Universitat Autònoma de Barcelona

2019/2020

Digitization and Microcontrollers

Code: 104534
ECTS Credits: 6

Degree	Type	Year	Semester
2503743 Management of Smart and Sustainable Cities	OB	2	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Lluís Ribas Xirgo

Prerequisites

For the full understanding of the contents of the course, it is convenient to have a basic ability in programming and a good knowledge of how programs execute in computers. For this, you should have completed "Computer science", "Basic electronics" and "Internet applications' programming"

Objectives and Contextualisation

This course is the first within the subject of microcontrollers and embedded systems. The main topics are data acquisition and development of systems capable to deal with this data. In this context, the course objective is that students acquire the following competences:

- Get a global vision of the data digitalization process, understanding its utility and requirements.
- To know the main sensors types and their signals.
- To know the basic architectures for microcontrollers
- To develop a system based on a microcontroller
- To learn basic concepts of real time processing and the use of a RTOS (Real-Time Operating System) with microcontrollers.
- To able to evaluate the performance of a microcontroller based system

Competences

- Design platforms of management, integration of public and government services applying technologies and systems of sensorization, acquisition, processing and communication of data.
- Generate innovative and competitive proposals in professional activity.
- Integrate cyberphysical systems based on the interrelationship between information technology and physical processes in urban environments.

- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Learning Outcomes

1. Be aware of existing actuators and the use of control variables as a response tool.
2. Describe the process of the specification, selection and integration of digital sensors for the digitisation of data in smart and sustainable cities.
3. Distinguish the architecture of embedded systems for the integration of digital sensors.
4. Generate innovative and competitive proposals in professional activity.
5. Recognize the limitations and advantages of sensors based on their specifications for a particular purpose.
6. Recognize the requisite information to be obtained from an urban environment, and which sensors and electronic systems should be used.
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
9. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
10. Understand the integration of digital sensors and embedded systems in developing cyberphysical systems.
11. Understand the use of captured information, as well as the importance of presenting and communicating it.
12. Use data-acquisition and processing systems as a control and decision-making tool.
13. Use specific information captured for a concrete purpose and evaluate this use.
14. Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Content

- Introduction to microcontrolers system based design
- Basic architectures for microcontrollers
- Analog and digital Input / Output. Digitalization
- Microcontroller sensor interface
- Communication protocols for sensors
- Basic HW platforms based on microcontrollers
- SW tools for design of microcontroller systems.

Methodology

Teaching is structured in the following face-to-face activities:

Theory classes: Presentations of course contents, with a first part that is devoted to the dissemination of the necessary knowledge for the analysis and the design of embedded systems, and to explain cases that situate in context the knowledge and the abilities that are acquired during the course like, for example, the explanation of how the electronic part of a car works. The second part will be devoted to discuss the problems that will be dealt with in the corresponding seminars.

Problem-solving seminars: Discussion of small case studies (for example, control of a microwave oven) that serve to consolidate theoretical knowledge regarding the analysis and design of embedded systems.

Laboratory practices: Team work at laboratory, following a walk-through guide under the supervisions of a teacher. Each session will deal with a specific aspect regarding the implementation of embedded systems.

There is a very important part of team work outside the classroom and the laboratory. In this sense, each member of each team will have to assume different roles for each assignment. This also means having to work in an organized way and know how to work autonomously when appropriate.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory	12	0.48	11, 10, 5, 12, 13
Theory classes	20	0.8	1, 2, 3, 11, 10, 8, 6, 5, 12, 13
Type: Supervised			
Evaluation	5	0.2	2, 4
Problem-solving: Reporting solutions to proposed problems	12	0.48	2, 11, 10, 4, 9, 7, 8, 5, 14
Type: Autonomous			
Study	14	0.56	1, 3, 11, 9, 7, 8, 6, 5
Writing reports	8	0.32	4, 7, 8, 14

Assessment

a) Procedure and assessment activities' plan

The assessment is continuous with specific activities (exams and assignments) throughout the course. These assessment activities generate a series of grades that determine the final grade.

The calculation of the final grade, n, follows the expression:

$n = t \cdot 50\% + p \cdot 20\% + q \cdot 30\%$

where t, p, and q are the grades of the theory, problem-solving, and laboratory parts, respectively.

