Unit 5012: Industrial Systems

Unit Code: **K/651/0866**

Level: **5**

Credits: **15**

Introduction

The speed and efficiency of many industrial processes is due, largely, to the control systems selected for the application and the engineer's ability to apply the most appropriate technology for their operation.

This unit presents a structured approach to the development of advanced electronic solutions in a range of modern industrial situations. An essential requirement here is the engineer's ability to utilise the most appropriate technology for each application, to ensure the most efficient monitoring and control of variables such as pressure, temperature, and speed.

Among the topics included in this unit are techniques and applications of electrical and electronic engineering, as they apply to various branches of industry, such as component handling, controlling actuators, responding to change of circumstances in a process, or security issues of connected sensors and systems.

On successful completion of this unit students will be able to learn about system elements and their overall characteristics, and analytically assess the accuracy and repeatability of a range of instruments.

Learning Outcomes

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

LO1 Appraise the main elements of an electronically controlled industrial system

LO2 Review and specify the interface requirements between electronic, electrical, and mechanical transducers and controllers

LO3 Employ practical and computer-based methods to design and test a measurement system

LO4 Apply appropriate analytical techniques to predict the performance of a given system.

Essential Content

LO1 Appraise the main elements of an electronically controlled industrial system

Fundamental concepts of industrial systems:

Discrete control

Input and output devices; open and closed loop systems

System elements, principles, and applications of important and representative AC, DC and Stepper motors, and various types of linear actuators.

LO2 Review and specify the interface requirements between electronic, electrical, and mechanical transducers and controllers

Interfacing and transducers:

Discrete automation using relays and solenoids, AC and DC motors, pneumatic, hydraulic and electrical actuators, and other transducers and devices for measuring and comparing physical parameters

Sensors, passive and active including, hall effect, thermocouples, proximity, acoustics, RFID

Interfacing between electrical, electronic and mechanical transducers

Practical measurement using sensors and transducers, process actuators for temperature and pressure control including Internet enabled technologies.

LO3 Employ practical and computer-based methods to design and test a measurement system

System modelling and analysis:

The use of transfer functions to help predict the behaviour and constancy of an industrial process, including accuracy, resolution and tolerances, repeatability and stability, sensitivity and response time

Dealing with error and uncertainty in industrial systems

Use of computer packages in measurement and control, and dealing with uncertainty and errors in systems (including Industry 4.0 systems).

LO4 **Apply appropriate analytical techniques to predict the performance of a given system**

Use of analytical techniques for performance measurement. Examples of analytical techniques could include: the Monte Carlo method to predict locations and timings of machine failure for maintenance planning, or regression modelling to analyse raw material influence on production outputs

Industry 4.0 and current trends in technology, including the future of industrial systems, seamless integration of systems, the impact of digital developments, the increase of wireless and remote control, Internet of Things, and big data.

Management and strategic issues relating to Industry 4.0, specifically, security and hacking issues of connected sensors and systems.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Appraise the main elements of an electronically controlled industrial system		
P1 Appraise the key components used in an electronically controlled industrial system. **P2** Review the main concepts underlying electronically controlled industrial systems.	**M1** Analyse the characteristics of an electronically controlled industrial system by applying a variety of techniques to the solution of a given problem.	**D1** Critically examine the performance of an electronically controlled system to make recommendations for improvement.
LO2 Review and specify the interface requirements between electronic, electrical, and mechanical transducers and controllers		
P3 Review the interface requirements between electronic, electrical, and mechanical transducers and controllers. **P4** Justify the choice of transducers and controllers for a given task.	**M2** Predict the behaviour of an electronically controlled industrial system by applying a variety of transducers to the solution of a given problem and choose a 'best' solution.	**D2** Critically investigate the behaviour of a given control system to compare different electrical, electronic and mechanical approaches to control.
LO3 Employ practical and computer-based methods to design and test a measurement system		
P5 Employ any two practical and computer-based methods to design and test a measurement system. **P6** Explain the use of practical and analytical methods in creating and testing a measurement system.	**M3** Interpret the characteristics and behaviour of an existing electronic measurement system by applying a variety of methods to find a solution to a given problem.	**D3** Develop an evaluative report on the performance of an ideal measurement system required to function within Industry 4.0 operations.
LO4 Apply appropriate analytical techniques to predict the performance of a given system		
P7 Apply the main analytical techniques to explain the performance of a given system.	**M4** Evaluate the characteristics of an electronically controlled industrial system by applying a variety of analytical techniques to the solution of a given problem.	**D4** Analyse an existing industrial system by using appropriate analytical techniques to provide justified recommendations to improve performance.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Badiru A.B. and Omitaomu O.A. (2023) *Systems 4.0: Systems Foundations for Industry 4.0.* 1st Ed. CRC Press.

Balamurugan S. (Editors) (2022) *Industrial Internet of Things: Technologies and Research Directions.* 1st Ed. CRC Press.

Bidanda B. (2022) *Maynard's Industrial and Systems Engineering Handbook.* 6th Ed. McGraw-Hill.

Bird J. (2022) *Electrical Circuit Theory and Technology*. 7th Ed. Routledge.

Bishop O. (2021) *Electronics: A First Course.* 3rd Ed. Routledge.

Hughes E. et al. (2016) *Electrical and Electronic Technology*. Pearson.

Massaro A. (2021) *Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances.* Wiley-IEEE Press.

McMillan G.K. and Vegas P.H. (2019) *Process/Industrial Instruments and Controls Handbook.* 6th Ed. McGraw-Hill.

Patin N. (2016) *Power Electronics Applied to Industrial Systems and Transports.* 1st Ed. Elsevier.

Peacock B. and Badiru A.B. (2023) *Industrial Engineering in Systems Design: Guidelines, Practical Examples, Tools, and Techniques.* 1st Ed. CRC Press.

Rehg J.A. and Sartori, G.J. (2005) *Industrial Electronics*. Prentice-Hall.

Sharma A., Jangir S.K., Kumar M., Choubey D.K., Shrivastava T. and Tan R.R., Aviso K.B. and Promentilla M.A.B. (2018) *Input-Output Models for Sustainable Industrial Systems: Implementation Using Lingo (Lecture Notes in Management and Industrial Engineering).* Springer.

Wilamowski B.M. and Irwin J.D. (2011) *The Industrial Electronic Handbook: Fundamentals of Industrial Electronics*. CRC Press.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

Future Industrial Systems: Opportunities and Challenges

IEEE Transactions on Industrial Informatics

Intelligent Industrial Systems

International Journal of Industrial and Systems Engineering

Journal of Industrial and Systems Engineering

Journal of Industrial Information Integration

Journal of Industrial System Engineering and Management

Journal of Manufacturing Systems

Journal of Mechanical Design Transactions of the ASME

Technovation

Links

This unit links to the following related units:

Unit 4016: Instrumentation and Control Systems

Unit 4019: Electrical and Electronic Principles.