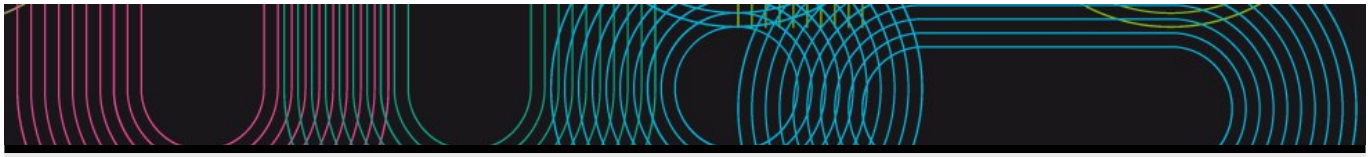

IDENTIFYING DATA				
Design of Industrial Electronic Systems				
Subject	Design of Industrial Electronic Systems			
Code	V04M141V01218			
Study programme	(*)Máster Universitario en Enxeñaría Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Nogueiras Meléndez, Andres Augusto			
Lecturers	Nogueiras Meléndez, Andres Augusto Soto Campos, Enrique			
E-mail	aaugusto@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The objective of this course is to provide the students with the theoretical and practical fundamental knowledge needed to design, select and implement industrial electronic systems. In case of any discrepancy between this translation of the guide and the Spanish version, the valid one is the Spanish version.			

Competencies	
Code	
C1	CET1. Project, calculate and design products, processes, facilities and plants.
C5	CET5. Technically and economically manage projects, installations, plants, companies and technology centers.
C18	CTI7. Ability to design electronic and industrial instrumentation systems.
D1	ABET-a. An ability to apply knowledge of mathematics, science, and engineering.
D3	ABET-c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D9	ABET-i. A recognition of the need for, and an ability to engage in life-long learning.

Learning outcomes	
Expected results from this subject	Training and Learning Results
An ability to specify power electronic systems	C1 C18 D1
An ability to specify digital electronic systems based on microcontrollers for industrial control and instrumentation	C1 C18 D1
An ability to specify electronic communication systems for industrial control applications	C1 C18 D1
An ability to specify the analysis, design and deployment of electronic equipment	C5 D3 D9
An ability to apply RAMS technologies to electronic systems	C5 D3 D9

