Universitat de les Illes Balears

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| Academic year | 2017-18 |
| Subject | 11557 - Embedded Networks |
| Group | Group 1, 1S |
| Syllabus | C |
| Language | English |

# Syllabus

## Subject

**Name** 11557 - Embedded Networks
**Credits** 0.72 in-class (18 hours) 2.28 distance (57 hours) 3 total (75 hours).
**Group** Group 1, 1S (Campus Extens)
**Period** First semester
**Language** English

### Lecturers

| Lecturers | Office hours for students | | | | | |
|---|---|---|---|---|---|---|
| | Starting time | Finishing time | Day | Start date | End date | Office |
| Julián Proenza Arenas<br>julian.proenza@uib.es | 12:00 | 13:00 | Tuesday | 13/09/2017 | 06/07/2018 | 115 (primer pis, ala nord, A. Turmeda) |

## Context

This subject is included within the itinerary called "Distributed Computing and Embedded", which is one of the possible choices for the "Information Technology" module. Therefore the subject is compulsory for any student who opts for this itinerary.

The subject purports to initiate the students in the basics of embedded networks, in such a way that they could acquire some minimum knowledge, that could later on be expanded to allow its use both in industrial and academic activities, including the research in this area.

The learning goals of the subject are:

1 Understanding the theoretical and practical fundamentals of embedded networks
2 Knowing standards and protocols that are habitually used in this type of system

## Requirements

### Recommended

Basic knowledge of computer networks, such as the ISO's OSI reference model.

## Skills

There are basic skills that correspond to all subjects of the master's programs taught at UIB. The list of these skills can be found by clicking on the link http://estudis.uib.es/en/master/comp_basiques/



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Next, both the specific and generic skills that will be partially acquired in this subject are indicated.

### Specific

* CE4 - Model, design, and define architectures, implement, manage, operate and maintain computer applications, networks, systems, services and content.
* CE5 - Understand and apply the workings and organisation of internet, new-generation network technologies and protocols, models of components, intermediary software and services.
* CE9 - Design and evaluate operating systems and servers and applications and systems based on distributed computing.
* CE11 - Design and develop computer systems, applications and services in embedded and ubiquitous systems.

### Generic

* CG1 - Propose, calculate and design products, processes and installations in all areas of computer engineering.
* CG4 - Undertake mathematical modelling, calculation and simulation in technological centres and engineering companies, especially in research, development and innovation tasks in all areas related to computer engineering.
* CG8 - Integrate and apply the knowledge acquired and solve problems in new or little-known situations within broader (or multidisciplinary) contexts.

### Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

## Content

### Theme content

1. Networks adapted to control applications
    * The communication subsystem
    * Requirements
    * Structure according to the OSI model
2. The fieldbus concept
3. Aspects related to the real-time response in networks
    * Timing
    * Types of messages
    * Event-triggered and time-triggered networks
    * Operational flexibility
4. Some relevant networks
    * Controller Area Network
    * KNX
    * Time-Triggered Protocol
    * FlexRay
    * FTT
5. Traffic scheduling
    * Basic concepts



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* The case of the Controller Area Network

## Teaching methodology

At the beginning of the semester the chronogram of the subject will be available for the students through the UIBdigital platform. This chronogram will include at least the dates of the assessment sessions and the deadlines for submitting the assignments. Moreover, the lecturer will inform the students if the work plan of the subject will be executed by means of the chronogram or by other means, such as the Campus Extens platform.

### In-class work activities

| Modality | Name | Typ. Grp. | Description | Hours |
|---|---|---|---|---|
| Theory classes | Master classes | Large group (G) | The lecturer will describe the theoretical and practical fundamentals of the different topics covered in the course. In addition, for each topic the lecturer will provide information on the recommended working method and materials that students should use to autonomously study the subject. These master classes will be distributed throughout the semester. Each session will last either 2 or 3 hours, during which the theoretical descriptions and the resolution of exercises and problems will alternate. | 12 |
| Seminars and workshops | Laboratory | Medium group (M) | Practical sessions related to the modelling and simulation of embedded networks will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical sessions. | 3 |
| Assessment | Oral defence of the practical exercices | Small group (P) | The student will do an oral examination at the end of the semester in order to defend the work carried out in the practical part of the course. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. | 1 |
| Assessment | Presentation of a revision of the state of the art | Large group (G) | The student will do an oral presentation (using her or his own slides) at the end of the semester in order to describe in a pedagogic manner a review of a part of the existent technology for embedded networks. The specific aspects to describe by the student would have been previously agreed between the student and the lecturer. This presentation will allow assessing if the student is competent to autonomously interpret and assimilate descriptions of embedded systems, by using the concepts presented in the theory classes. | 1 |
| Assessment | Written exam | Large group (G) | The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if she or he knows how to correctly use the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions. | 1 |

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to



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whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

