

22.2.0 INDUSTRIAL PROGRAMMABLE LOGIC CONTROLLERS

22.2.01 Introduction

The module unit is designed to equip the trainee with knowledge, skills and attitudes necessary to apply programmable logic controllers in industrial controls and measurements.

22.2.02 General Objectives

At the end of the Module Unit, the trainee should be able to:

- a) Observe safety regulations and standards that govern operation of programmable logic controllers
- b) Understand different application of industrial programmable logic controllers
- c) Maintain sequential control and data acquisition (SCADA) systems
- d) Maintain programmable logic control (PLC) systems

22.2.03 Module Unit Summary and Time Allocation

Industrial Soft Ware Engineering

Code	Sub-Module Unit	Content	Time Hrs
22.2.1	Introduction to Industrial programmable logic controllers	<ul style="list-style-type: none">• Need for industrial programmable logic controllers• Types of industrial programmable logic controllers	8
22.2.2	PLC Systems	<ul style="list-style-type: none">• Hardware configuration• Ladder logic programming• External peripherals• PLC maintenance	15
22.2.3	Supervisory Control and Data Acquisition (SCADA)	<ul style="list-style-type: none">• Definition• Human machine interface• Data acquisition• Sequential control• Data storage & archiving• Security (Access control)	15
22.2.4	Industrial Communication	<ul style="list-style-type: none">• Networks – LAN & WAN	15

Code	Sub-Module Unit	Content	Time Hrs
	Network	<ul style="list-style-type: none"> • Industrial net works Topologies • Industrial net works Protocols • Network construction • Physical net work address • Network Devices 	
22.2.5	Calibration Software	<ul style="list-style-type: none"> • Types of calibration software • Operation of calibration software • Device connection to software 	13
Total Hours			66

22.2.1 INTRODUCTION TO INDUSTRIAL PROGRAMMABLE LOIC CONTROLLERS

Theory

- 22.2.1T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) describe the need for industrial programmable logic controllers
 - b) explain different types of industrial programmable logic controllers

Content

- 22.2.1T1 Need for industrial software engineering
- i) Process control
 - ii) Process monitoring
- 22.2.1T2 Explaining types of industrial software systems
- i) Graphical use interface -SCADA
 - ii) PLC programming software
 - iii) Configuration software
 - iv) Calibration software

Practice

- 22.2.1P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) programme the software

- b) interpret software output
- c) simulates practical circuits
- d) install industrial software engineering systems

Content

- 22.2.1P1 Programming the software
- 22.2.1P2 Interpreting software output
- 22.2.1P3 simulating practical circuits
- 22.2.1P1 Installing industrial software engineering systems

22.2.1C Competence

The trainee should have the ability to: install, programme and simulate industrial software

Suggested teaching/Learning Activities

- Discussion
- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Project work
- Visits to industries

Suggested teaching/Learning Resources

- Electrical measuring instruments
- Electronic tool kit
- Dc Power supply
- Signal generators
- Computer and computer software

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project

22.2.2 PROGRAMMABLE LOGIC CONTROLLER SYSTEM (PLC)

Theory

- 22.2.2T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) describe hardware configuration of a plc
 - b) describe ladder logic programming and sequential control
 - c) list PLC external peripherals
 - d) explain the maintenance procedure for PLC systems

Content

- 22.2.2T1 Hardware configuration of a PLC
- i) CPU module
 - ii) Memory
 - iii) Analogue inputs
 - iv) Passive inputs
 - v) Active inputs
 - vi) Digital input
 - vii) Analogue outputs
 - viii) Passive inputs
 - ix) Active inputs
 - x) Digital output

- 22.2.2T2 Ladder logic programming and sequential control
- i) Ladder logic
 - ii) Sequence control
- 22.2.2T3 PLC external peripherals
- i) Printers
 - ii) Network cards
 - iii) Human machine interface
 - iv) Programmer interface
- 22.2.2T4 Maintenance procedure for PLC system
- i) Care and handling of PLC modules during installation
 - ii) Care and handling of PLC module on the run
 - iii) Planned maintenance procedure

Practice

- 22.2.2P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) identify parts of a PLC system
 - b) install PLC systems
 - c) maintain PLC

Content

- 22.2.2P1 Identification output / input cards
- i) Central processing unit (CPU)
 - ii) Memory cards
 - iii) Network cards
 - iv) Peripherals
- 22.2.2P2 Installation procedure
- 22.2.2P3 PLC maintenance

- i) Care and handling PLC modules during installation
- ii) Care and handling of PLC modules on the run
- iii) Planned maintenance

22.2.2C Competence

The trainee should have the ability to:

- Identify parts of PLC system
- Install PLC systems
- Maintain PLC

Suggested teaching/Learning Activities

- Discussion
- Question and answer
- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Project work

Suggested Teaching and Learning Resources

- Maintenance manuals
- Operation manuals
- PLC systems
- PLC peripherals
- Electronic tool kit
- Electrical tool kit
- Dc Power supply
- Signal generators
- Ac power supply
- Computer and software
- Industrial visit

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project

22.2.3 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

Theory

22.2.3T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) list the application of SCADA system
- b) describe human machine interface (HMI)
- c) explain sequential control SCADA system
- d) describe data acquisition in SCADA system
- e) describe security (access) control in SCADA
- f) describe the procedure of SCADA maintenance

