

# WM915-15 Robust Automotive Embedded Systems

**22/23**

**Department**

WMG

**Level**

Taught Postgraduate Level

**Module leader**

Valentina Donzella

**Credit value**

15

**Module duration**

2 weeks

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

Robust Automotive Embedded Systems aims to provide the students with a comprehensive knowledge of:

- embedded automotive systems from an hardware and software viewpoint;
- robustness of embedded system in the context of smart connected and autonomous vehicles.

The module aims to systematically analyse industry motivations, legislations, roadmaps and customer requirements related to automotive embedded systems. Key parameters to design, test and evaluate robustness of the on-board electronics systems are discussed. Topics are introduced from a practical viewpoint thus allowing the students to critically and independently apply the learning to design, assess and test a wide variety of embedded systems used in smart connected and autonomous vehicles.

[Module web page](#)

### Module aims

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knowledge of:

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- robustness of embedded system in the context of smart connected and autonomous vehicles. The module aims to systematically analyse industry motivations, legislations, roadmaps and customer requirements related to automotive embedded systems. Key parameters to design, test and evaluate robustness of the on-board electronics systems are discussed. Topics are introduced from a practical viewpoint thus allowing the students to critically and independently apply the learning to design, assess and test a wide variety of embedded systems used in smart connected and autonomous vehicles.

## **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.

- Definition, terminology and classifications of smart connected and autonomous vehicles (SCAVs). Current status of SCAV and challenges;
- Introduction to embedded systems;
- basic structure of a typical automotive embedded system (hardware/software);
- Overview of the different embedded systems in the context of automotive applications;
- A case study of an automotive electronic control unit.
- Overview of robustness, including covering aspects such as faults/failures, reliability/dependability and safety related automotive embedded systems;
- Main features and requirement for automotive electronics;
- Parasitic components in electronics circuits, environmental and operational conditions, aging;
- Analysis and simulation of parasitic components and their effect on circuit response;
- Automotive software development and documentation;
- Automotive software robustness including investigated coding best practices;
- Automotive standards and guidelines (MISRA C and ISO 26262);
- Introduction to version control;
- Models for developing complex embedded systems using V-model and Model Based Design (MBD).
- Understanding requirements capture, including natural, semi-formal, and formal requirements;
- General approaches to testing, functional/non-functional, randomised and generation of test cases.
- Design and development of ADAS electronics systems;

## **Learning outcomes**

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

- Independently design and simulate one function of an advanced driving assistance/autonomous driving embedded system, evaluating its robustness from a software and hardware point of view
- Independently analyse and simulate an electronic circuit taking into account parasitic

components and dependencies on environmental and working parameters

- Critically evaluate the quality of a program used to drive an automotive embedded system and independently identify weaknesses
- Critically understand the implication of automotive guidelines (MISRA C, ISO 26262) on system design and robustness
- Critically interpret and criticise current automotive embedded systems development processes
- Independently generate test cases for functional and not functional testing of automotive embedded systems

## **Indicative reading list**

For reference:

- “Automotive Embedded Systems Handbook” edited by N. Navet, F. Simonot-Lion, CRC Press, 2009, ISBN: 9780849380266.
- “Understanding Automotive Electronics; An Engineering Perspective”, William Ribbens, Butterworth Heinemann, 7th Edition, 2012, ISBN: 9780080970974.
- “Bosch Automotive Electrics and Automotive Electronics; Systems and Components, Networking and Hybrid Drive”, Bosch Professional Automotive Information, Robert Bosch GmbH, Springer, 5th Edition, ISBN 978-3-658-01784-2.

A variety of up-to-date sources including:

- Latest government / UK Automotive Council roadmaps for autonomous vehicles
- Latest automotive legislation and standards
- Current academic research in the field of smart connected and autonomous vehicles.

[View reading list on Talis Aspire](#)

## **Subject specific skills**

Automotive embedded system robustness, requirement, safety standards, V and V models, Model based development and related tools, software robustness, hardware robustness, testing.

## **Transferable skills**

Team work; Work effectively in a group or team to achieve goals; Personal Motivation, Organisation and Time Management skills; Research and Analytical Skills; presentation skills; Oral and written communication skills

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## **Study**

## **Study time**

<b>Type</b>	<b>Required</b>
Lectures	19 sessions of 1 hour (13%)
Tutorials	5 sessions of 1 hour (3%)
Practical classes	5 sessions of 1 hour (3%)
Other activity	11 hours (7%)
Private study	50 hours (33%)
Assessment	60 hours (40%)
Total	150 hours

### **Private study description**

Self-Directed Study

### **Other activity description**

Class presentations: 3 hr

Case studies/seminars: 3 hr

Syndicate exercises: 2 hr

Module review and PMA introduction: 1 hr

individual preparatory work: 2hr

### **Costs**

No further costs have been identified for this module.

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### **Assessment**

You do not need to pass all assessment components to pass the module.

#### **Assessment group A3**

	<b>Weighting</b>	<b>Study time</b>
Post-module assessment	70%	42 hours
Problem set to be solved and justified		

In-module assessments	30%	18 hours
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The IMA will be composed by a coursework comprising reports and answers to IMA questions and a 10 minutes slide presentation based on the individual presentation during group work. Preparation and completion time is covered in learning hours breakdown.

#### **Assessment group R2**

	<b>Weighting</b>	<b>Study time</b>
Assessed work as specified by department 100% Assignment	100%	

### **Feedback on assessment**

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

Formative assessment during the group activities, tutorials, class quizzes using on-line tools (e.g. kahoot quizzes).

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### **Availability**

#### **Courses**

This module is Core optional for:

- Year 1 of TWMS-H33L Postgraduate Award Smart, Connected and Autonomous Vehicles
- Year 1 of TWMS-H33M Postgraduate Certificate Smart, Connected and Autonomous Vehicles
- Year 1 of TWMS-H33N Postgraduate Diploma Smart, Connected and Autonomous Vehicles
- Year 1 of TWMS-H33P Postgraduate Taught Smart, Connected and Autonomous Vehicles