The final grade will be, at most, a 4.5 if t, p or q <5. In other words, each part (theory, problem-solving and laboratory) must be passed separately.

The theory grade (t) is obtained from the average between the grades of the two parts. There will be two exams, one at midterm for the first part and another at the end, for the second part. A final exam lets students improve either part or both.

Problem-solving grade (p) is calculated from a weighted average of report grades. Missing reports count as 0. Worst grades are excluded, but the quantity of grades to be considered depend on the number of problem-solving sessions that are effectively done.

The grade of laboratory work (q) will be the result of a weighted average of the grades of the work that is done in the laboratory and the corresponding reports. Therefore, attendance at the laboratory sessions is mandatory.

b) Assessment activities schedule

The dates of the continuous assessment theory and problem-solving tests, assignment submission deadlines will be published on the Campus Virtual (CV) and may change to adapt to eventual incidents: it will always be reported previously through the CV since it is understood that it is the usual communication platform between lecturers and students outside the classroom.

c) Re-assessment procedures

Late submissions, subject to prior notice, will be accepted and penalized with a lower grade. Late submissions without prior notice or justification of force majeure will not be accepted. A second submission period may be opened for reports that receive a negative evaluation. Unaccepted or unsubmitted assignment reports will be scored 0 and will not have the option of a second assessment.

In accordance with the coordination of the Degree and the deanship of the School of Engineering, the following activities cannot be re-assessed:

- Problem-solving, 20% of the final grade

- Laboratory, 30% of the final grade

The final exam lets students improve the grades from partial exams, independently. There is no minimum score for either part to be re-assessed in the final examination.

d) Assessment review procedure

All assessment activities can be reviewed in tutoring hours of the teaching staff can be reviewed. For the theory and problem-solving exams, a specific place, date and time will be indicated.

Should the change of a grade be agreed upon, that grade may not be modified in a later review.

No reviews will be done after the closure of the reviews of the final exam.

e) Grading

A "non-assessable" grade will be assigned to students that have not participated in any assessment activity nor have attended any laboratory sessions. In any other case, not participating in an assessment activity, including unattendances to lab, is scored with a 0 for calculating the weighted average.

Honours will be awarded to those who obtain grades greater than or equal to 9.0 in each part, up to 5% of those enrolled in descending order of final grade. They may also be granted in other cases, provided that they do not exceed 5% and the final grade is equal to or greater than 9.0.

f) Irregularities, copies and plagiarism

Copies are evidences that the work or the examination has been done in part or in full without the author's intellectual contribution. This definition also includes attempts of copying in exams and reports, and violations of the norms that ensure intellectual authorship. Plagiarisms refer to the works and texts of other authors that are passed on as their own. They are a crime against intellectual property. To avoid plagiarism, quote the sources you use when writing the corresponding work reports or examinations.

In accordance with the UAB regulations, copies or plagiarisms or any attempt to alter the assessment result, for oneself of for others, like e.g. letting other copy, imply a final grade for the corresponding part (theory, problem solving or laboratory) of 0 and, in this case, failing the course. This does not limit the right to take action against perpetrators, both in the academic field and in the criminal.

g) Assessment of repeaters

There is no differentiated treatment for repeaters but they can take advantage of their own material from the previous year provided it is informed in the corresponding reports.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Examns	50	4	0.16	1, 3, 11, 4, 6, 5
Laboratory reports	50	50	2	1, 3, 11, 10, 9, 7, 8, 14, 12
Problem-solving reports	25	25	1	2, 10, 4, 9, 8, 14, 13

Bibliography

[1] James O. Hamblen and Michael D. Furman. (2000). *Rapid prototyping of digital systems*. Kluwer Academic Publishers.

[2] LL. Ribas Xirgo. (2011). "Estructura bàsica d'un computador", Capítol 5 de Montse Peiron Guàrdia, Lluís Ribas i Xirgo, Fermín Sánchez Carracedo i A. Josep Velasco González: *Fonaments de computadors*. Material docent de la UOC. OpenCourseWare de la UOC. [http://ocw.uoc.edu/informatica-tecnologia-i-multimedia/fonaments-de-computadors/materials/].

[3] Oliver H. Bailey. (2005). *Embedded Systems Desktop Integration*. Wordware Publishing.

[5] Jon Wilson. (2004). *Sensor Technology Handbook*. Elsevier.