Contents

Topic	
Topic 1: Introduction to Microcontrollers	Introduction. Components of a Microcontroller. Memory Architectures. Instruction Set Architectures. Selection Criteria.
Topic 2: Characteristics of Microcontrollers	Introduction. Overview of the Internal Structure. Arithmetic and Logic Unit. Program Memory. Data Memory. Peripherals. Microchip PIC Microcontrollers.
Topic 3: Programming a Microcontroller. Instruction Set.	Concept of a Computer Program. Abstraction Level. Structure of Instructions. Classification of Instructions. Microchip PIC Instructions.
Topic 4: Microcontroller peripherals	Introduction. Basics of Parallel Input/Output. Information Transfer Control. Input/Output Structures. Basic Structure of a Timer. Timers/Counters in a Microchip PIC. Interruptions. Interruptions in a Microchip PIC.
Topic 5: Industrial Communications	Elements of a Communications System. Selection and Design Parameters: Electromagnetic Spectrum, Time Domain and Frequency. Noise.
Topic 6: Linear and Switch-Mode Power Sources	Introduction to Linear Power Sources. Rectifiers. Rectified Voltage Filtering. Types of Regulators. Parts of a Lineal Regulator. Integrated Lineal Regulators. Introduction to Switch-Mode Power Sources.
Topic 7: AC-to-DC Converters (Rectifiers)	Introduction. Classification. Non-Controlled Rectifiers. Associative Configuration of Rectifiers. Three-Phase Rectifiers. Losses Evaluation.
Topic 8: AC-to-AC Converters	Introduction. Classification. Monophasic AC Regulators. Three-Phase AC Regulators. Control of AC Regulators.
Topic 9: DC-to-AC Converters (Inverters)	Introduction. Classification. Single-Phase Inverters. Three-Phase Inverters. Output Voltage Control. Output Filtering.
Topic 10: DC-to-DC Converters	Introduction. Classification. Step-Down Converter (Buck). Step-Up Converter (Boost). Step-Up-and-Down Converter (Buck-Boost). Control of DC-to-DC Converters.
Topic 11: Uninterrupted Power Sources (UPS)	Introduction. Electric Power Variations. Types of UPS. UPS Selection.
Topic 12: Reliabitily of Electronic Components, Circuits, Systems and Facilities	Introduction and Definitions. Reliability. Unreliability. Other Parameters. Failure Mechanisms of Electronic Components. Reliability of Assembled Components and Connectors. Failure Rate Estimation for Electronic Components. Series and Parallel Systems. Redundant Systems: Types, Calculations of Parameters and Optimization.
Topic 13: Availability, Maintainability and Safety	Introduction and Definitions. Availability of Series and Parallel Systems. Definition and Types of Maintainability. Maintainability Parameters. Maintainability Parameters Determination. Applications and Critical Variables in Circuits, Systems and Facilities. Definitions Related to Safety. Electronic Systems for Safety Related Applications. Safety Standards.
Laboratory Session 1: Programming and Debugging Environment for Microcontrollers	Introduction to the software and hardware tools for the design, simulation and test of applications for the PIC18F microcontroller family.
Laboratory Session 2: Parallel Communications	PIC18F Parallel communications peripheral programming and testing
Laboratory Session 3: Uncontrolled Rectifiers	Half-Wave Mono-Phase Rectifier with R-L Load. Half-Wave Mono-Phase Rectifier with R-L Load and Free-Wheeling Diode. Mono-Phase Rectifier with R-L Load and Free-Wheeling Diode.
Laboratory Session 4: Inverters	Mono-Phase Full-Bridge Inverter Analisis. PWM Modulation.
Laboratory Session 5: DC-to-DC Converter	Step-Down (Buck) Converter Analysis. Continuous and Non-Continuous Operating Mode. Load Regulation.
Laboratory Session 6: Reliability	Analysis of the reliabilty of an electronic circuit according to the MIL-HDBK-217F. Analysis and optimization of reduncant parallel and series systems.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	0	48	48
Master Session	16	0	16
Troubleshooting and / or exercises	10	0	10
Laboratory practises	12	0	12
Autonomous troubleshooting and / or exercises	0	19.5	19.5
Self-assessment tests	4	0	4
Reports / memories of practice	3	0	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description

Introductory activities	Previous preparation of the theoretical sessions: Prior to the start of the theoretical sessions, the students will have available a series of materials that have to prepare, as the sessions will rely on them. Previous preparation of the laboratory sessions: It is mandatory that the students make all the assigned previous tasks prior to access the laboratory. These tasks are intended to greatly improve the laboratory knowledge acquisition. The fulfillment of all the tasks will be taken in consideration in the laboratory session evaluation.
Master Session	These sessions will be held in the rooms and dates fixed by the head office of the school. They will consist in an oral explanation by the professor of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions.
Troubleshooting and / or exercises	During these sessions, in the classroom, interleaved with the lectures, the professor will proceed to solve examples and/or exercises that properly illustrate the problems to solve. As long as the number of participants in the classroom allows, active participation will be promoted.
Laboratory practises	Laboratory sessions will be held in the time schedule established by the school's head office. Students will work in groups of two students each. The sessions will be supervised by a professor, who will control the assistance and will also evaluate the harnessing of it. At the end of each laboratory session each group will deliver the corresponding score sheets.
Autonomous troubleshooting and / or exercises	Self study and review of the theoretical sessions for knowledge consolidation: The student must study, in a systematic time schedule, after each lecture session, in order to dissipate any doubts. Any doubts or unsolved questions will have to be exposed to the professor as soon as possible in order to enhance the feedback of the learning process.

