500 PLCs using TIA Portal in multiple programming languages.

- Configure and administer SCADA systems using WinCC Advanced, including alarms, trends, and data logging.

- Design user-friendly HMI interfaces aligned with industry standards and best practices.

- Perform analog signal processing, fault diagnostics, and parameter management.

- Develop, deploy, and troubleshoot integrated industrial automation solutions.

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**Table of Contents:**

- Writing instructions and logical operations (AND, OR, NOR)

- Data types and result of logic operation (RLO) concepts

- Load, work, and system memory

- Practical labs: lamp and motor control using NO/NC contacts and branching networks

Module 6: Timers, Counters, and Advanced Program Design

- Timer types and usage (pulse, delay, etc.)

- Counter operations and comparison functions

- Program design techniques

- Practical labs: sequential motor control, conveyor systems, car parking logic

Module 7: Program Structure, Blocks, and Interrupts

- FB vs FC block architecture and editing

- Program organization and calling routines

- Warm, cold, and hot restart behavior

- Time-of-day and cyclic interrupts

Module 8: Processing of Analog Values

- Analog sensor wiring and signal flow

- Engineering value conversion

- Use of Norm X and Scale X function blocks

- Practical lab: analog speed regulation using potentiometer signals

Module 9: Diagnostics, Faults, and Parameter Passing

- Functional vs system faults

- Cross-reference tools and forcing I/O variables

- Parameter passing and shared data blocks

- Practical troubleshooting scenarios

Module 10: Practical Examples and Course Review

- Real-world integrated programming examples

- Consolidated course review and discussion

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**Part 2: Siemens SCADA Systems with WinCC Advanced**

Module 11: Introduction to SCADA Systems

- Overview and functions of SCADA

- Siemens SCADA architecture examples

- Data acquisition, communication, and visualization

- Comparison of PLC vs PC and real-world applications

Module 12: Creating SCADA Projects in WinCC Advanced

- Project creation and adding devices

- Setting up Ethernet addresses and runtime configuration

- Connecting to integrated and non-integrated PLCs

- Basic configuration exercises with buttons and outputs

Module 13: Configuring Graphics and Displays

- Graphic view setup

- Text and alphanumeric displays

- Configuring text lists, graphic lists, movement and fill properties

Module 14: Alarm Management

- Alarm configuration steps and message blocks

- Alarm classes and discrete trigger settings

- Displaying and managing alarms in WinCC Advanced

- Practical exercises

Module 15: Data Logging and Trend Analysis

- Process value logging and data log setup

- Editing tags and trend view configuration

- Properties of trend views

- Practical exercises in data analysis

Module 16: Recipe Management

- Structure and editing of recipes

- Communication with controllers through tags

- Table representation, sorting, exporting, and configuring views

- Recipe editor setup and practical exercises

Module 17: User Administration and Access Control

- User administration structure and access protection

- Creating authorizations and assigning them to objects

- Configuring user groups and login dialogues

- Practical exercises in user management

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**Part 3: HMI Design and Implementation**

Module 18: HMI Fundamentals and WinCC Overview

- HMI definition and its role in automation

- Components of WinCC and engineering/runtime editions

- Licensing, system limits, and requirements

Module 19: Project Creation and Device Integration

- Adding devices and establishing PLC connections

- Configuring runtime settings and basic HMI elements

- Practical exercises with push buttons and outputs

Module 20: HMI Configuration and Best Practices

- Designing user-friendly screens

- Input/output field configuration and graphical lists

- Configuring movement, fill properties, and navigation

Module 21: Advanced HMI Functions

- Alarm, data logging, trend and recipe integration into HMI

- User administration and security in HMI applications

- Best practices for usability, visualization, and ethical design