COURSE SYLLABUS

Academic Year: 2020/2021

Identification and characteristics of the course			
Code	501107	ECTS Credits	6
Course title (English)	**INDUSTRIAL COMPUTING**		
Course title (Spanish)	Informática Industrial		
Degreeprograms	Degree in Electronics Engineering and Automation (Industrial Branch)		
Faculty/School	Industrial Engineering School		
Semester	7th	Course type (compulsory/optional)	Obligatory
Module	Specific Technology of Industrial Electronics and Automation		
Subject matter	Automation and Control		
Lecturer/s			
Name	Room	E-mail	Web page
José Ignacio Suarez Marcelo	D1.16	jmarcelo@unex.es	CVUEX
Subject Area	Systems Engineering and Automation		
Department	Electrical, Electronics Engineering and Automation		
Coordinator (Only if there is more than one lecturer)			

Competencies*(see table at http://bit.ly/competenciasGrados)

Basic Competences	Check With an "X"	General Competences	Check With an "X"	Transversal Competences	Check With an "X"	Specific Competences Basic Formation	Check With an "X"	Specific Competences Common to the Industrial Branch	Check With an "X"	Specific Competences Specific Technology	Check With an "X"
CB1	X	CG1	X	CT1	X	CEFB1		CECRI1		CETE1	
CB2	X	CG2	X	CT2	X	CEFB2		CECRI2		CETE2	
CB3	X	CG3	X	CT3	X	CEFB3		CECRI3		CETE3	
CB4	X	CG4	X	CT4	X	CEFB4		CECRI4		CETE4	
CB5	X	CG5	X	CT5	X	CEFB5		CECRI5		CETE5	
		CG6	X	CT6	X	CEFB6		CECRI6		CETE6	
		CG7	X	CT7	X			CECRI7		CETE7	
		CG8	X	CT8	X			CECRI8		CETE8	
		CG9	X	CT9	X			CECRI9		CETE9	
		CG10	X	CT10	X			CECRI10		CETE10	X
		CG11	X					CECRI11		CETE11	
		CG12						CECRI12		CETFG	

The following ENAEE transversal competences are also applied:

- CTE1, CTE2 and CTE3.

* The sections concerning competencies, course outline, teaching activities, teaching methodology, learning outcomes and assessment methods must conform to those included in the ANECA verified document of the degree program.

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Contents
Course outline*
Embedded control systems: architecture and programming
Course contents

THEORY

BLOCK I – EMBEDDED CONTROL SYSTEMS: ARCHITECTURE AND PROGRAMMING

I.1 – Introduction to Embedded Systems.

I.2 – Inside the "Brain" of an Embedded System.

I.3 – Instruction Execution.

I.4 – Communication with Outer World.

BLOCK II –MICROCONTROLLERS PROGRAMMING: BASIC RESOURCES

II.1 – Internal Architecture.

II.2 – Memory.

II.3 – In-Circuit Programming and Debugging.

II.4 – Oscillator.

II.5 –Instruction Set.

II.6 – Input/Output Ports.

II.7 – Timers.

II.8 – Interrupts.

II.9 – Reset.

BLOCK III – MICROCONTROLLERS PROGRAMMING: ADVANCED RESOURCES

III.1 – Data Converters.

III.2 – Signal Generation and Control Modules.

III.3 – Communication Modules.

III.4 – Watchdog Timer and Sleep Mode.

PRACTICAL ACTIVITIES

The development of the practice (lab) sessions will be continuous with increasing difficulty. Several practice sessions will be carried out which will cover the following concepts:

- Basics of assembler language programming (assembler & linker programs, directives, instructions, comments, flow charts, etc.).

- Programming with the Integrated Development Environment (IDE).
- Management of microcontroller basic resources.
- Usage of I/O techniques and addressing modes.
- Usage of manufacturer datasheets.

And more precisely:

1. Assembly language programming with Microchip's MPASM and MPLAB X Integrated Development Environment. Creating a project. Simulatorfundamentals (6.5 h).
2. Control of the primary oscillator, basic I/O, pushbuttons and switch debouncing techniques.(6 h).
3. Table reading and implementation using "Computed GOTO" method(2 h).
4. Timers and Interrupts (4 h).
5. Other I/O interfaces (4 h).