Personalized attention

Methodologies	Description
Laboratory practises	
Autonomous troubleshooting and / or exercises	

Assessment

	Description	Qualification	Training and Learning Results	
Self-assessment tests	Continuous Assessment: This assessment is integrated by three individual exams, each one of them related to a block of topics. These individual exams will be held by electronics means with an online immediately assessment, along lecture time hours. The exam will be a combination of any of the following types of exercises: - Test Questions - Short Answer Questions - Analysis Problems - Practical Cases Each test will have a maximum value of 10 points and the final score will be the average value of the three test. In order to have a final score, it is necesary that the minimum score in each test will be 2 points out of 10. If one of the test have a score of less than two points, this will be the final score.	70	C1	D1 D9
Reports / memories of practice	The laboratory sessions will be evaluated in a continuous way, on each session. The applied criteria are: - A minimum attendance of 80% - Punctuality - Previous task preparation of the sessions - Make the most of the session The practical sessions will be held in groups of two students. The documents of the practices will be available prior to the sessions. The students will fill a report, that will be delivered when the session ends. This report serves to justify both the attendance and how they have done the work asked for.	30	C18	D1

Other comments on the Evaluation

Guidelines for progress and recovery:

If a student don't pass the course on the first call for exams, a second call is made. The grade of this second call will be the sum of:

1 - The grade from the laboratory sessions, with a weight of 30% of the final grade.
2 - The grade of the individual exam made in this second call, with a weight of 70% of the final grade.

In order to pass the final score achieved must be equal or great then 5 points out of 10.

Once finished the current academic period, the final grade looses its validity. The grade achieved in the self-assessment and in the laboratory sessions will be valid, unless the student wants to repeat them.

Students who waive the continuous assessment must take a written exam, on the day and time established by the school direction board and a specific laboratory test, on the day and time when the professors and the laboratory are available.

Both exams will be evaluated on a maximum of 10 points each. The final grade will be the average of the two exams, and in order to pass the course it is necessary to achieve a grade equal or higher than 5 points on the written exam and on the laboratory test.

Ethical Commitment:

It is expected that the student should present appropriate ethical behavior. In case of detecting a non-ethical behavior (for instance: copying, plagiarism, unauthorized electronic devices use), shall be deemed that the student is not eligible to overcome. In this case, the overall rating in the present academic year will be the lowest one (0.0).

The use of any electronic device is not allowed during the assessment tests. Exceptions will be specifically stated for those authorized. Enter a not authorized electronic device in the test room will be considered reason for not overcoming the matter in the present academic year, and the overall grade will be the lowest one (0.0).

Sources of information

Basic Bibliography

Valdés Pérez, F. y Pallás Areny, R., **Microcontroladores. Fundamentos y Aplicaciones con PIC.**, Marcombo, 2006

Blake, R., **Electronic Communication Systems**, Delmar Thomson Learning, 2001

Rashid, M. H., **Electrónica de Potencia**, Pearson-Prentice Hall, 2015

Complementary Bibliography

Ballester, E. y Piqué, R., **Electrónica de Potencia: Principios Fundamentales y Estructuras Básicas**, Marcombo, 2011

Barrado Bautista, A. y Lázaro Blanco, A., **Problemas de Electrónica de Potencia**, Pearson-Prentice Hall, 2012

Creus Solé, A., **Fiabilidad y Seguridad: Su aplicación en procesos industriales, 2ª Ed.**, Marcombo, 2005

MIL-HDBK-338B: Electronic Reliability Design Handbook, 1998

Kales, P., **Reliability: for technology, engineering, and management**, Pearson-Prentice Hall, 1998

Rashid, M. H., **Power Electronics. Circuits, Devices, and Applications**, Pearson, 2014

Recommendations

Other comments

It is very important that the students keep updated the profile in the FAITIC platform. All communications related with this course will be made through this platform. All individual communications will be made through the email listed in this platform.

The students can solve doubts related with the laboratory previous activities in the personal attention hours (tutoring time), or by any other contact procedure available in FAITIC.

The students must meet the deadlines for all the activities.

All the achieved results must be justified, in any of the exams or activities. No result will be considered valid unless an appropriate explanation of how it was found is provided. The selected method for solving a problem is considered when grading the solution.

When writing the solutions and answers in reports and tests, avoid spelling mistakes and unreadable symbols.

Exams lacking some of the sheets will not be graded.

Use of cell phones, notes or books is forbidden during exams.