COURSE PROGRAM

Academic year: 2023/2024

Identification and characteristics of the course				
Code	401077		ECTS Credits	6
Title	Hardware Systems Description			
Degree	Master in Informatics Engineering (**MUII**) Master in Telecommunications Engineering (**MUIT**) Master in ICT Management (**MUDT**)			
Center	School of technology			
Semester	First	Character	Basic Studies	
Module	Informatics Technology (MUII) Telecommunication Technology (MUIT) Technology Module (MUDT)			
Subject	Informatics and Telecommunication Technologies (MUII) Informatics and Telecommunication Technologies (MUDT) Hardware Systems Description (MUIT)			
Lecturers				
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Subject Area	Architecture and Technology of Computers			
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Name		Office	e-mail	Web page
Ramón Gallardo Caballero		T-10	rgallardo@unex.es	
Subject Area	Electronics			
Department	Electrical, Electronic and Automation Engineering			
Coordinating lecturer	Juan Antonio Gómez Pulido			

Competencies

According to the approved study plan, this course should cover, totally or partially, the following technical competencies and their learning outcomes.

Master in Informatics Engineering (MUII)

Basic competencies:

CB7: Ability to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

CB8: Ability to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

General competencies:

CG4: Capacity for mathematical modeling, calculation and simulation in technological centers and engineering of company, particularly in research, development and innovation tasks in all fields related to Informatics Engineering.

CG10: Ability to apply the principles of economics and the management of human resources and projects, as well as legislation, regulation and standardization of information technology.

Specific competencies:

CETI8: Ability to design and develop systems, applications and IT services in embedded and ubiquitous systems.

Cross-curricular competencies:

CT04: Skills to communicate conclusions, along with the knowledge and the reasons behind them, to specialized and non-specialized audiences, both orally and in writing, in Spanish and English.

CT07: Critical thinking skills and creativity as a means to have the opportunity to be original in the generation, development and / or application of ideas in a research or professional context.

CT11: Autonomous learning capacity.

Master in ICT Management (MUDT)

Basic competencies:

CB7: Ability to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

CB8: Ability to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

Specific competencies:

CETEC03: Knowledge of hardware description languages for high complexity circuits.

Cross-curricular competencies:

CT10 - Ability to adapt to new problematic situations and changes.

CT13 - Organization and planning capacity.

Master in Telecommunications Engineering (MUIT)

Basic competencies:

CB8: Ability to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

General competencies:

CG1: Ability to plan, calculate and design products, processes and facilities in all areas of telecommunications engineering.

CG8: Ability to apply the acquired knowledge and solve problems in new or unfamiliar environments in broader and multidisciplinary contexts, being able to integrate this knowledge.

Specific competencies:

CETT11: Knowledge of hardware description languages for high circuit complexity.

Cross-curricular competencies:

CT04: Skills to communicate conclusions, along with the knowledge and the reasons behind them, to specialized and non-specialized audiences, both orally and in writing, in Spanish and English.

CT07: Critical thinking skills and creativity as a means to have the opportunity to be original in the generation, development and / or application of ideas in a research or professional context.

CT11: Autonomous learning capacity.

Groups

This course applies to just **one group of theory and two groups of practices** according to the student's profile. These groups of practices are:
- Group Informatics + ICT Management **(Group MUII/MUDT**)
- Group Telecommunication + ICT Management (**Group MUIT/MUDT**)

The syllabus of the course covers the above competencies, in such a way that the course develops the competencies of MUII and MUDT for the Group MUII/MUDT, whereas it develops the competencies of MUIT and MUDT for the Group MUIT/MUDT.

Themes and syllabus

Brief description of the syllabus

Languages and tools for describing hardware architectures. Hardware/software co-design. Rapid prototyping. Design of processors and multiprocessors. Design of embedded and ubiquitous systems. Improving performance.

Common Course Syllabus

Theme 1: **Introduction to the hardware systems**.
Contents of Theme 1: *Hardware description languages. Design, simulation and synthesis of electronic systems.*
Practical activities of Theme 1: *Introduction to PLD design. Simulation and implementation*.

Theme 3: **Ubiquitous systems**.
Contents of Theme 3: *Introduction. Ubiquitous systems. Basic concepts. Platforms and architectures. Context and interaction. Applications.*
Practical activities of Theme 3: There is not practical section.

Course Syllabus. Group MUII/MUDT

Theme 1: **Tools for the hardware description**.
Contents of Theme 1: *Methodologies of design, simulation and implementation of hardware for hardware system prototyping. Hardware description languages. Design tools.*
Practical activities of Theme 1: *Design, simulation, synthesis and implementation on FPGA of systems using Xilinx Vivado and C HLS and VHDL*.