### Distance education work activities

| Modality | Name | Description | Hours |
|---|---|---|---|
| Individual self-study | Study to assimilate the theory described in the sessions. | Each student will have to devote some time to individually assimilate the theoretical contents that were presented by the lecturer in the sessions. | 15 |
| Group or individual self-study | Completion of the practical exercises started in the laboratory | Each student will have to devote some extra time (besides the time established in the course schedule) to complete the resolution of the problems proposed in the laboratory sessions. The solutions to these problems will have to be delivered for the lecturer to score them. Moreover, the student will have to devote some additional time to prepare the oral presentation to the lecturer. | 15 |
| Group or individual self-study | Revision of some literature on embedded networks | Each student will have to devote some time to complete a revision of a part of the existent technology for embedded networks. The specific aspects to describe by the student would have been previously agreed between the student and the lecturer. The student will prepare some slides to assist in the later presentation of the revision. The goal of the presentation is to demonstrate that the student is competent to autonomously assimilate and describe to his or her pairs descriptions of embedded networks, by using the concepts presented in the theory classes. Therefore the student will have to devote some time to the preparation of the presentation to be performed for all the other students of the subject. | 27 |

### Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

## Student learning assessment

The skills that have to be acquired in this course will be evaluated by means of a series of assessment procedures associated to each evaluative activity. The table in this section describes, for each evaluative activity, the evaluation technique that will be used, the type of evaluation (recoverable or non-recoverable), the scoring criteria and the weight of the mark in the final mark of the subject (depending on the specific evaluative itinerary). This subject considers a single evaluative itinerary (labelled “A”) which is suitable both for students who can attend to all the sessions and for those who cannot. The students commit themselves to perform all the activities included in the “A” itinerary.

The student will get a numeric mark comprised between 0 and 10 for each evaluative activity. This mark will be used (with the corresponding weight) to compute the final mark of the subject. In order to pass the student must get a minimum of 5 points in each evaluative activity.

Any student that takes the written exam will be considered as evaluated and will get a final mark.



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### Oral defence of the practical exercices

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| Modality | Assessment |
| Technique | Oral tests **(non-retrievable)** |
| Description | The student will do an oral examination at the end of the semester in order to defend the work carried out in the practical part of the course. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. |
| Assessment criteria | Correctness of the design and implementation of the solutions proposed for the practical exercises.<br>Correctness of the answers and explanations given during the interview with the lecturer |

Final grade percentage: 20% with minimum grade 5

### Presentation of a revision of the state of the art

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|---|---|
| Modality | Assessment |
| Technique | Oral tests **(non-retrievable)** |
| Description | The student will do an oral presentation (using her or his own slides) at the end of the semester in order to describe in a pedagogic manner a review of a part of the existent technology for embedded networks. The specific aspects to describe by the student would have been previously agreed between the student and the lecturer. This presentation will allow assessing if the student is competent to autonomously interpret and assimilate descriptions of embedded systems, by using the concepts presented in the theory classes. |
| Assessment criteria | Accuracy and depth of the revision of the state of the art.<br>Clarity and correctness of the presentation and quality of the slides.<br>Correctness of the answers and explanations given during the interview with the lecturer |

Final grade percentage: 40% with minimum grade 5

### Written exam

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| Modality | Assessment |
| Technique | Other methods **(non-retrievable)** |
| Description | The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if she or he knows how to correctly use the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions. |
| Assessment criteria | Correctness of the answers which have to be properly explained and justified. |

Final grade percentage: 40% with minimum grade 5

## Resources, bibliography and additional documentation

### Basic bibliography

* B. M. Wilamowski and J. D. Irwin (editors), 'Industrial Communication Systems' (A volume of 'The Industrial Electronics Handbook' Second Edition), CRC Press, Taylor & Francis Group, 2011
* H. Kopetz, 'Real-Time Systems: Design Principles for Distributed Embedded Applications', Kluwer Academic Publishers, 1997.

### Complementary bibliography



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* P. Veríssimo and L. Rodrígues, 'Distributed Systems for System Architects', Kluwer Academic Publishers, 2001.
* A. Burns, A. Wellings, 'Sistemas de tiempo real y lenguajes de programación' (3/e), Addison Wesley, 2003
* J. R. Pimentel et al. 'Dependable Automotive CAN Networks', Chapter in the Automotive Embedded Systems Handbook, CRC Press, 2009.
* G. Rodríguez-Navas et al. 'Using Timed Automata for Modeling the Clocks of a Distributed Embedded System', Chapter in Behavioral Modeling for Embedded Systems and Technologies: Applications for Design and Implementation, IGI Global, 2009.
* J. R. Pimentel, 'Communication Networks for Manufacturing', Prentice- Hall, 1990.
* W. Lawrenz, 'CAN System Engineering. From Theory to Practical Applications', Springer, 1997

**Other resources**

* Official page of the CAN in Automation user's group: http://www.can-cia.org/
* Official page of the KNX stadard: http://www.knx.org/
* Page for the LonWorks system by the Echelon company: http://www.echelon.com/