Educational activities *

Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
I.1	3	2						1
I.2	5.5	1		1.5				3
I.3	2	1						1
I.4	5	1		1				3
II.1	2	1						1
II.2	6	1		2				3
II.3	7	2		2				3
II.4	7	2		2				3
II.5	5	1		2				2
II.6	7	2		2				3
II.7	8	2		2				4
II.8	4	1		2				1
II.9	4	1		2				1
III.1	8	2		2				4
III.2	8	2		2				4
III.3	2.5	1						1.5
III.4	2	1						1
Team work	54	3					3	48
Assessment **	10	3						7
TOTAL ECTS	150	30	0	22.5	0	0	3	94.5

L:Lectures (100 students)
HI: Hospital internships (7 students)
LAB:Lab sessions or field practice (15 students)
COM:Computer room or language laboratory practice (30 students)
SEM:Problem-solving classes, seminars or case studies (40 students)
SGT:Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS:Personal study, individual or group work and reading of bibliography

** Insert as many rows as necessary. For instance, you can include one row for a partial exam and another for the final exam.

Teaching Methodology*

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Check with an "X" the ones used
1. Explanation and discussion of contents	X
2. Solution, analysis and discussion of examples and exercises	
3. Oral presentation of assignments	X
4. Development of practical cases in labs, computer rooms, seminars, etc.	X
5. Attention to the student and advice of the assignments in small groups	X
6. Search of information prior to the explanation of the contents of an unit or search of complementary information once the activities of a unit have been developed	X
7. Elaboration of assignments either individually or in groups	X
8. Study of each unit: study of contents, preparation of exercises or cases, preparation of the final exam, etc.	X

The subject will be developed according to the following activities:

- **Big-Group Lectures:** (ENAEE transversal competences: CTE[2]).
  - Lectures of theoretical contents: with a lot of slides and examples to clarify the subject concepts. The student will be **continuously involved** in such a way to make him **tothink and question**, with a critical attitude, all the theoretical concepts.
  - Lectures of practical contents: some lectures will be periodically dedicated to help students to make their team work. Some practical orientations will be given to help students to carried out the electronic design of an embedded control system.
- **Laboratory sessions:**(ENAEE transversal competences: CTE[1, 2]).
  - Students will use computer tools for learning the process of programming an embedded control system based on a microcontroller. The learning will be continuous and from less to greater difficulty. Practical concepts, complementary to those seen in theory, will be studied.
- **Monitoring sessions:**(ENAEE transversal competences: CTE[2, 3]).
  - They will be used for monitoring the students team work, clearing up some doubts and proposing some solutions or alternatives.
- **Practical team work:**(ENAEE transversal competences: CTE[1, 2, 3]).
  - In small groups, students will develop a **design project of an embedded control system**, based on some **technical requirements** and under the supervision of the teacher. They will apply knowledge learnt in theoretical and practical sessions and will develop the profession skills. The methodology will be based on **Project Based Learning (PBL)**, which is very appropriate for the student formation and their future work in a company. Students will make an **oral presentation** of the project and a **practical demonstration** of the system operation which must show it meets the given requirements. Students will also deliver a **technical report** which summarizes the adopted solutions and a description of the development of the work.

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Learning outcomes *

- Knowledge and skills related to the fundamentals of designing embedded control systems based on microcontrollers.
- Knowledge of the fundamentals of microcontrollers and their basic architecture.
- Knowledge and skills related to microcontroller programming in assembly language and the associated tools.
- Knowledge of basic concepts of digital computers architecture.
- knowledge and skills related to basic I/O programming techniques used in digital computers.

Assessment methods *

Assessment criteria (CR)

CR1: To understand and apply basic concepts of computers architecture: Von Neumann & Harvard architectures, I/O techniques, pipelining, microprocessor & microcontroller differences, etc. (related to competences CB[1,3,4&5], CG[1,3,5,7,8&11] and CT[1&10]).

CR2: To understand the fundamentals of microcontrollers: basic architecture, programming, etc. (related to competences CB[1,3,4&5], CG[1,3,5,7,8&11] and CT[1&10]).

CR3: To show skills for programming in assembler language by using the software and hardware tools and the manufacturer datasheets (related to competences CB[1,2,3,4&5], CG[1,3,5,7,8&11], CT[1,4,5,7&10] and CETE[10]).

CR4: To show skills for understanding and carrying out design projects of embedded control systems based on microcontrollers (related to competences CB[1,2,3,4&5], CG[1,2,4,6,7,8&11], CT[2,4,8&10], CETE[10] and ENAEE transversal competences: CTE[1, 2, 3]).

CR5: To show skills for planning and allocating the tasks in a team work by presenting and submitting results and knowledge (related to competences CB[2,3,4&5], CG[1,2,4,5,6,8,9,10&11], CT[2,3,5,6,7,8,9&10], CETE[10] and ENAEE transversal competences: CTE[1, 2]).

