WM984-15 Systems Engineering and Functional Safety

23/24

Department
WMG
Level
Taught Postgraduate Level
Module leader
Borislav Dimitrov
Credit value
15
Module duration
1 week
Assessment
100% coursework
Study locations
University of Warwick main campus, Coventry Primary
Distance or Online Delivery

Description

Introductory description

The module details the fundamental principles pertinent to Systems Engineering, Systems thinking and Functional Safety. Beginning with Systems Engineering the module covers the principles and concepts of complexity and systems thinking, system architecture, automotive sub-systems functional analysis, customer needs and requirements definition. Moving on to functional safety, and incorporating the systems engineering principles the student covers the safety lifecycle, hazard and risk analysis, system/hardware/software development, and the associated processes including safety and change management, confidence levels and ultimately verification. Learning is reinforced via case studies and practical exercises.

Module aims

The module aims to ensure the student understands and follows the essential processes in developing complex automotive systems, from understanding the user cases, requirements, and specifications to validation and verification of functional and safe systems. Systems Engineering is the industrial framework for developing complex systems, and functional safety ensures they are safe to use.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The module details the fundamental principles pertinent to Systems Engineering, Systems Thinking and Functional Safety. Presenting the Systems Engineering basic methods and approaches, the module continues with the main electric drivetrain sub-systems such as energy storages, converters, inverters, electric motors and control systems. The main focus is on the sub-systems concept of operation, requirements, functionality, interfaces, assembling and test procedures. Moving on to functional safety and incorporating the systems engineering principles, the student covers the safety lifecycle, hazard and risk analysis, system/hardware/software development, and the associated processes, including safety and change management, confidence levels and ultimately verification. Learning is reinforced via case studies, projects and practical exercises.

Learning outcomes

By the end of the module, students should be able to:

- Critically evaluate the Systems Engineering methods and approaches for the entire System Engineering life-cycle, showing their application in the Electric Drivetrain systems.
- Evaluate customer needs, interpret the global requirements and cascade requirements to the sub-systems in advanced complex Electric Drivetrain systems.
- Systematically define the concept of operation, functional analysis, high-level and detailed engineering design procedures for Electric Drivetrain systems.
- Systematically define Electric Drivetrain sub-systems assembling, testing and validation procedures, along with the risk assessment and risk mitigation techniques.
- Comprehensively apply functional safety principles, HARA and ASIL evaluation in the design of complex Electric Drivetrain systems.

Subject specific skills

The students will be able to apply systems thinking to complex engineering problems, following a structured, methodical process applied in Electric Drivetrain development. The students with gain the ability to understand interactions and integration across multiple disciplines and domains – mechanical, electrical/electronics, thermal, software, etc. – applicable in the primary Electric Drivetrain sub-systems development process. The student will understand the System Engineering needs analysis, requirements elicitation, the concept of operation and functional analysis, hazard and risk analysis, functional safety and management processes, engineering design, assembling and verification procedures in order to develop Electric Drivetrain industrial projects meeting the customer needs and requirements.

Core Skills:

| To understand the System Engineering methods and approaches and their applications in Electric Drivetrain systems |

| To understand the main Electric Drivetrain sub-systems concept of operation and to define the conceptional architecture as a part of a complex industrial project |

| To understand the main Electric Drivetrain requirements and practically apply requirements cascading techniques, functional analysis and functional architecture definition |

| To understand and practically apply the high-level and detailed engineering design methodologies, assembling and testing procedures necessary for the Electric Drivetrain development process |

| To understand the functional safety basic principles and application in Electric Drivetrain development, based on ISO26262 standard |

| Gain a deep understanding of technical responsibility for complex engineering systems |

| Ability to validate that the design will satisfy the requirements of the product or service |

| Ability to ensure that engineering integrity is achieved and engineering procedures are complied with |

| Ability to ensure the rigorous application of risk management and lessons learnt to ensure project risk is understood and minimised through the project life cycle |

| Knowledge to ensure all internal process, regulatory and customer requirements are met |

Transferable skills

The module develops problem solving and troubleshooting capabilities, in addition to team working and lateral thinking. The ability to get into the "customer mindset" and work through issues in a thorough and methodical manner whilst working with different teams is essential in todays work force.

Core Behaviours
| Professional commitment
Demonstrating a personal, ethical and professional commitment to society, their profession and the environment, adopting a set of values and behaviours that will maintain and enhance the reputation of the profession as well as their organisation and fulfilling requirements with respect to maintenance of personal records for Professional Registration.|

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour 30 minutes (10%)
Seminars	2 sessions of 6 hours (8%)
Total	150 hours

Type	Required
Tutorials	1 session of 3 hours (2%)
Online learning (scheduled sessions)	2 sessions of 2 hours (3%)
Online learning (independent)	23 sessions of 2 hours (31%)
Private study	10 hours (7%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Self-study time for preparation for assessed tasks, including independent research activity.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Assessment component			
Post Module assignment: Systems Engineering and Functional Safety	80%	48 hours	Yes (extension)

Following the System Engineering methods, develop a project – Describe the System Engineering procedure and life cycle for Battery Electric Vehicle development, engineering design, sub-system assembling, testing and production.

Reassessment component is the same

Assessment component			
In module online assessement (Video Presentation)	20%	12 hours	No

Following the System Engineering life-cycle, develop and present a System Engineering project –

	Weighting	Study time	Eligible for self-certification
An electric car battery charging system based on renewable energy sources.			

Reassessment component is the same

Feedback on assessment

Scaled ratings for Comprehension, Effort and Presentation. Individual written feedback and overall mark.

Availability

Courses

This module is Core optional for:

- Engineering Competence (Sustainable Automotive Electrification) [New Course]
- MSc in Sustainable Automotive Electrification (FT) [New Course]
- MSc in Sustainable Automotive Electrification (PT) [New Course]