Course guides
300302 - ISECI - Instrumentation and Electronic Systems in Smarts Cities

Last modified: 02/03/2016

Unit in charge:	Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit:	739 - TSC - Department of Signal Theory and Communications.

Degree:	BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Optional subject).
	BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
	BACHELOR'S DEGREE IN AIR NAVIGATION ENGINEERING (Syllabus 2010). (Optional subject).
	BACHELOR'S DEGREE IN AIRPORT ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2015   **ECTS Credits:** 6.0   **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

Analysis of analog and digital circuits

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE 14 TELECOM. Capacidad de análisis y diseño de circuitos combinacionales y secuenciales, síncronos y asíncronos, y de utilización de microprocesadores y circuitos integrados.
2. CE 24 SIS. Capacidad para la selección de circuitos, subsistemas y sistemas de radiofrecuencia, microondas, radiodifusión, radioenlaces y radiodeterminación. (CIN/352/2009, BOE 20.2.2009.)

Generical:
5. PROJECT MANAGEMENT - Level 2: Define the objectives of a well-defined, narrow scope, and plan development, identifying resources, tasks, shared responsibilities and integration. Use appropriate tools to support project management.
7. EFFICIENT USE OF EQUIPMENT AND INSTRUMENTS - Level 2: Use the correct instruments, equipment and laboratory software for specific or specialized knowledge of their benefits. A critical analysis of the experiments and results. Correctly interpret manuals and catalogs. Working independently, individually or in groups, in the laboratory.

Transversal:
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
6. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
8. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

Lectures, participatory classes, group work and problem and projects based learning.

LEARNING OBJECTIVES OF THE SUBJECT

The course aims to further develop skills in the field of analog signal conditioning, digital systems and signal processing and the integrity of the complete systems. This is laying the groundwork for students to learn to design complete measuring systems based on microcontrollers using the techniques and the newest devices.

At the end of the course, the student must be able to:
· To know electronic architectures and performance measurement systems for applications in smart cities and airports.
· To know the most common sensors used for designing and conditioning steps of these alternatives.
· To describe the architecture of electronic measurement systems and performance for applications in smart cities and airports.
· To identify the most common alternative for sensors and to design circuits for them.
· To design simple embedded systems using professional EDA tools like Cypress PSoC Designer or Microchip MPLAB, programming applications in C language
· To use simulation platforms and protoboards for programming microcontrollers and verify the final application operation.
· To compare alternatives for designing of a single electronic system and to know how to determine and to explain the advantages and disadvantages of each option.
· To explain the techniques to optimize low-power applications.

STUDY LOAD

Type	Hours	Percentage
Self study	84,0	56.00
Hours small group	13,0	8.67
Hours large group	32,5	21.67
Hours medium group	13,0	8.67
Guided activities	7,5	5.00

Total learning time: 150 h

CONTENTS

-Sensors

Description:
This first part of the course aims to broaden the knowledge and skills acquired by students in the subjects studied electronics during the race with the study of the stages of measurement and performance of electronic systems for applications in smart cities. It is therefore begin with a research subject who want to measure the magnitudes in these applications so that they can represent the starting point to introduce the architecture of electronic systems to present an approach to design.

Specific objectives:
The topics covered are:

1. Introduction to electronic systems for applications in smart cities and airports.
2. architectures and performance measurement systems.
3. Sensor Systems. Types and characteristics.
4. Front end. Signal conditioning.
5. Consumption conditioning systems. Reduction techniques.
6. Noise in the measurement systems. Reduction techniques.
7. Systems performance.

Related activities:
Lectures, problems and exams

Full-or-part-time: 35h
Theory classes: 15h
Self study : 20h

-Simple microcontrollers and embedded systems

Description:

The second part of the course aims to extend the knowledge and skills acquired by students in previous courses.

Two topics to advance the design of simple applications in embedded systems that contain digital, analog modules, signal processing and communication are proposed.

The various families of PICs from Microchip or Atmel microcontroller and the PSoC (PSoC1, PSoC3 and PSoC5), are quite complex, as to try on a subject like this, just to give an introduction and, in any case, students can, for example, reach, in the final degree, more advanced applications.

