



COURSE DESCRIPTION

1. Program identification information

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|----------------------------------|---|
| 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 Microelectronics |

2. Date despre disciplină

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|---|---|--------------|-----------------|--|---|----------------------|------|
| 2.1 Course name (ro) | | | | Proiectarea sistemelor digitale: Proiect 2 | | | |
| (en) | | | | Digital System Design R&D 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.M2.O.04-07 | | 2.10 Tipul de notare | Nota |

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

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|--|-------|--------------------------|------|-------------------------|-------|
| 3. Total estimated time (hours per semester for academic activities) | | | | | |
| 3.1 Number of hours per week | 1.5 | Out of which: 3.2 course | 0.00 | 3.3 seminary/laboratory | 1.5 |
| 3.4 Total hours in the curricula | 21.00 | Out of which: 3.5 course | 0 | 3.6 seminary/laboratory | 21 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes | | | | | 50 |
| Supplemental documentation (library, electronic access resources, in the field, etc) | | | | | |
| Preparation for practical activities, homework, essays, portfolios, etc. | | | | | |
| Tutoring | | | | | 2 |
| Examinations | | | | | 2 |
| Other activities (if any): | | | | | 0 |
| 3.7 Total hours of individual study | 54.00 | | | | |
| 3.8 Total hours per semester | 75 | | | | |
| 3.9 Number of ECTS credit points | 3 | | | | |

4. Prerequisites (if applicable) (where applicable)



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|-------------------------|---|
| 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 computer 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)

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| 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 (*Referring 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 curricula 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 professional growth. They reflect the employers requirements.*)

| | |
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| 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 accomplishments 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.*)

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|------------------------------------|--|
| Knowledge | <p><i>The result of knowledge acquisition through learning. The knowledge represents the totality of facts, principles, theories and practices for a given work or study field. They can be theoretical and/or factual.</i></p> <p>Apply the knowledge and skills acquired in the previous subjects taken during the undergraduate cycle.</p> |
| Skills | <p><i>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 instrumentation).</i></p> <p>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.</p> |
| Responsability and autonomy | <p><i>The student's capacity to autonomously and responsibly apply their knowledge and skills.</i></p> <p>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).</p> |

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.



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



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 | 4 |
| 3 | Design and verification of a memory controller | 6 |
| 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. | 4 |
| 5 | System synthesis, FPGA implementation and testing | 2 |
| 6 | Drafting design specifications | 2 |
| 7 | Project presentation | 1 |
| | Total: | 21 |
| 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

31.10.2024

Head of department

Prof. Dr. Claudiu DAN

Date of approval in the Faculty Council

01.11.2024

Dean

Prof. Dr. Mihnea Udrea