Course Syllabus. Group MUIT/MUDT

Theme 2: **Design of electronic systems.**
Contents of Theme 2: *Control structures. Intercommunication buses. Design of controllers. Hierarchical design*.
Practical activities of Theme 2: *Clock management, finite state machines. Algorithms in PLD, coders, subsistems, buses, ADCs, DACs and LCDs.*

Educational activities

Horas de trabajo del alumno por tema		Horas teóricas	Actividades prácticas				Actividad de seguimiento	No presencial
Tema	**Total**	**GG**	**CH**	**L**	**O**	**S**	**TP**	**EP**
1	55	20						35
2	43			15				28
3	49.5	18						31.5
Evaluación	2	2						
Total	150	40		15				94.5

GG: Large Group (85 students).
CH: Clinical practices (7 students)
L: Practices in laboratory (15 students)
O: Practices in computer rooms (20 students)
S: Seminar (40 students).
TP: Programmed Tutorials (educational monitoring, in the form of ECTS tutorials).
EP: Personal study, individual or group tasks, and reading the literature.

Learning methodologies

- Learning based on problems.
- Learning based on projects.
- Participation in large groups.
- Problem solving.

Learning results

1. Students know the methodologies and tools for describing hardware architectures. They are able to design high performance and specific purpose hardware systems. They are able to apply this knowledge to develop final products.
2. Students know the techniques to design processors, multiprocessors, embedded and ubiquitous systems by means of reconfigurable computing. They are able to implement algorithms and systems in hardware in order to improve the computing performance.
3. Students can project, calculate and design products, processes and facilities in all the ambits of Communication Engineering.
4. Students can lead, plan and supervise multidisciplinary teams.
5. Students can model mathematically, calculate and simulate in technological and engineering company centers, especially in research, development and innovation tasks in all the areas with regard to Communication Engineering and similar multidisciplinary areas.
6. Students can elaborate, plan, manage, coordinate, and manage projects in technical and economy aspects in all the areas or Communications Engineering, following quality and environmental criteria.

Evaluation systems

Students can choose between two evaluation modes:

- Continuous assessment.
  - It is mandatory the student attends the lab sessions.
  - The evaluation will consider the most out of the lab sessions, the works development and problem solving.
  - Those students that fail the continuous assessment must attend the final exam in the corresponding official call.
- Alternative assessment.
  - The students that do not choose the continuous assessment must attend the final exam in the corresponding official call. This final exam will consist of a written test and a lab test of similar level than the developed by continuous assessment.

Either of the two modes, the final score will be the weighted mean of the scores obtained in the three themes, provided that all they were approved; otherwise, the course is failed.

Final score = N1x0,25 + N2x0.5 + N3x0,25

It will be applied the scoring system according to current RD 1125/2003, article 5º.

Bibliography

- Notes and presentations given by the lecturer.
- References:
  - Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation. Morgan.Kaufmann, 2008.
  - Reconfigurable Computing. Accelerating Computation with Field-Programmable Gate Arrays. M. Gokhale and P. Graham. Springer, 2005.
  - Asenden, Peter J., "The Designer's Guide to VHDL", Morgan Kaufmann
  - G.F. Coulouris, J. Dollimore, T. Kindberg: Distributed Systems. Concepts and Design (4th edition). Addison-Wesley, 2005

- D. E. Culler, H. Mulder: Smart Sensors to Network the World, Scientific American, Jun 2004
- D. Saha, A. Mukherjee, S. Bandyopadhyay. Networking infrastructure for pervasive computing: enabling technologies and systems, Kluwer, 2003
- A. Greenfield: Everyware: The Dawning Age of Ubiquitous Computing, New Riders, Berkeley, 2006
- S. Poslad, Ubiquitous Computing: Smart Devices, Environments and Interactions, Wiley, 2009
- E. Mandado, L. J. Alvarez, M.D. Valdés, Dispositivos Lógicos Programables y sus aplicaciones, Thomson, 2002.
- S.A. Pérez, E. Soto, S. Fernández, Diseño de Sistemas Digitales con VHDL, Thomson, 2002.
- D. G. Maxinez, J. Alcalá Jara. El arte de programar sistemas digitales. CECSA, 2002.
- R. Kamal, Embedded Systems: Architecture, Programming and Design 2e, McGraw-Hill, 2008.
- Artículos en revistas de investigación relacionados con la temática.

Other resources

- Web resources:
  - Online campus.
  - www.xilinx.com
  - www.digilentinc.com
- Software resources:
  - Xilinx Vivado 2015.1.
  - Agility DK.
  - Integrated development framework for microcontroller programming.
- Hardware resources:
  - Prototyping board Digilent Nexys-4.
  - Prototyping boards for embedded and ubiquity systems.
  - Prototyping board BASYS 3.