Specific objectives:

Topic 1: Applications microcontroller (4 weeks)

This issue arises directly as a continuation of the knowledge acquired in CSD, preparing for discovering new peripherals such as timers, UART, I2C, USB, etc., and other operating modes to optimize designs: sleep mode, low consumption, etc. The VL Proteus VSM is used to simulate the operation based on the PIC16F / 18F families of Microchip and Atmel AVR circuits.

Item 2: programmable analog and digital integrated chip Systems: Programmable Systems on Chip (PSoC) (6 weeks)

This topic will focus on learning the family of Cypress Programmable System on Chip (PSoC) as it is a reconfigurable microcontroller system that includes all kinds of peripherals: analog, digital signal processing and communication. Cypress also has an extensive web documents and support of all kinds to facilitate autonomous learning tools and devices. PSoC These chips offer a couple of very important advantages that make them special and very appropriate to introduce developments in teaching about is shifting electronic technology:
1) An initial hardware configuration before programming the application (Reconfigurable Systems).
2) The use of analog modules and signal processing available on-chip (embedded systems on a single chip), which in more conventional microcontrollers involve the use of various components.

Related activities:

Problems simulation and design (two exercises for each topic)

Full-or-part-time: 45h
Laboratory classes: 20h
Self study : 25h

(ENG) -Projecte integrador

Full-or-part-time: 35h
Guided activities: 15h
Self study : 20h

GRADING SYSTEM

Apply the evaluation criteria defined in Infoweb subject.

EXAMINATION RULES.

Many of the activities, unless otherwise noted, are held in groups of three students.

Essentially, it is mandatory that each exercise, control or any other task must have: planning, development, solution and, usually, verification of solution (most of designs can be simulated with software and then they can be used protoboards). In addition, the work must be submitted by the deadline. On the website of the subject or Athena (atenea.upc.edu) can be found examples of solved exercises.

All group members have to participate in the implementation of the activities and they have to learn any aspect of the exercises. Each exercise must be explained and exposed the assessment made by the group or students in particular.

If a student, in a group, has not involved in the resolution of a exercise, he must notify the teacher, so the exercise can be changed for other work of the same characteristics.

If student can not follow the established work plan must notify the teacher in order to organize an alternative route that involves the same dedication.

To perform any activity, except individual controls, the student can use any material: lecture notes, problems of previous semesters, the Internet, PCs, calculators, etc.

BIBLIOGRAPHY

Basic:
- Pallás Areny, R.; Webster, J.G. Sensors and signal conditioning. 2nd ed. New York: Ed. John Wiley & Sons, 2001. ISBN 0471332321.
- Reese, Robert B. Microprocessors: from assembly language to C using the PIC18Fxx2. Massachusetts: Ed. Da Vinci Engineering Press, 2005. ISBN 1584503785.
- Ashby, Robert. Designer's guide to the Cypress PSoC. Boston: Ed. Elsevier Newnes, 2005. ISBN 9780750677806.

Complementary:
- Barnett, R.; Cox, S. Embedded C programming and the microchip PIC. New York: Ed. Thomson Delmar Learning, 2004. ISBN 1401837484.
- Ganssle, Jack G. The Art of designing embedded systems. Boston: Ed. Newnes, cop. 2000. ISBN 0750698691.
- Li, Q.; Yao, C. Real-Time concepts for embedded systems. San Francisco: Ed. CMPBooks, 2003. ISBN 9781578201242.
- Ganssle, Jack G. The art of designing embedded systems. 2nd ed. Amsterdam: Ed. Elsevier, 2008. ISBN 9780750686440.

RESOURCES

Hyperlink:
- Webs dels fabricants amb molts recursos: manuals, notes d'aplicació, kits d'entrenament, programari de lliure distribució, semanaris web, etc.
- Webs dels fabricants amb molts recursos: manuals, notes d'aplicació, kits d'entrenament, programari de lliure distribució, semanaris web, etc.
- Webs dels fabricants amb molts recursos: manuals, notes d'aplicació, kits d'entrenament, programari de lliure distribució, semanaris web, etc.
- Pàgina web de les assignatures de sistemes digitals de l'EETAC amb continguts docents i exemples de recuross per al seguiment del curs.