UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: DIGITAL ELECTRONIC SYSTEMS
Code: 59621
Type: CORE COURSE
ECTS credits: 6
Degree: 385 - DEGREE IN TELECOMMUNICATI TECHNOLOGY ENGINEERING
Academic year: 2021-22
Center: 308 - SCHOOL POLYTECHNIC OF CUENCA
Group(s): 30
Year: 2
Duration: C2
Main language: Spanish
Second language:
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **ESTEFANIA PRIOR CANO** - Group(s): **30**

Building/Office	Department	Phone number	Email	Office hours
2.11	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES		Estefania.PriorCano@uclm.es	

Lecturer: **ROBERTO ZANGRONIZ CANTABRANA** - Group(s): **30**

Building/Office	Department	Phone number	Email	Office hours
E. Politécnica Cuenca (0.03)	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES	926054061	roberto.zangroniz@uclm.es	Office hours will be posted on the bulletin board

2. Pre-Requisites

It is recommended that students have previously followed and passed the courses “Fundamentals of Mathematics I”, “Fundamentals of Mathematics II”, “Fundamentals of Mathematics III”, “Components and Circuits”, “Electronics Devices”, “Computing”, “Programming”, and “Electronics I”.
More precisely, students are required to undersand and handle basic concepts about numerical methods, electronics components, analysis and design of electronic circuits, C language, and programmable devices

3. Justification in the curriculum, relation to other subjects and to the profession

Electronic systems is a key technology of Telecommunications engineering.

Starting from electronics foundations ("Components and Circuits" and "Electronic Devices"), Digital Electronic Systems are studied from the point of view of software ("Computing" and "Programming") and hardware ("Electronics I"). This course involves the integration of previous acquired knowledge and its particularization to embedded systems.

The knowledge gained in this course will be required to understand more advanced concepts in upper subjects of the degree program, such as "Audiovisual Equipment in Medicine", "Sensors and Wireless Sensor Networks", "Electronics Technology", and "Interdisciplinary Applications in Telecommunications"

4. Degree competences achieved in this course

Course competences

Code	Description
E07	The ability to use communication and computer applications (office automation, databases, advanced calculation, project management, visualisation, etc.) to support the development and operation of telecommunication and electronic networks, services and applications.
E08	The ability to use computer tools to search for bibliographic resources or for information related to telecommunications and electronics.
E14	The ability to analyse and design combinational and sequential circuits, synchronous and asynchronous, and use of microprocessors and integrated circuits.
G01	Knowledge of Information and Communication Technologies (ICT).
G02	Correct, oral and written, communication skills.
G06	Knowledge of basic subjects and technologies, enabling students to learn new methods and technologies, as well as providing great versatility to adapt to new situations
G12	The ability to work in a multidisciplinary group and in a multilingual environment and to communicate, both in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics
G13	The ability to look for and understand information, wether technical or commercial in different sources, to relate and structure it to integrate ideas and knowledge. Analysis, synthesis and implementation of ideas and knowledge.

5. Objectives or Learning Outcomes

Course learning outcomes

Description
Comparison between microprocessors and / or microcontrollers based on their characteristics.
Compression, analysis and synthesis of technical documentation and mastery of specific vocabulary.
Application of software design and debugging methodologies.
Distinction of the different applications of digital electronic systems.
Design of simple systems based on microcontroller.

Design and use of external resources expansion in sufficiently simple situations.
Familiarization in the use of commercial circuits, interpreting the information provided by the manufacturers.
Realization of assemblies and measurements of circuits in the laboratory.
Correct use of oral and written expression to convey ideas, technologies, results, etc.
Use of ICT to achieve the specific objectives set in the subject.
Use of high-level languages to perform programming (in real time, concurrent, distributed and event-based) of a microcontroller.

6. Units / Contents

Unit 1: Overview
- **Unit 1.1** Embedded systems
- **Unit 1.2** Microprocessor (MPU)/microcontroller (MCU)
- **Unit 1.3** MCU based embedded systems
- **Unit 1.4** Motivation

Unit 2: Emdedded C
- **Unit 2.1** Compilation model
- **Unit 2.2** Integer data types
- **Unit 2.3** Bitwise operators
- **Unit 2.4** Volatile qualifier
- **Unit 2.5** Pointers

Unit 3: ARM Cortex-M architecture
- **Unit 3.1** Core, processor, and microcontroller
- **Unit 3.2** Cortex-M3 processor
- **Unit 3.3** Memory map
- **Unit 3.4** Bus protocols

Unit 4: Exceptions
- **Unit 4.1** Timeline
- **Unit 4.2** Priority and service
- **Unit 4.3** Data sharing

Unit 5: Integrated peripherals
- **Unit 5.1** General purpose input/output
- **Unit 5.2** Timer
- **Unit 5.3** Analog-to-digital converter
- **Unit 5.4** Universal synchronous/asynchronous receiver/transmitter
- **Unit 5.5** Serial peripheral interface
- **Unit 5.6** Inter-integrated circuit interface

Unit 6: [LAB]
- **Unit 6.1** Introduction to development enviroment
- **Unit 6.2** Digital input/output
- **Unit 6.3** Analog input/output
- **Unit 6.4** Timing
- **Unit 6.5** Communication

Unit 7: [PROJECT]
- **Unit 7.1** Design and coding

ADDITIONAL COMMENTS, REMARKS

Hardware and software tools, available in the electronics laboratory, will be used

