Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și Tehnologia Informației

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Electronic Devices, Circuits and Architectures**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Computing in Embedded Systems

2. Date despre disciplină

2.1 Course name (ro) (en)				Proiectarea sistemelor digitale: Proiect 2 Digital System Design: Project 2			
2.2 Course Lecturer				NA			
2.3 Instructor for practical activities				Lect. Zoltan HASCSI, PhD			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M1.O.22-08		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2	Out of which: 3.2 course	0.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	28.00	Out of which: 3.5 course	0	3.6 seminary/laboratory	28
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					43
Tutoring					2
Examinations					2
Other activities (if any):					0

3.7 Total hours of individual study	47.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Digital Integrated Circuits Microprocessors Computer System Architectures Programming (C/Java) Digital Systems Design: Project 1
4.2 Results of learning	Accumulation of the following knowledge at the base level: digital circuits and microprocessors instruction set architectures and computter architectures digital design methods and techniques (acquaintance with the HDL verilog language and an IDE tool) Fully functional pipeline processor and floating point coprocessor designed and verified in Semester I.

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	NA
5.2 Seminary/ Laboratory/Project	Room with computers and a videoprojector Personal computer on which Xilinx Vivado IDE Suite is installed

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

Familiarizing students with the design flow and design methodology of a digital integrated system (design requirements, system partitioning, choice of architecture, design and optimization at block and system level);
Learn and apply modern design concepts (mixed hardware-software design, parameterization, reuse, scaling, parallelization);
Introduction to digital circuits verification at the block and system levels;

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	Students who complete the second part of the project will be able to: design a system architecture starting from the specifications/requirements; partition a complex system into functional blocks; define new protocols/interfaces suitable to specific blocs design digital blocks at the rtl level; integrate functional blocks into the system; design a system-level verification environment
Transversal (General) Competences	Honorable, responsible and ethical behavior to ensure the reputation of the profession. Team work, task partition and synchronization. Awareness of the need for continuous training. Efficient use of resources (specifications, standards, tutorials, user-guides) for project development and for personal and professional development.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* **Apply** the knowledge and skills acquired in the previous subjects taken during the undergraduate cycle.
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* **Analyze** design requirements and define a specific high-level protocol. **Design** a digital system of high complexity at the level of blocks and algorithms. **Partition** a digital system into functional modules and define their interfaces. **Integrate** third party IPs into a system. **Reuse** and adapt generic or previously designed blocks/modules. **Use** an HDL language to describe the system and its components. **Imagine** test scenarios and plan a verification strategy. **Analyze** simulation results, identify operating errors, deduce their causes, develop solutions to eliminate them. **Implement** a circuit in FPGA and employ applications and methodologies to test the implemented system. **Write** design and implementation specifications.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* **Effectively** use software tools and hardware resources in the learning, analysis and design process. **Select** appropriate documentation sources. **Demonstrate** autonomy in planning and implementing solutions to given problems, as well as identifying and correcting errors/mistakes. **Demonstrate** collaboration with other colleagues and teaching staff in carrying out teaching activities. **Responsibly** apply the principles, norms and values of professional ethics in completing homework and laboratory assignments. **Self-evaluate** objectively, identifying gaps and needs, provide proactive feedback. **Demonstrate** real-life situation management skills (time management, task prioritization, project milestone planning).

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Teaching is based on the use of the videoprojector (covering communication and demonstration function). The oral communication methods are expository method and problem-solving method. All materials are available online (direct or via links) on the project’s site and on the faculty’s “Moodle” platform.

10. Contents

PROJECT		
Crt. no.	**Content**	**No. hours**
1	Presentation of AXI and UART protocols. Define a high-level protocol.	2
2	Design and verification of an AXI interface block	6
3	Design and verification of a memory controller	8
4	System level integration and system verification. The system is composed of the processor, a data memory, an instruction memory, a memory controller, a UART interface block.	6
5	System synthesis, FPGA implementation and testing	2
6	Drafting design specifications	2
7	Project presentation	2
	Total:	28
Bibliography: http://users.dcae.pub.ro/~zhascsi/courses/dsd/dsd.html		

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course			
11.5 Seminary/laboratory/project	Memory controller implementation and verification	project delivery and presentation	40%
	System implementation, verification and testing	project delivery and presentation	40%
	Design spec document	project delivery and presentation	20%
11.6 Passing conditions			
At least 50% of the total marks			

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

Through the activities carried out, students develop skills in the design and verification of digital systems and become familiar with the design tools and methodologies used in the industry.
The gradual increase of the project complexity facilitates the development of skills to manage practical challenges that can be encountered in real industrial projects.

Date	Course lecturer	Instructor(s) for practical activities
09.09.2022		Lect. Zoltan HASCSI, PhD

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Date of department approval	Head of department
31.10.2024	Prof. Dr. Claudius DAN
Date of approval in the Faculty Council	Dean
01.11.2024	Prof. Dr. Mihnea Udrea