Course guide
270504 - SEU - Embedded and Ubiquous Systems

Last modified: 25/07/2025

Unit in charge: Barcelona School of Informatics
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: DANIEL GARCIA SOLÀ

Others: Primer quadrimestre:
DANIEL GARCIA SOLÀ - 11, 12

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE8. Capability to design and develop systems, applications and services in embedded and ubiquitous systems .

Generical:
CG1. Capability to plan, calculate and design products, processes and facilities in all areas of Computer Science.
CG2. Capacity for management of products and installations of computer systems, complying with current legislation and ensuring the quality of service.
CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.
CG7. Capacity for implementation, direction and management of computer manufacturing processes, with guarantee of safety for people and assets, the final quality of the products and their homologation.
CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

Transversal:
CTR2. SUSTAINABILITY AND SOCIAL COMMITMENT : Capability to know and understand the complexity of the typical economic and social phenomena of the welfare society. Capacity for being able to analyze and assess the social and environmental impact.
CTR5. APPROPIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.

TEACHING METHODOLOGY

There will be no distinction between theory and problem classes, the theoretical classes will be reinforced with examples showing possible alternatives and solutions to the problems posed.
Self-assessment exercises will be proposed in the different topics so that the student can be aware of his progress, and can request help from the teacher in the event that he detects any deficiency.
The practical sessions will be held in the department's teaching laboratory. It is an essential requirement to have carried out previous work that will be specified for each of the practices.

LEARNING OBJECTIVES OF THE SUBJECT

1.The objective of this subject is to show what an embedded system is, how to specify the functional requirements of an embedded system and how to evaluate it.

The aim is to provide sufficient elements of judgment to be able to select the most appropriate hardware and software platforms that meet the specified requirements at an adjusted cost.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	16.00
Hours small group	24,0	16.00
Self study	96,0	64.00
Guided activities	6,0	4.00

Total learning time: 150 h

CONTENTS

Introduction

Description:
Definitions and basic concepts of embedded systems.

Reliability and safety concepts: critical systems.

Applications: control systems, Real-Time systems.

Hardware platforms for embedded systems

Description:
Description of various hardware alternatives. Architectures, application examples.

Industrial communication buses and interfaces.

I/O devices. Sensors and actuators.

Data acquisition and processing.

Design and development of embedded systems

Description:
Functional requirements of a system.

Design of software architecture according to hardware.

Methodologies and models of design and development.

Tools to support design and development.

Operating systems for embedded systems

Description:
Software architectures.

Real-time operating systems (RTOS) and hardware resource management.

Multitasking concepts: threads, mutex, message queues, synchronization mechanisms, deadlocks, etc.

Scheduling algorithms

Mobile and ubiquitous systems

Description:
Basic concepts of ubiquitous systems.

Interconnection of devices. Networks for embedded systems. Topologies. Access to the environment.

Technologies and standards of wireless communications.

Application examples: automotive, home automation, security, robotics, agriculture, environmental intelligence, IoT...

Embedded systems evaluation

Description:
Reliability and fault tolerance.

Safety: safety standards (SIL).

Efficiency.

Test.

ACTIVITIES

Development of topic 1 of the subject

Specific objectives:
1

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Full-or-part-time: 10h
Self study: 4h
Theory classes: 3h
Laboratory classes: 3h

Development of topic 2 of the subject

Specific objectives:
1

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Full-or-part-time: 24h
Self study: 10h
Theory classes: 7h
Laboratory classes: 7h

Development of topic 3 of the subject

Specific objectives:
1

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Full-or-part-time: 12h
Self study: 6h
Theory classes: 4h
Laboratory classes: 2h

Development of topic 4 of the subject

Specific objectives:
1

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Full-or-part-time: 18h
Self study: 8h
Theory classes: 5h
Laboratory classes: 5h

Development of topic 5 of the subject

Specific objectives:
1

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Full-or-part-time: 18h
Self study: 8h
Theory classes: 5h
Laboratory classes: 5h

Development of topic 6 of the subject

Specific objectives:
1

Related competencies :
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Full-or-part-time: 8h
Self study: 6h
Theory classes: 2h

First midterm exam

Specific objectives:
1

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Full-or-part-time: 12h
Self study: 12h

Second midterm exam

Full-or-part-time: 12h
Self study: 12h

Guided Project Proposal (P1)

Full-or-part-time: 8h 18m
Self study: 8h
Guided activities: 0h 18m

Guided Project Development (P2)

Full-or-part-time: 17h 42m
Self study: 12h
Guided activities: 1h 42m
Laboratory classes: 4h

Guided Project Defense (P3)

Full-or-part-time: 14h
Self study: 12h
Guided activities: 2h

GRADING SYSTEM

During the course, 2 theory and problem assessable tests will be carried out, corresponding to different parts of the course. They will be carried out individually. A theory grade (NT) will be obtained from the weighted average of the assessments.

* Only exceptionally will a final exam be taken, from which the grade NT will be obtained. The student who wishes to be assessed through a final exam must request it in writing to the subject coordinator before the first assessment test.

* The NL laboratory grade is obtained from the average of the individual assessments of the practices. 5 assessable practices will be carried out during the course. Repeating students who have passed the practices can validate the practices with NL=5.

* Throughout the development of the subject, students must present a work proposal, a pre-project and a design of an embedded system chosen by the group members. This design will be defended by the group in an act open to the entire class. The grade for these three acts will be NPF.

* The final grade (NF) of the subject is obtained from the theory grade NT, the laboratory grade NL and the final presentation grade NPF.

NF = 0.4 NT + 0.4 NL + 0.2 NPF.

* It is a necessary condition to pass the subject to carry out and present the laboratory practices in the form and within the established deadline.

BIBLIOGRAPHY

Basic:

- Koopman, P. Better embedded system software. Drumnadrochit Press, 2010. ISBN 978-0-9844490-0-2.
- Pfeiffer, O.; Ayre, A.; Keydel, C. Embedded networking with CAN and CANopen. Coperhill Media Corporation, 2008. ISBN 9780976511625.
- Zurawski, R. Embedded systems handbook [on line]. 2nd ed. CRC Press, 2009 [Consultation: 10/05/2023]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9781315218281/embedded-systems-handbook-richard-zurawski. ISBN 9781315222301.
- Marwedel, P. Embedded system design: embedded systems, foundations of cyber-physical systems, and the internet of things [on line]. 4th edition. Springer, 2021 [Consultation: 18/01/2023]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-030-60910-8. ISBN 9783030609108.
- Valvano, J. Embedded systems: real-time operating systems for ARM CortexTM-M microcontrollers. 4th ed, 5th printing. Jonathan W. Valvano, 2019. ISBN 9781466468863.
- Kopetz, H. Real-time systems: design principles for distributed embedded applications. 2nd ed. Springer, 2011. ISBN 978-1-4419-8236-0.