Politehnica University of Bucharest
Faculty of Electronics, Telecommunications and Information Technology

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	Polytechnic University of Bucharest
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Department of Applied Electronics and Information Engineering
1.4 Domain of studies	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	License (engineering)
1.6 Program of studies/Qualification	Applied Electronics

2. Course identification information

2.1 Name of the course				Reconfigurable Computing Systems			
2.2 Lecturer				s.l. dr. ing. Ioana Dogaru			
2.3 Instructor for practical activities				s.l. dr. ing. Ioana Dogaru			
2.4 Year of studies	IV	2.5 Semester	II	2.6 Evaluation type	Assesments tests	2.7 Course choice type	mandatory

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week, out of which	3	3.2 course	2	3.3 practical activities	1
3.4 Total hours in the curricula, out of which	42	3.5 course	28	3.6 practical activities	14

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	25
Supplemental documentation (library, electronic access resources, in the field, etc)	3
Preparation for practical activities, homeworks, essays, portfolios, etc.	5
Tutoring	0
Examinations	3
Other activities	0

3.7 Total hours of individual study	36
3.9 Total hours per semester	78
3. 10 Number of ECTS credit points	3

4. Prerequisites (if applicable)

4.1 curricular	Digital Integrated Circuits (Logic Systems) Programmable Electronic Systems Microcontrollers
4.2 competence-based	General knowledge: digital signal processing, digital integrated circuits

5. Requisites (if applicable)

5.1 for running the course	Not applicable
5.2 for running of the applications	Compulsory attendance at laboratories (under UPB's regulations).

6. Specific competences

Professional competences	C4: Designing and implementing of low complexity hardware and software applications, specific to applied electronics. C4.1 Defining concepts, principles and methods used in the following areas: computer programming, high level and specific programming languages, reconfigurable computing systems.
Transversal competences	**CT1** Analysis of practical problems to identify elements and their consacrated solutions in order to achieve professional goals.

7. Course objectives (as implied by the grid of specific competences)

7.1 General objective of the course	The course familiarizes students with the most current paradigms of hardware reconfigurable systems (circuits type: CPLD, FPGA, FPAA etc.), development tools and specific design (integrated development environments, development platforms and debugging applications) and practical methods for implementing a finished product in a reconfigurable technology.
4.2 Specific objectives	Applications will focus on understanding through experiment and practice specific problems of reconfigurable hardware architectures. By using a set of software tools and development boards with Xilinx FPGA circuits, will be completed through all stages of development and testing of applications. An important part will be assigned after completing works to allow familiarization with specific elements in the design of reconfigurable systems.

8. Content

8.1 Lectures	Teaching techniques	Remarks
Reconfigurable systems,	Teaching is based on using the	2 hours

necessity, historical trends, compared to dedicated hardware (ASICs) and microcontrollers.	projector (covering communication and demonstration teaching techniques) used oral communication methods like expository method and questioning method. Course materials are lecture notes and presentations, suggested problems. All other materials are available electronically through the course website.	
Reconfigurable system architecture, components (CLB, arithmetic units and memory interfaces with the outside world) performance criteria in evaluating a specific architecture.		2 hours
Types of reconfigurable systems (FPGA, CPLD, etc.) Examples on chips produced by Xilinx (Spartan, Virtex, etc..), Altera, Cypress (PSOC). Differences and considerations regarding specific items of interest from the point of view of the application.		2 hours
Design of FPGA applications, specific design cycle, and software design tools. Hardware systems development (for example systems used in the laboratory).		4 hours
HDL s (hardware description languages); VHDL and Verilog basics and exercises aiming to describe of basic signal processing blocks (e.g. multipliers, FIR filters, 7 segments display decoders, etc.).		6 hours
Schematic editors, hardware		4 hours

libraries. Intellectual property (IP), reuse and productivity, designing with IP modules. Designing hierarchies of modules to define an application. Assigning I/O ports to external leads of the reconfigurable chip.		
Interfacing with other devices. Configuring and using external devices (memories, A/D converters, video output, USB, Ethernet, Serial etc.). Interfacing with host computers. Programming the reconfigurable devices. Coarse grain and other recently introduced reconfigurable architectures.		4 hours
FPGA-oriented microcontroller cores (e.g. PicoBlaze si MicroBlaze – Xilinx), and their use for speeding up the prototyping process. Associated tools (bootloaders, compilers, etc.). Systems on programmable chips (SOPC)		4 hours

Bibliography

Ioana Dogaru, Radu Dogaru - Lecture notes.
Tutorials and application notes from XESS , Xilinx and Digilent
Website course (http://atm.neuro.pub.ro/radu_d/html/09_10/) contains references and PDF documents, the program's use in laboratory, addresses and useful information, project themes etc. Dynamically updated during the semester.

