Universitat de Lleida

DEGREE CURRICULUM

SYSTEMS INTEGRATION II

Coordination: TRESÁNCHEZ RIBES, MARCEL

Academic year 2019-20

Subject's general information

<table>
<tr><td>Subject name</td><td>SYSTEMS INTEGRATION II</td></tr>
<tr><td>Code</td><td>102131</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Automation and Industrial Electronic Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><th>Number of credits</th><td>3</td><td>3</td></tr>
<tr><th>Number of groups</th><td>1</td><td>1</td></tr>
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</td></tr>
<tr><td>Coordination</td><td>TRESÁNCHEZ RIBES, MARCEL</td></tr>
<tr><td>Department</td><td>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Total load: 150h
- 60h of lectures (40%)
- 90h of independent student work (60%)</td></tr>
<tr><td>Language</td><td>Speaking: As required (Catalan, Spanish or English).
Materials and resources: English.
Student workload: English.</td></tr>
<tr><td>Distribution of credits</td><td>Theoretical sessions: 2 ECTS
Experimental training sessions: 2 ECTS
Practical sessions: 2 ECTS</td></tr>
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Teaching staff

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
TRESÁNCHEZ RIBES, MARCEL	mtresanchez@diei.udl.cat	7,2	

Subject's extra information

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

Learning the internal working of a high-performance microcontroller of 32 bits.

Being able to program any peripheral of a 32-bit microcontroller for an automated specific task.

Knowing the ARM Cortex-M architecture and its application in microcontrollers of 32 bits.

Understanding the operation with sensors, MEMS sensors and actuators systems by means of low cost microcontrollers.

Learning the use of the main intra-board comunication busses for integrated circuits.

Acquire necessary knowledge to be able to design and program a intelligent integrated system.

Significant 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 embedded systems
2. Working principles of a microcontroller
3. ARM Cortex-M architecture
4. STM32F4 microcontrollers
5. STM32F4Discovery kit
6. STM32F407VGT6 MCU
7. CMSIS files & libraries
8. Digital I/O

9. System Clock Configurations

10. System timer (SysTick)

11. The USART Peripheral

12. Interrupts (NVIC) and EXTI

13. I2C communication

14. SPI communication

15. MCU Timers

16. Analog I/O (ADC and DAC peripherals)

17. SWV and ITM Debugging

Methodology

The subject will be developed by conducting several experimental works to be carried out in the electronics lab 2.05 (2nd floor) of the Polytechnic School (EPS).

Learning systems integration will be carried out by STMicroelectronics development tools, mainly with STM32F4 - Discovery.

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

Practical exercises will be based on microcontroller programming using C language development environments.

The sessions will be divided into three consecutive stages repeated for each of the contents of the subject:

- Sessions of theory (classroom): Preliminary theoretical concepts.
- Experimental training sessions (electronics lab): Acquire skills with teacher support.
- Practice sessions (electronics lab) : Individual student work with exercises and activities.

Development plan

Week	Description	Classroom Activity	Classroom Hours	Student workload Hours
1	Presentation	Masterclass	2	0
	Lesson 1: Lecture	Masterclass	2	3
2	Lesson 2: Lecture	Masterclass	2	3
2	Lesson 3: Lecture	Masterclass	2	3
3	Lesson 4: Lecture	Masterclass	2	5

Week	Description	Classroom Activity	Classroom Hours	Student workload Hours
3-4	Lesson 5-6: Lecture/Experimental	Experimentation	4	4
4	Lesson 7-8: Experimental	Experimentation	2	6
5	Lesson 8: Practices	Practical exercise 1	2	5
5-6	Lesson 9-10: Experimental	Experimentation	4	3
6	Lesson 11: Experimental	Experimentation	2	4
7	Lesson 12: Experimental	Experimentation	4	2
8	Lesson 12: Practices	Practical exercise 2	2	8
8	Lesson 13: Experimental	Experimentation	2	2
9	Evaluation exam 1	Practices doubts	2	0
10	Lesson 14: Experimental	Experimentation	2	2
10	Lesson 12-14: Practices	Practical exercise 3	2	8
11	Lesson 15-16: Lecture/Experimental	Experimentation	4	5
12	Lesson 15-16: Practices	Practical exercise 4	2	8
12	Lesson 17: Experimental	Experimentation	2	3
13-14	Final project	Practical exercise 5	8	10
15-16	Evaluation exam 2	Practices doubts	2	0
17	Tutorials	Tutorials	2	0
18	make-up exam	Evaluation	2	6

Evaluation

The course assessment will take place continuously and be based on the weighted evaluation of the reports of the activities undertaken throughout the course.

These experimental exercises should be carried out individually. Each student will have available the electronics devices required to work with the proposed exercises at home and at hours of electronics laboratory.

The practical exercises are composed for four practical tasks and one final project. The difficulty of the activities will be increased as regarding on the punctuation weight of final qualification: 0.5, 1, 1.5, and 2 points respectively. Finally, there will be a final project that will be focused on the global knowledge acquired. This project will be carried out in workgroups and will have a weight about final qualification of 50% (5 points).

Bibliography

STM32 32-bit ARM Cortex MCUs

http://www.st.com/web/en/catalog/mmc/FM141/SC1169

STM32F4Discovery - STMicroelectronics

http://www.st.com/web/catalog/tools/FM116/SC959/SS1532/PF252419

Atollic TrueSTUDIO

http://www.atollic.com/index.php/truestudio

ARM Cortex-M architecture

http://www.arm.com/products/processors/cortex-m/