Unit 4006: Mechatronics

Unit Code:	**Y/651/0716**
Level:	**4**
Credits:	**15**

Introduction

Auto-focus cameras, car cruise control and automated airport baggage handling systems are examples of mechatronic systems. Mechatronics is the combination of mechanical, electrical, and computer/controlled engineering working together in automated systems and 'smart' product design.

Among the topics included in this unit are: consideration of component compatibility, constraints on size and cost, control devices used, British and/or European standards relevant to application, sensor types and interfacing, simulation and modelling software functions, system function and operation, advantages and disadvantages of software simulation, component data sheets, systems drawings, flowcharts, wiring and schematic diagrams.

On successful completion of this unit students will be able to learn about the basic mechatronic system components and functions, designing a simple mechatronic system specification for a given application, appropriate simulation and modelling software to examine its operation and function, and solving faults on mechatronic systems using a range of techniques and methods.

Learning Outcomes

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

LO1   Explain the design and operational characteristics of a mechatronic system

LO2   Produce a mechatronic system design specification for a given application

LO3   Examine the operation and function of a mechatronics system using simulation and modelling software

LO4   Demonstrate fault finding skills and fault analysis on a mechatronic system.

Essential Content

LO1 Explain the design and operational characteristics of a mechatronic system

Origins and evolution:

History and early development, evolution

Industrial and consumer examples of mechatronic systems

Extent of mechatronic systems use

Current operational abilities and anticipated improvements.

Systems characteristics:

Design of systems in an integrated way

Design systems to optimise performance

Design systems using emerging technologies, Industry 4.0 and analyse impact on organisations

Sensor and transducer types used

Consideration of component compatibility

Constraints on size and cost

Control device requirements and examples of applications.

LO2 Produce a mechatronic system design specification for a given application

Systems specifications:

British and/or European standards relevant to application

Electrical system circuit diagrams, operation of the various components that make up mechatronic system, understanding technical documents

Sensor types and interfacing

Actuator technology availability and selection

Selection and use of appropriate control software/devices.

Consideration of the interaction of system variables

System commissioning parameters.

LO3 Examine the operation and function of a mechatronics system using simulation and modelling software

Operation and functions:

Simulation and modelling software functions

System function and operation

Modes of operation simulation, loading and surges

Advantages and disadvantage of software simulation.

LO4 Demonstrate fault finding skills and fault analysis on a mechatronic system

Locating and correcting system faults:

Component data sheets, systems drawings, flowcharts, wiring and schematic diagrams, technical documentation (e.g. manuals), fault reports

Within the context − effective use of data collection systems (e.g. databases), data management systems, data analytics and dashboards; documentation control processes and procedures (e.g., format, location, access, authorisation)

Original system correct function and operation

Instrumentation usage and faults: multimeter, flowmeter, temperature measurement, pressure meter etc. and the measurement data transmission

Inspection and testing using methodical fault location techniques and methods, use of control software to aid fault location

Identification, evaluation and verification of faults and their causes, rectification, final system testing and return to service

Safety first culture in using equipment and resolving the faults − health and safety policies, procedures and regulations, compliance, risk assessment processes and procedures, risk mitigation.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Explain the design and operational characteristics of a mechatronic system		
P1 Explain the key requirements and components of a given mechatronics system **P2** Explain the types of actuators, sensors and transducers used in a given mechatronics system.	M1 Analyse how the components operate as part of an integrated mechatronic system. M2 Analyse the methods of control used by the mechatronic system.	**D1** Evaluate the mechatronic system specification and propose an alternative solution.
LO2 Produce a mechatronic system design specification for a given application		
P3 Produce a design specification for a given mechatronic system application including the details of the sensor and actuator technologies.	**M3** Justify the sensor and actuator technologies selected with reference to available alternatives.	**D2** Evaluate the operational capabilities and limitations of the mechatronic system design specification produced.
LO3 Examine the operation and function of a mechatronics system using simulation and modelling software		
P4 Examine the operation and function of a given mechatronics system using industry standard simulation/modelling software.	**M4** Analyse the operation and function of a simulated/modelled mechatronics system, with improvements to the system.	**D3** Evaluate the advantages and disadvantages of the simulation/modelling software used, based on the results obtained, with recommended improvements.
LO4 Demonstrate fault finding skills and fault analysis on a mechatronic system		
P5 Explain the safe use of fault finding test equipment **P6** Demonstrate fault finding analysis by locating and rectifying faults on a given mechatronic system.	**M5** Apply and document the safe and correct use of fault-finding equipment and techniques/methods on a given mechatronic system.	**D4** Investigate the causes of faults in a given mechatronic system, with suggested amendments to the design specification to improve system reliability.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Alciatore D.G. and Histand M.B. (2019) *Introduction to Mechatronics and Measurement Systems.* 5th Ed. McGraw-Hill.

Bolton W. (2018) *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*. 7th Ed. Pearson Education Limited.

Hami A.E. and Pougnet P. (2020) *Embedded Mechatronic Systems 2: Analysis of Failures, Modeling, Simulation and Optimization*. 2nd Ed. ISTE Press – Elsevier.

Indri M. and Oboe R. (2022) *Mechatronics and Robotics: New Trends and Challenges.* 1st Ed. CRC Press.

Lyshevski S.E. (2020) *Mechatronics and Control of Electromechanical Systems.* 1st Ed. CRC Press.

Mahalik N.P. (2010) *Mechatronics: Principles, Concepts and Applications*. New Delhi: McGraw-Hill.

Onwubolu G.C. (2005) *Mechatronics: Principles and Applications*. Oxford: Elsevier.

Ramachandran K.P., Vijayaraghavan G.K. and Balasundaram M.S. (2008) *Mechatronics: Integrated Mechanical Electronic Systems*. India: Wiley.

Singh S.B., Ranjan P. and Haghi A.K. (2022) *Applied Mechatronics and Mechanics: System Integration and Design*. 1st Ed. Apple Academic 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.

[IEEE/ASME Transactions on Mechatronics](#)

[IET Robotics and Mechatronics Network](#)

[International Journal of Advanced Mechatronic Systems](#)

[Journal of Mechatronics and Robotics](#)

[Journal of Mechatronics Engineering](#)

[Mechatronics](#)

Links

This unit links to the following related units:

Unit 4015: Automation, Robotics and Programmable Logic Controllers (PLCs)

Unit 5021: Further Control Systems Engineering.