8.2 Practical applications	Teaching techniques	Remarks
Introducing a few types of FPGA development board (XESS XSA-50, minimal number of de interfaces,	Teaching is based on using the projector (covering communication and demonstration teaching techniques) used oral	3 hours

XESS XSB-300 with extended signal processing capabilities, and Basys2 Digilent development boards), connecting with host PC, demonstration of the whole design flow for a certain application (a 7 segments decoder). Assessment of competencies.	communication methods like expository method and questioning method. Students simulate, implement, test and evaluate independently the same problems using the computer, a software environment and a development board. The teaching materials are included in the tutorial platforms laboratory.	
Development tools (Xilinx ISE). Application part I: Schematic and VHDL designs. Assessment of competencies.		3 hours
Development tools (Xilinx ISE). Application part II: Hierarchical design using VHDL modules, use and reuse of IP (intelectual property) modules. Assessment of competencies		3 hours
Implementing a PicoBlaze microcontroller on the Digilent Basys2. Simple programs running on it. Constructing digital filters using the Picoblaze. Assessment of competencies		3 hours
Undoing laboratory works, discussions.		2 hours

Bibliography

Ioana Dogaru, Radu Dogaru, *Sisteme Reconfigurabile de Calcul: Lucrari Practice*, Editura Printech, februarie 2009, ISBN 978-606-521-245-9, 90 pages. (title translation: Reconfigurable systems, applications).

- The site for laboratory and course activities: http://atm.neuro.pub.ro/radu_d/html/09_10/

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

Current technology requires rapid prototyping of applications, required by the market. In this regard, reconfigurable hardware technology is the optimal compromise between flexibility cost and speed execution. The industry has a demand for qualified engineers with specializations related to the design using FPGA circuit type, with a solid foundation in electronics and information technology systems so that they can maintain and develop new hardware and software applications.

The course syllabus is a concrete answer to these existing requirements, subscribed services in the European economy Electronics and Telecommunication Engineering (ETC). In the context of current technological advancement devices, fields concerned are virtually endless, from applications "consumer" technologies (digital cameras, mobile terminals "smart-phone"), healthcare (products and technologies for the analysis and medical imaging), the military (products and technology of "remote sensing" satellite imaging), the security (surveillance and biometric systems), Industrial Automation, robotics (systems human-machine interface) and others.

This provides graduates with the appropriate skills and training needs of current scientific skills and modern technical quality and competitive, enabling rapid employment after graduation is perfectly framed in policy Politehnica University of Bucharest, both in terms of content and structure and in terms of skills and international openness for students.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	Knowledge of fundamental theoretical concepts; - Knowledge of the application of theory to specific problems; - Differential analysis techniques and theoretical methods.	Two written tests with equal marks during the semester, the topics cover the whole field, providing a synthesis of comparative theoretical material covering and explaining the exercises and problems of application patterns.	60%
10.5 Practical applications	Knowledge of how to design using reconfigurable circuit (FPGA), design flow	Evaluation at the end of each laboratory, including a theoretical component and a	40%

	application, development tools - Xilinx ISE. Developing projects using specific methods and using schematic-level and hardware description language VHDL.	practical component. Theoretical component is checked by applying a set of questions on concepts used in the laboratory. The practical component is assessed by verifying the implementation solution by the student.	

10.6 Minimal performance standard
Promoting tests (queries) regarding the architecture and functional principles of hardware/software structures. The student will be capable to follow all steps of the design flow in order to complete the implementation of a module on a reconfigurable computing platform (HDL or schematic description, implementing using software tools, modeling and simulation with performance evaluation).

Date	Lecturer	Instructor for practical activities
	s.l. d r. ing. Ioana Dogaru	s.l. d r. ing. Ioana Dogaru
1-10-2015	.....	.....

Date of department approval
20-10-2015

Director of Department,
Prof. Sever Pasca