Unit 5008: Distributed Control Systems

Unit Code: D/651/0862

Level: 5

Credits: 15

Introduction

With increased complexity and greater emphasis on cost control and environmental issues, the efficient control of manufacture and processing plant becomes ever more important. While small and medium scale industries require Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) technologies, large scale applications require Distributed Control Systems (DCS).

This unit introduces students to the applications of Distributed Control Systems in industrial measurements and control engineering, the different types of industrial networking used in control and instrumentation, the analysis of the performance of a given control system, and how to suggest appropriate solutions using a variety of possible methods.

On successful completion of this unit students will be able to explain the impact of automated systems in modern control processes, explain the basic concepts, architecture, operation and communication of distributed control systems, identify appropriate techniques to specify and implement a simple DCS and develop programmes to use machine interfaces to monitor and control the behaviour of a complex system.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Explore the impact of automated systems in modern control processes

LO2 Evaluate the basic concepts, architecture, operation and communication of Distributed Control Systems

LO3 Suggest appropriate techniques to specify and implement a simple Distributed Control System

LO4 Develop programmes to use machine interfaces to monitor and control the behaviour of a complex system.

Essential Content

LO1 Explore the impact of automated systems in modern control processes

Modern control processes:

Introduction to computer-based control systems and typical distributed control systems

An overview of DCS and SCADA systems

Fundamentals of PLC

Comparison of DCS, SCADA and PLCs

Selection and justification of control strategies.

LO2 Evaluate the basic concepts, architecture, operation and communication of Distributed Control Systems

Distributed Control Systems:

Evolution and description of commercial DCS, DCS elements

Basic DCS controller configuration

Introduction to basic communication principles and protocol for DCS, PLC and SCADA

Hierarchical systems and distributed systems

Introduction to simulation models and packages.

LO3 Suggest appropriate techniques to specify and implement a simple Distributed Control System

Techniques:

Introduction to programmable controllers, programming of PLC and DCS systems

Operator interface

Alarm system management for DCS systems

Distributed Control System reporting

Configuration of hardware and software of PLC and DCS

Programmable controller interfacing and troubleshooting

Configuration of a typical DCS control using typical plant problems.

LO4 **Develop programmes to use machine interfaces to monitor and control the behaviour of a complex system.**

Behaviours:

Computation of control systems

Control and supervision of Distributed Control Systems

Human Machine Interfaces (HMIs) and alarms

Network communication standards

Application of field interfaces and networks

Application of diagnostic and maintenance consideration

Project implementation phases and life cycle

Overview of future trends (e.g. digital control, intelligent systems and virtual instruments).

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Explore the impact of automated systems in modern control processes		
P1 Discuss the application of DCS, SCADA and PLC, and their respective fields of application. **P2** Investigate the component parts and their respective functions, in a modern control process. **P3** Review the main building blocks (layout), communication paths and signal level(s) of a DCS.	**M1** Evaluate the use of DCS from field devices to commercial data processing. **M2** Illustrate the control modes, structures, and diagnostic methods used in controllers.	**D1** Critically evaluate and justify the selection of control strategies and their function against the specifications of a DCS.
LO2 Evaluate the basic concepts, architecture, operation and communication of Distributed Control Systems		
P4 Evaluate the concept, architecture, operation and communication of DCS, SCADA and PLC in their respective applications. **P5** Review the hierarchical systems in DCS. **P6** Assess the use of Local Area Network, field bus types, and protocols.	**M3** Critique the input output interface, fieldbus protocols and physical layers of a distributed control system. **M4** Critically examine the application of local area network communication and network types to distributed control systems.	**D2** Critically evaluate the performance of the operator interface in a DCS and its associated hardware.

Pass	Merit	Distinction
LO3 Suggest appropriate techniques to specify and implement a simple Distributed Control System		
P7 Review the application and implementation of the DCS systems. **P8** Determine appropriate techniques for the application of DCS in different environments. **P9** Design and implement a simple DCS to satisfy predefined parameters.	**M5** Develop a high level programme for a typical plant problem. **M6** Explore the hardware and software configuration of a typical plant problem, making use of various operator display configurations.	**D3** Analyse the interfacing, structure and performance of a good alarm system.
LO4 Develop programmes to use machine interfaces to monitor and control the behaviour of a complex system.		
P10 Explain the importance of the control principles and supervision of a DCS. **P11** Apply HMI to different process control applications and understand the alarm reporting. **P12** Demonstrate the role of the operator interface, associated hardware, diagnostics and maintenance for a DCS.	**M7** Show how the configuration control procedures ensure data integrity. **M8** Explore the requirements for in-built diagnostics and maintenance diagnostic routines.	**D4** Analyse and justify the choice of hardware, software and communication systems and strategy in terms of architecture, system requirements, system integration and toolkits available.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Bailey, D. and Wright, E. (2003) *Practical SCADA for Industry*. Newnes.

Bolton W. (2021) *Instrumentation and Control Systems.* 3rd Ed. Elsevier.

Boyer, S. (2004) *SCADA-Supervisory Control and Data Acquisition System*. 3rd Ed. The Automation Systems and Automation Society (ISA) publication.

Ghosh A. (2015) *Distributed Systems: An Algorithmic Approach*. 2nd Ed. CRC Press.

Sharma, K. (2011) *Overview of Industrial Process Automation*. Elsevier.

Links

This unit links to the following related units:

Unit 5007: Commercial Programming Software

Unit 5021: Further Control Systems Engineering.