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E14 G01 G02 G06	0.8	20	N	-	Teaching of theoretical content
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	E14 G02 G06 G12	0.64	16	N	-	Solving of examples and exercises
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	E07 E08 E14 G01 G02 G06 G12 G13	0.8	20	N	-	Conducting of lab sessions
Writing of reports or projects [OFF-SITE]	Problem solving and exercises	E07 E08 E14 G01 G02 G06 G12 G13	1	25	N	-	Study and preparation of homework activities
Study and Exam Preparation [OFF-SITE]	Practical or hands-on activities	E07 E08 E14 G01 G02 G06 G12 G13	0.4	10	N	-	Study and preparation of lab activities
Study and Exam Preparation [OFF-SITE]	project-based learning	E07 E08 E14 G01 G02 G06 G12 G13	2.2	55	N	-	Study and preparation of a singular project
Other on-site activities [ON-SITE]	Assessment tests	E07 E08 E14 G01 G02 G06 G12 G13	0.08	2	Y	Y	For each lab activity, oral defense of the solution achieved, and submission of the code developed. Each activity can be individually recovered in the above indicated manner. A final examination may be required
							For each homework activity, oral defense of the solution achieved,

Other on-site activities [ON-SITE]	Assessment tests	E07 E08 E14 G01 G02 G06 G12 G13	0.02	0.5	Y	N	and submission of the code developed. Each activity can be individually recovered in the above indicated manner
Other on-site activities [ON-SITE]	Assessment tests	E07 E08 E14 G01 G02 G06 G12 G13	0.02	0.5	Y	Y	Oral defense of the carried-out project, and submission of the code developed. This activity can be recovered in the above indicated manner
Individual tutoring sessions [ON-SITE]		E07 E08 E14 G01 G02 G06 G12 G13	0.04	1	N	-	Resolution of questions and review of marks
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Test	40.00%	40.00%	Lab. The work developed, the defense of the solution achieved, and the time spent will be considered
Test	60.00%	60.00%	Project (and homework). The work developed, its complexity, and the defense of the solution achieved will be considered.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

To pass the course, it is mandatory to submit and defense all lab activities and obtain a grade higher than 4 points (out of 10) in each compulsory activity. In any case, the final grade must be equal or higher than 5 points (out of 10).
In the case of failing the course, the average mark on the laboratory activities (if it is equal or higher than 5 points) will be maintained for the next offering, unless the student voluntarily decides to retake this set of activities

Non-continuous evaluation:

To pass the course, it is mandatory to submit and defense all lab activities and obtain a grade higher than 4 points (out of 10) in each compulsory activity. In any case, the final grade must be equal or higher than 5 points (out of 10).
In the case of failing the course, the average mark on the laboratory activities (if it is equal or higher than 5 points) will be maintained for the next offering, unless the student voluntarily decides to retake this set of activities

Specifications for the resit/retake exam:

Students will be able to recover the assessable activities

Specifications for the second resit / retake exam:

Students will be able to recover the assessable activities by means of an exam on the date set by the management of the Centre

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Writing of reports or projects [AUTÓNOMA][Problem solving and exercises]	25
Study and Exam Preparation [AUTÓNOMA][Practical or hands-on activities]	10
Study and Exam Preparation [AUTÓNOMA][project-based learning]	55
Other on-site activities [PRESENCIAL][Assessment tests]	2
Other on-site activities [PRESENCIAL][Assessment tests]	.5
Other on-site activities [PRESENCIAL][Assessment tests]	.5
Individual tutoring sessions [PRESENCIAL][]	1

General comments about the planning: The topics will be taught consecutively adapting to the actual calendar that is held in the semester in which the course is located. Planning can be adapted depending on the development of the course

Unit 1 (de 7): Overview

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5

Unit 2 (de 7): Emdedded C

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5

Unit 3 (de 7): ARM Cortex-M architecture

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	3

Unit 4 (de 7): Exceptions

Activities	Hours

Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	4.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	3

Unit 5 (de 7): Integrated peripherals	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	10.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	7
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	14

Global activity	
Activities	**hours**
Other on-site activities [PRESENCIAL][Assessment tests]	2
Study and Exam Preparation [AUTÓNOMA][Practical or hands-on activities]	10
Other on-site activities [PRESENCIAL][Assessment tests]	0.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	16
Study and Exam Preparation [AUTÓNOMA][project-based learning]	55
Class Attendance (theory) [PRESENCIAL][Lectures]	20
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Writing of reports or projects [AUTÓNOMA][Problem solving and exercises]	25
Individual tutoring sessions [PRESENCIAL][]	1
Other on-site activities [PRESENCIAL][Assessment tests]	0.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
STMicroelectronics	STM32F10xxx -Reference Manual, RM0008	STMicroelectronics			2018	
	https://www.st.com/resource/en/reference_manual/cd00171190.pdf					
Stuart R. Ball	Analog Interfacing to Embedded Microprocessor Systems	Newnes		978-0750677233	2004	
Trevor Martin	The Designer's Guide to the Cortex-M Processor Family, 2nd Edition	Newnes		978-0081006290	2016	
Joseph Yiu	The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors	Newnes		978-0124080829	2014	
STMicroelectronics	STM32 Nucleo-64 Boards - User Manual, UM1724	STMicroelectronics			2019	
	https://www.st.com/resource/en/user_manual/dm00105823.pdf					
STMicroelectronics	STM32F103xx - DataSheet, DS13587	STMicroelectronics			2015	
	https://www.st.com/resource/en/datasheet/stm32f103rb.pdf					