Industrial automation concepts and practical applications of PLC, HMI, SCADA, drives, and communication protocols

▢ Introduction to Industrial Automation

Explain the need for automation in industry, the benefits of automation, and the basic components of an automation system. Cover the basic concepts of control, including open-loop and closed-loop control, feedback, and control systems.

- Definition and scope of industrial automation
- Advantages of industrial automation
- Industrial automation applications and examples

Training Materials:

- Presentation slides introducing industrial automation
- Videos showcasing real-world applications of industrial automation
- Case studies of successful industrial automation projects

▢ PLC Programming Fundamentals (CODESYS ST)

Teach students how to program a PLC, including the basics of ladder logic, function blocks, and structured text. Cover the different types of PLCs, I/O modules, and communication protocols.

- Introduction to PLCs and their components
- PLC hardware and software architecture (Wago PLC)
- PLC programming languages (Ladder Logic, Function Block Diagram, Structured Text)
- Input/output addressing
- Programming and testing PLC applications

Training Materials:

- Presentation slides covering PLC programming fundamentals
- PLC programming software (such as Codesys or Siemens TIA Portal) for hands-on practice
- PLC programming exercises and quizzes
- PLC programming tutorial videos

HMI Design and Programming

Teach students how to program an HMI, including creating screens, designing user interfaces, and connecting to a PLC. Cover the different types of HMIs and communication protocols.

- Introduction to HMIs and their components
- HMI hardware and software architecture
- HMI design guidelines
- HMI programming languages / Tools
- HMI testing and troubleshooting

Training Materials:

- Presentation slides covering HMI design and programming
- HMI programming software for hands-on practice
- HMI programming exercises and quizzes
- HMI programming tutorial videos

SCADA System Design and Configuration

Teach students how to program a SCADA system, including creating tags, designing screens, and connecting to PLCs and HMIs. Cover the different types of SCADA systems and communication protocols.

- Introduction to SCADA systems and their components
- SCADA hardware and software architecture
- SCADA system design and configuration
- SCADA programming languages (such as IEC 61131-3 or ladder logic)
- SCADA testing and troubleshooting

Training Materials:

- Presentation slides covering SCADA system design and configuration
- SCADA software for hands-on practice
- SCADA programming exercises and quizzes
- SCADA programming tutorial videos

Drives and Motion Control

Teach students how to control motors using drives, including speed control, torque control, and position control. Cover the different types of drives and motors, as well as control methods such as VFDs and servo drives.

- Introduction to drives and motion control systems
- Types of drives (AC drives, DC drives, servo drives)
- Motion control system components (motors, encoders, position sensors)
- Programming drives and motion control systems
- Testing and troubleshooting drives and motion control systems

Training Materials:

- Presentation slides covering drives and motion control
- Drives and motion control software for hands-on practice
- Drives and motion control programming exercises and quizzes
- Drives and motion control tutorial videos

▢ Communication Protocols

Teach students about different communication protocols used in industrial automation, including Ethernet/IP, Modbus, Profinet, and OPC. Cover the basics of networking, including IP addressing, subnet masks, and gateways.

- Introduction to communication protocols (such as Ethernet/IP, Modbus, Profibus)
- Types of communication protocols
- Protocol selection and configuration
- Testing and troubleshooting communication protocols

Training Materials:

- Presentation slides covering communication protocols
- Software for testing and configuring communication protocols (such as Wireshark or Modbus poll)
- Communication protocol exercises and quizzes
- Communication protocol tutorial videos

▢ Integration and Project Development

Guide students through the process of developing a complete automation project, from initial design to final implementation. Encourage them to integrate all the components they have learned in the previous topics, and provide hands-on experience with real-world projects.

1. Project development tools (e.g. project management software, design software)
2. Project development tutorials and exercises
3. Real-world project examples

- Integration of all components (PLC, HMI, SCADA, drives, communication protocols) into a project
- Project development and testing
- Project documentation and reporting

Training Materials:

- Presentation slides covering project development and integration
- PLC, HMI, SCADA, drive, and communication protocol software for hands-on practice
- Project development exercises and quizzes
- Project development tutorial videos

Have fun!