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	• Need for industrial programmable logic controllers • Types of industrial programmable logic controllers	8
22.2.2	PLC Systems	• Hardware configuration • Ladder logic programming • External peripherals • PLC maintenance	15
22.2.3	Supervisory Control and Data Acquisition (SCADA)	• Definition • Human machine interface • Data acquisition • Sequential control • Data storage & archiving • Security (Access control)	15
22.2.4	Industrial Communication	• Networks – LAN & WAN	15

Code	Sub-Module Unit	Content	Time Hrs
	Network	• Industrial net works Topologies • Industrial net works Protocols • Network construction • Physical net work address • Network Devices	
22.2.5	Calibration Software	• Types of calibration software • Operation of calibration software • Device connection to software	13
Total Hours			66

22.2.1 **INTRODUTION 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

- 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

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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 peripheries
- 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 Net works

22.2.4T5 Network devices
i) Modems
ii) Network switches
iii) Terminal reflectors
iv) Signal amplifiers
v) Network hubs
vi) Network budges

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

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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