Universitat de Lleida

# DEGREE CURRICULUM
# SYSTEMS INTEGRATION II

Coordination: TRESANCHEZ RIBES, MARCEL

Academic year 2016-17

## Subject's general information

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|---|---|
| **Subject name** | SYSTEMS INTEGRATION II |
| **Code** | 102131 |
| **Semester** | 2nd Q(SEMESTER) CONTINUED EVALUATION |

| **Typology** | Degree | Course | Typology | Modality |
|---|---|---|---|---|
| | Bachelor's Degree in Automation and Industrial Electronic Engineering | 4 | OPTIONAL | Attendance-based |

| | |
|---|---|
| **ECTS credits** | 6 |
| **Groups** | 1GG |
| **Theoretical credits** | 2 |
| **Practical credits** | 4 |
| **Coordination** | TRESANCHEZ RIBES, MARCEL |
| **Department** | INFORMATICA I ENGINYERIA INDUSTRIAL |
| **Teaching load distribution between lectures and independent student work** | Total load: 150h<br>- 60h of lectures (40%)<br>- 90h of independent student work (60%) |
| **Important information on data processing** | Consult this link for more information. |
| **Language** | Speaking: As required (Catalan, Spanish or English).<br>Materials and resources: English.<br>Student workload: English. |
| **Distribution of credits** | Theoretical sessions: 2 ECTS<br>Experimental training sessions: 2 ECTS<br>Practical sessions: 2 ECTS |
| **Office and hour of attention** | Robotics Lab (2.04-EPS building). Monday 10:00-11:00 AM. |

# SYSTEMS INTEGRATION II 2016-17

| Professor/a (s/es) | Adreça electrònica professor/a (s/es) | Crèdits | Horari de tutoria/lloc |
|---|---|---|---|
| TRESANCHEZ RIBES, MARCEL | mtresanchez@diei.udl.cat | 7,2 | Wensday 17-18h, 2.07 EPS |

## Subject's extra information

It is mandatory to have coursed previously Systems Integration I subject. Also, it is very recommended to extend this optative subject to the third part (Systems Integration III) due to the complementary and shared content.

As the previous part of this optative module, to follow this subject properly previous knowledge on C programming, digital electronics design and signal processing are recommended.

## Learning objectives

Acquire knowledge to be able to develop integrated systems with more complexity and automation.

Learn to develop embedded low-cost integrated systems for signal audio processing.

Master the peripheral interfaces for advanced communication of multimedia embedded devices.

Know how to integrate wireless transceivers for remote automation and control systems.

Understanding advanced techniques for the developement of low cost integrated systems.

Learn how to build control systems devices based on digital microelectronics.

## Competences

**Strategic Competences of the UdL**

> **UdL2**. Command of a foreign language.

> **UdL3**. Mastering ICT's.

**Cross-disciplinary competences**

> **EPS4**. To have the skills required to undertake new studies or improve the training with self-direction.

> **EPS9**. Capacity for unidisciplinary and multidisciplinary teamwork.

**Specific competences**

> **GEEIA21**. Knowledge of the basics and applications of the digital electronics and microprocessors.

> **GEEIA25**. Knowledge and capacity for modelling and simulation of systems.

> **GEEIA27**. Knowledge of principles and applications of robotic systems.

## Subject contents

1. Introduction to USB hardware

2. USB OTG interfaces on microcontrollers

3. Introduction to Keil MDK-ARM

4. Digital audio processing on embedded systems

5. MMC and SD Card interfaces

6. Wireless connectivity on embedded systems

## Methodology

Learning systems integration will be carried out by STMicroelectronics development tools, mainly with STM32F4-Discovery that includes an ARM Cortex-M high performance 32 bit microcontroller.

Development kits will be provided entirely by the school where each student will work individually.

The student assessment will take place continuously and will be based on the weighted evaluation of the reports of the activities undertaken throughout the course. The practical exercices, as far as possible, have to be carried out individually both in class and at home. These practices will be based on microcontroller programming using C language and application digital integrated circuits on microcontrollers.

## Development plan

| Week | Description | Classroom activity | Clasroom hours | Student workload hours |
|------|-------------|--------------------|----------------|------------------------|
| 1 | Presentation | Masterclass | 2 | 0 |
| 1-2 | Lesson 1: Lecture | Masterclass | 4 | 5 |
| 2 | Lesson 1: Exercices | Exercices | 2 | 4 |
| 3 | Lesson 2: Lecture | Masterclass | 4 | 6 |
| 4 | Lesson 2: Lecture/Experimental | Experimentation | 2 | 3 |
| 4-5 | Lesson 2: Practices | Practical exercice 1 | 4 | 8 |
| 5 | Lesson 3: Lecture/Experimental | Experimentation | 2 | 4 |
| 6 | Lesson 4: Lecture | Masterclass | 4 | 6 |
| 7 | Lesson 4: Experimental | Experimentation | 4 | 5 |
| 8 | Lesson 4: Practices | Practical exercice 2 | 4 | 10 |
| 9 | Evaluation exam 1 | Practices doubts | 2 | 0 |
| 10 | Lesson 4: Practices | Practical exercice 2 | 2 | 5 |
| 10-11 | Lesson 5: Lecture/Experimental | Experimentation | 4 | 6 |
| 11 | Lesson 6: Lecture/Experimental | Experimentation | 2 | 4 |
| 12 | Lesson 6: Exercices | Exercices | 2 | 6 |

| Week | Description | Classroom activity | Clasroom hours | Student workload hours |
|------|-------------|--------------------|----------------|------------------------|
| 12-14 | Final project | Practical exercice 3 | 10 | 12 |
| 15-16 | Evaluation exam 2 | Practices doubts | 2 | 0 |
| 17 | Tutorials | Tutorials | 2 | 0 |
| 18 | make-up exam | Evaluation | 2 | 6 |

## Evaluation

The workload assesed consist in the enforcement of three main consistent practical works based on the developement of integrated applications using microcontrollers. Specifically, the issues will be:

**P1: Design an USB mouse peripheral with an accelerometer**

**P2: Implementaion of an integrated system for audio processing**

**P3: Developement a bidirectional wireless walkie-talkie device**

At this way, the course qualification (NC) will be calculated as:

**NC = P1*0.3 + P2*0.3 + P3*0.4**

If **NC** is lower than 5.0 there will be an optional exam with a weight of 8 points, the final mark will be computed with:

**NF** = **NR** + ( **NC** x **0,2** )

## Bibliography

- Reference manuals and application notes from manufacturers

- STM32F4Discovery from STMicroelectronics
http://www.st.com/web/catalog/tools/FM116/SC959/SS1532/PF252419

- STMicroelectronics development boards
http://www.st.com/web/catalog/tools/FM116/SC959/SS1532/PF252419
http://www.st.com/web/catalog/tools/FM146/CL1984/SC720/SS1462/PF255417

- Jan Axelson (2009) USB Complete: The Developer's Guide, Fourth Edition, Lakeview Research LLC. Madison, WI 53704.

- Jonathan W Valvano (2015) Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers , Fifth Edition. ISBN: 978-1477508992

- Joseph Yiu (2013) The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors. Elseiver. Cambidge, UK.

- Donald Reay (2015) Digital Signal Processing and Applications Using the Arm Cortex M4. Wiley. ISBN: 978-1118859049.

- Warwick A. Smith (2009) C Programming for Embedded Microcontrollers. Publitronic-Elektor. ISBN: 978-0905705804.