Assessment activities

Among the assessment activities included in the formative program, in this course the following are used:

	Range fixed	Ordinary call	Extraordinary call	Global assessment
1. Final exam and/or partial examinations.	0%–80%	40%	40%	50%
2. Practical activities in: classroom, lab, computers room, visits, etc.	0%–50%	20%	20%	50%
3. Solution and delivery of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups.	0%–50%	40%	40%	-
4. Active participation in the learning activities.	0%–10%	-	-	-
5. Attendance to the learning activities.	0%–10%	-	-	-

Description of the assessment activities

Continuous Evaluation

Examination Activity 1 (EA1)

- **Oral defence and practical demonstration of the team work (CR[3,4&5])**
  - 40%, recoverable grade. **Rating (R1)**from 0 to 10.
  - In the practical demonstration, students will have up to 3 attempts for demonstrating a correct operation (failures can be corrected between each attempt). At all times the teacher can ask questions to any member of the team.
  - **EA1 grade = 0,4 x R1**

Examination Activity 2 (EA2)

- **Delivery of a laboratory report and the program source codes (CR[1,2&3])**
  - 20%, non-recoverable grade. **Rating (R2)** from 0 to 10, weighed by **percentage of the student attendance (PA)**to laboratory sessions. R2 will be computed as the average grade of all delivered reports. Each individual report will be rated as 10 (PASS) or 0 (FAIL).
  - **EA2 grade = 0,2 x R2 x PA**

    Example:

    Average grade of reports (R2) = 7
    Percentage of attendance (PA) = 60%.
    AE2 grade = 0,2 x 7 x 0,6 = 0,84
  - The attendance control will be carried out by taking student signed register in every laboratory session. The unsigned registers cannot be recovered.

Examination Activity 3 (EA3)

- **Delivery of a team work report (CR[1,2,3,4&5])**
  - 40%, recoverable grade. **Rating (R3)** from 0 to 10.
  - **EA3 grade = 0,4 x R3**

Final Grade

- **Final Grade = EA1 + EA2 + EA3**

Global Evaluation

Examination Activity 1 (EA1)

- **Exam with contents related to theory and practice (CR[1&2])**
  - 50%. **Rating (R1)** from 0 to 10. Minimum rating 5.
  - **EA1 grade = 0,5 x R1 (if R1 is equal or greater than 5).**
  - **EA1 grade = 0 (if R1 is less than 5).**

Examination Activity 2 (EA2)

- **Practical exam with the laboratory equipment (CR[3])**
  - 50%. **Rating (R2)**from 0 to 10. Minimum rating 5.
  - **EA2 grade = 0,5 x R2 (if R2 is equal or greater than 5).**
  - **EA2 grade = 0 (if R2 is less than 5).**

Final Grade

- **Final Grade = EA1 + EA2**

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Bibliography (basic and complementary)

Basic Bibliography:

[1] Subject slides.

[2] Microcontroller manufacturer datasheets.

Complementary Bibliography:

[3] P. De Miguel Anasagasti, "*Fundamentos de los Computadores*". Paraninfo (2004).

[4] J. M. Angulo Usategui e I. Angulo Martínez, "Microcontroladores PIC. Diseño Práctico de Aplicaciones (1ª parte)". McGraw-Hill (2007). ACCESIBLE THROUGH UEX DIGITAL LIBRARY.

[5] J. M. Angulo Usategui, S. Romero Yesa e I. Angulo Martínez, "Microcontroladores PIC. Diseño Práctico de Aplicaciones (2ª parte)". McGraw-Hill (2006).

[6] T. Wilmshurst "Designing Embedded Systems with PIC Microcontrollers. Principles and Applications". Newnes (2007).

[7] D. G. Alciatore y M. B. Histand, "*Introducción a la Mecatrónica y los Sistemas de Medición*". McGraw-Hill (2007).

[8] J. M. Angulo Usategui, S. Romero Yesa e I. Angulo Martínez, "*Microbótica*". Paraninfo (1999).

Other resources and complementary materials

Material resources

- Notes taken down in lessons and other documents provided in theoretical and practical sessions.

Web resources

- www.microchip.com (PIC microcontrollers manufacturer web page)
- Keywords to look for in the Internet (Spanish/English):
  - "Arquitectura Harvard", "Harvard Architecture".
  - "Microcontroladores PIC", "PIC Microcontrollers".
  - "SistemasEmpotrados", "Embedded Systems".