# 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 | Bachelor/Undergraduate |
| 1.6 Programme of studies | Microelectronics, Optoelectronics and Nanotechnologies |

## 2. Date despre disciplină

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|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Arhitectura microprocesoarelor 2. Microcontrolere<br>Microprocessor architecture 2. Microcontrollers | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Sorin Zoican | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Sorin Zoican | | | |
| 2.4 Year of studies | 2 | 2.5 Semester | II | 2.6. Evaluation type | E | 2.7 Course regime | Ob |
| 2.8 Course type | | D | 2.9 Course code | 04.D.04.O.018 | | 2.10 Tipul de notare | Nota |

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

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Number of hours per week | 3.5 | Out of which: 3.2 course | 2 | 3.3 seminary/laboratory | 1.5 |
| 3.4 Total hours in the curricula | 49 | Out of which: 3.5 course | 28 | 3.6 seminary/laboratory | 21 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | 45 |
| Tutoring | | | | | 0 |
| Examinations | | | | | 6 |
| Other activities (if any): | | | | | 0 |

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| 3.7 Total hours of individual study | 51.00 |
| 3.8 Total hours per semester | 100 |
| 3.9 Number of ECTS credit points | 4 |

## 4. Prerequisites (if applicable) (where applicable)

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| 4.1 Curriculum | Completion of the following courses:<br>• Electronic Devices and Circuits, Digital Integrated Circuits, Microprocessor Architecture 1 |
| 4.2 Results of learning | Acquisition of the following knowledge:<br>• Knowledge of simple digital circuits (at functional level), the basic architecture of a microprocessor |

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

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| 5.1 Course | The course will take place in a room equipped with a video projector and a computer. |
| 5.2 Seminary/ Laboratory/Project | The laboratory will take place in a room with specific equipment, which must include: computers and installed software: CVAVR, Astudio, Visual DSP++ |

**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)*

This course is studied within the field of Electronic Engineering, Telecommunications and Information Technologies / specialization Telecommunications Networks and Software and aims to familiarize students with the main approaches, models and explanatory theories of the field, used in solving practical applications and problems, relevant for stimulating the learning process in students.
The course specifically addresses basic/advanced notions, specific concepts and principles in the field of microprocessor architectures (the microprocessor components and their interaction), assembly programming languages and the design of a microprocessor-based system from both hardware and software perspectives, all of which contribute to providing students with an overall vision of the methodological and procedural benchmarks specific to the field.

**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.)*

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| **Specific Competences** | Demonstrates possession of basic/advanced knowledge in the field of Electronic Engineering, Telecommunications and Information Technologies<br>Correlates knowledge from various areas (electronic circuits, programming) to solve problems using a microprocessor-based system.<br>Applies in practice knowledge of algorithmization and programming languages by creating assembly language programs with all necessary stages: formal description, coding, testing and debugging.<br>Applies standardized methods and tools specific to the field to carry out the evaluation and diagnosis process of a situation, depending on the problems identified/reported, and identifies solutions.<br>Coherently and correctly argues and analyzes the context of applying the basic knowledge of the field, using key concepts of the discipline and the specific methodology.<br>Oral and written communication in Romanian: uses the scientific vocabulary specific to the field for effective written and oral communication.<br>Oral and written communication in a foreign language (English): demonstrates understanding of the vocabulary of the field in a foreign language. |

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| **Transversal (General) Competences** | Works in a team and communicates effectively, coordinating efforts with others to solve problem situations of medium complexity.<br>Autonomy and critical thinking: the ability to think in scientific terms, to search for and analyze data independently, as well as to draw and present conclusions / identify solutions.<br>Capacity for analysis and synthesis: presents the acquired knowledge synthetically, as a result of a systematic analysis process.<br>Respects the principles of academic ethics: in documentation activity, correctly cites the bibliographic sources used.<br>Puts into practice elements of emotional intelligence in the appropriate socio-emotional management of situations from real/academic/professional life, demonstrating self-control and objectivity in decision-making or in stressful situations. |

**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.)*

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| **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.*<br>Developing the skills to apply general knowledge regarding the architectural attributes of microcontrollers for various projects and implementing them at hardware and software level. The ability to evaluate, based on acquired performance criteria, which specific microcontroller and in what manner it can be used for an efficient solution to concrete problems. |
| **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).*<br>Selects and groups relevant information in a given context.<br>• Uses, with justification, specific principles for solving various problems with the help of a program.<br>• Works productively in a team.<br>• Develops a scientific text.<br>• Experimentally verifies identified solutions.<br>• Solves practical applications.<br>• Properly interprets causal relationships.<br>• Analyzes and compares various ways of solving a problem<br>• Identifies solutions and develops solution plans.<br>• Formulates conclusions for the problems carried out.<br>• Argues the identified solutions and the ways of solving them. |

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| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>Selects appropriate bibliographic sources and analyzes them.<br>• Respects the principles of academic ethics, correctly citing the bibliographic sources used.<br>• Demonstrates receptiveness to new learning contexts.<br>• Shows collaboration with other colleagues and teaching staff in carrying out teaching activities<br>• Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved<br>• Demonstrates social responsibility through active involvement in student social life / involvement in events in the academic community<br>• Promotes/contributes through new solutions, related to the specialty field, to improve the quality of social life.<br>• Becomes aware of the value of one's contribution in the field of engineering to identify viable/sustainable solutions to solve problems in social and economic life (social responsibility).<br>• Applies principles of professional ethics/deontology in analyzing the technological impact of proposed solutions in the specialty field on the environment.<br>• Analyzes and capitalizes on business/entrepreneurial development opportunities in the specialty field.<br>• Demonstrates skills in managing real-life situations (time management, collaboration vs. conflict). |