Content

- 22.2.3T1 Application of SCADA systems
 - i) Process monitoring
 - ii) Process control
- 22.2.3T2 SCADA System Human machine interface (HMI)
 - i) Definition of SCADA system as HMI
 - ii) Application
- 22.2.3T3 Sequential control
 - i) Definition
 - ii) Elements of sequence control
 - iii) Feedback control operation
- 22.2.3T4 SCADA data acquisition
 - i) Definition of data acquisition

- ii) Types of data acquisition
- 22.2.3T5 SCADA security / access control
 - i) Definition SCADA access control
 - ii) Objectives of SCADA access control
- 22.2.3T6 SCADA maintenance
 - i) Care and handling of SCADA hardware during installation
 - ii) Care and handling of SCADA on the run
 - iii) Planned maintenance procedure

Practice

- 22.2.3P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
 - a) install SCADA facilities to inter-communicate with other instruments
 - b) demonstrate use of SCADA system in plant monitoring and control
 - c) maintain SCADA system

Content

- 22.2.3P1 SCADA facilities installation
 - i) SCADA computer
 - ii) Network cabling
 - iii) Power supply
 - iv) Testing
- 22.2.3P2 SCADA system in plant monitoring and control
 - i) Naming
 - ii) Trending data / receipt
 - iii) Access control in SCADA
 - iv) Log into SCADA

- v) Log out of SCADA
- vi) 22.2.3P3 Maintenance
- vii) SCADA shut down
- viii) SCADA start up
- ix) Cleaning of SCADA equipment

22.2.3C Competence

The trainee should have the ability to:

- i) Install SCADA facilities
- ii) Operate SCADA system
- iii) Maintain SCADA system

Suggested Teaching and Learning Resources

- Operating manual
- Maintenance manual
- SCADA
- Industrial visits

22.2.4 INDUSTRIAL COMMUNICATION NETWORK

Theory

- 22.2.4T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
 - a) list different types of industrial networks
 - b) list types of industrial network topology
 - c) list types of industrial network protocols
 - d) explain physical industrial networks
 - e) list network devices

Content

- 22.2.4T1 Industrial networks

- i) Typical networks
- ii) Local Area Network (LAN)
- iii) Wide Area Network (WAN)
- iv) Network physical layer wiring
- v) Category 5 (CAT 5) and category 6 (CAT 6) cable
- vi) Fibre optic cable
- vii) Co-axial cable
- viii) Twisted pair
- ix) Half duplex
- x) Full duplex
- 22.2.4T2 Network Design
 - i) Topology
 - ii) Ring topology
 - iii) STAR topology
 - iv) Bus topology
- 22.2.4T3 Protocols
 - i) Ethernet
 - ii) RS 485
 - iii) RS 232
 - i) Field bus
 - ii) HART
- 22.2.4T4 Physical industrial Networks
- 22.2.4T5 Network devices
 - i) Modems
 - ii) Network switches
 - iii) Terminal reflectors
 - iv) Signal amplifiers
 - v) Network hubs
 - vi) Network budgets

Practice

22.2.4P0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

- a) identify different types of industrial network
- b) identify industrial network topology

- c) identify industrial network protocols

Content

- 22.2.4P1 Industrial networks
 - i) Typical networks
 - ii) Network physical layer wiring
- 22.2.4P2 Network design topology
- 22.2.4P3 Protocols
 - i) Network Devices
 - ii) Install physical industries network

22.2.4C Competence

The trainee should have the ability to: install and maintain physical industrial network

Suggested teaching/Learning Activities

- Discussion
- Question and answer
- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Visits to industries

Suggested Teaching and Learning Resources

- i) Manuals
- ii) Charts
- iii) Network devices
- iv) Industrial visits

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project
- Project Report writing and presentation

22.2.5 CALIBRATION SYSTEM

Theory

22.2.5T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) list different types of calibration software
- b) describe operation of calibration software
- c) explain different methods of device connection to the software

Content

22.2.5T1 Types

- i) Hand held calibration system
- ii) Computer based calibration

22.2.5T2 Calibration procedure

- Calibration operation by use of software

22.2.5T3 Service connection to the software

- i) Hart communication
- ii) RS232 device connection
- iii) Field bus connection

Practice

22.2.5P0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) identify different types of calibration software
- b) calibrate instruction system by use of software
- c) demonstrate how to connect device to the software

Content

22.2.5P1 Calibration software

- i) Handheld calibration
- ii) Computer based calibration software

22.2.5. P2 Calibrate a system using:

- i) Hand held calibration
- ii) Computer based calibration software

22.2.5P3 Device connection to the software

- i) Hart communication
- ii) RS232 device connection
- iii) Field buss connection

22.2.5C Competence

The trainee should have the ability to:

- i) Operate calibration software
- ii) Connect device to the software

Suggested teaching/Learning Activities

- Discussion
- Question and answer
- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Calculations
- Project work
- Role play
- Visits to industries

Suggested Teaching and Learning Resources

- Manuals
- Calibration software
- Computer
- Dc Power supply

- Industrial visits

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project
- Project Report writing and presentation