**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.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository methods (lecture, presentation) and conversational–interactive methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling), as well as action-based methods such as exercises, practical activities and problem solving.
In teaching, lectures will be used, based on presentations that will be made available to students. Each course will begin with a recap of the chapters already covered, with emphasis on the notions covered in the previous course.
The presentations use images and diagrams so that the information presented is easy to understand and assimilate.
This course covers information and practical activities designed to support students in their learning efforts and in developing optimal collaboration and communication relationships in a climate conducive to discovery learning.
Practicing active listening and assertive communication skills will be pursued, as well as mechanisms for constructing feedback as ways of behavioral regulation in various situations and of adapting the pedagogical approach to the students' learning needs.
The ability to work in a team to solve different learning tasks will be practiced.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |

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|---|---|---|
| 1 | 1. Input–output (IO) interfaces<br>1.1. Types of IO transfers<br>1.2. Transfer protocols<br>1.3. Examples of IO ports | 6 |
| 2 | 2. Presentation of the general-purpose microcontroller core (Atmel, XMC 4500)<br>2.1. Operating modes<br>2.2. Register set<br>2.3. Memory and ports<br>2.4. Instruction set | 6 |
| 3 | 3. DSP microcontrollers (ADSP2181)<br>3.1. Data format<br>3.2. Registers of the arithmetic units<br>3.3. Fixed-point data-processing instructions | 6 |
| 4 | 4. Advanced CISC processors 80x86 – memory management, protection mechanism and multiprocessing<br>4.1. Virtual memory<br>4.2. Segmentation and paging mechanism<br>4.3. Descriptor tables<br>4.4. Translation of the virtual address and the segment descriptor structure<br>4.5. Protection of data and programs | 4 |
| 5 | 5. Principles of RISC processors – use of pipeline<br>5.1. Pipeline in RISC architecture<br>5.2. Characteristics of RISC architecture<br>5.3. Comparison between CISC, RISC and DSP architectures (performance and complexity) | 2 |
| 6 | 6. Advanced post-RISC processors<br>8.1. RISC elements in “classic” CISC processors<br>8.2. Pentium – general characteristics<br>8.3. Pentium processor registers<br>8.4. Functional block diagram of the processing units<br>8.5. Dynamic branch prediction | 4 |
| | **Total:** | 28 |

**Bibliography:**

- - Sorin Zoican, „Microprocesoare si microcontrolere. Aplicatii”, Editura Politehnica Press, Bucuresti, 2011
- - C. Burileanu s.a., “Microprocesoarele x86 – o abordare software”, Ed. “Grupul microInformatica”, Cluj-Napoca, 1999.
- - notite curs – platforma moodle

**LABORATORY**

| **Crt. no.** | **Content** | **No. hours** |
|---|---|---|
| 1 | Presentation of a development environment for microcontrollers with Atmel core (CVAVR and Astudio) | 2 |
| 2 | Presentation of the development environment for Infineon processors (XMC4500) – DAVE CE | 2 |

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|---|---|---|
| 3 | Presentation of the development environment for DSP processors ADSP2181 – Visual DSP++ | 2 |
| 4 | Implementation of logic circuits and sequential processes through programmable logic | 2 |
| 5 | Applications developed with DAVE CE (IO, Timers, DMA) | 2 |
| 6 | Signal processing application (with ADSP2181) | 2 |
| 7 | Final laboratory colloquium | 2 |
| | **Total:** | 14 |

**Bibliography:**

- Sorin Zoican, „Microprocesoare si microcontrolere. Aplicatii”, Editura Politehnica Press, Bucuresti, 2011
-www.elcom.pub.ro/discipline/amp2

**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | - knowledge of fundamental theoretical notions;<br>- knowledge of how to apply theory to specific problems;<br>- differential analysis of theoretical techniques and methods. | - Homework or in-class work (30% of the final score)<br>- Written exam in the exam session (50% of the final score)<br>Homework (in-class work) will not be recovered in the final exam. | 80% |
| 11.5 Seminary/laboratory/project | - - knowledge of how to write a program in assembly language to solve a given problem;<br>- knowledge of how to use tools for developing, simulating and debugging programs<br>- demonstration of the functioning of the developed programs | final laboratory colloquium. Both understanding of theoretical aspects and the ability to implement in C simple or medium-difficulty algorithms are evaluated;<br>- evaluation of activity during laboratory sessions | 20% |
| 11.6 Passing conditions | | | |
| - obtaining a minimum score of 50% after completing the evaluations carried out within the course.<br>**Attention**: *Any other* passing condition must be approved by the Faculty Council. | | | |

**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 the ability to provide solutions to problems and to propose ideas to improve the existing situation in the field of Electronic Engineering, Telecommunications and Information Technologies, industrial branch Telecommunications networks and software
In developing the course content, knowledge described in the specialized literature and our own published and presented research were considered.
The course has content similar to courses conducted at the POLITEHNICA University of Bucharest.
It takes into account the development of the graduate’s skills to manage practical situations that may be encountered in real life, in order to increase their contribution to improving the socio-economic environment.

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|---|---|---|
| Date | Course lecturer | Instructor(s) for practical activities |
| 29.09.2025 | Prof. Dr. Sorin Zoican | Prof. Dr. Sorin Zoican |
| Date of department approval | Head of department | |
| | Prof. Dr. Claudius Dan | |
| Date of approval in the Faculty Council | Dean | |
| | Prof. Mihnea UDREA | |