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	**Applied Electronics and Information Engineering**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Applied Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Arhitectura sistemelor de calcul Computer Architectures			
2.2 Course Lecturer				Prof. Dr. Radu RĂDESCU			
2.3 Instructor for practical activities				Prof. Dr. Radu RĂDESCU			
2.4 Year of studies	4	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	04.S.07.O.101		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	4	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	56.00	Out of which: 3.5 course	28	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.					16
Tutoring					16
Examinations					4
Other activities (if any):					8

3.7 Total hours of individual study	69.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Microprocessors Architecture Digital Integrated Circuits Boolean Algebra Information Transmission Theory
4.2 Results of learning	Creating the skills to apply general knowledge on the architectural features of computing systems for various projects in information engineering. The possibility to evaluate on the basis of the acquired performance criteria a certain type of computer and the manner in which it can be used in a concrete situation. Training the skills of analysis and design of a computer system (at the level of principles, structure and operation) in order to meet specific requirements.

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

5.1 Course	Room equipped with a video projector and a screen
5.2 Seminary/ Laboratory/Project	Room equipped with computers and specific software. Compulsory presence at laboratory classes, according to current UNSTPB regulations.

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 subject aims to familiarize students with the main approaches, models and explanatory theories of the field, used in solving practical applications and problems, with relevance to stimulate the learning process.
The subject addresses as a specific theme the following basic or advanced notions, specific concepts and principles, all contributing to the transmission/training to/students of an overall vision over the the methodological and procedural landmarks:
• Presentation of models of architectures for widely used computing systems.
• Study of the computer structure (central processing unit, memory, input devices, peripheral connection).
• Presentation of the components and interaction between them at the physical level (processor, interruptions, bus).
• Microprogramatized level (horizontal, vertical, mixed, nanoprogramming) and the operating system (management of virtual memory by paging and segmental).
• Analysis, design and exploitation of calculation systems, with examples and applications.
• Configuring a calculation system by establishing the main working parameters.
• Designing and sizing of the component blocks of the computer.
• establishing the interdependence relations between the functional blocks of a calculation system.
• Applying the algorithms that govern the operation of a calculation system at all levels.
• Evaluation of the performances of the components of a calculation system.

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	The students: Demonstrate that they have basic and advanced knowledge in the IT field. Correlate knowledge. Apply knowledge in practice. Apply standardized methods and instruments, specific to the field, to carry out the evaluation and diagnosis process of a situation, depending on the problems identified/reported, and identify solutions. It uses fundamental elements regarding electronic devices, circuits and instrumentation. Apply in practice the sets of knowledge, concepts and elementary methods regarding the architecture of the calculation systems, microcontrollers, languages and programming techniques. Acquire the ability to make decisions to solve current, or unpredictable problems that appear in the process of operating electronic appliances. Form their ability to inform and permanently document for personal and professional development by reading the specialized literature. Learn flexibility in the use of new systems and technologies within a team in which members together reach a well-defined objective, while assuming different roles or tasks. Argue and analyze coherently and correctly the context of applying the basic knowledge of the field, using key concepts of the discipline and the specific methodology. Acquire methods of oral communication and in writing in English: they use the scientific vocabulary specific to the field, for effective communication, in writing and oral. Acquire methods of oral communication and writing in a foreign (English) language: it demonstrates the understanding of the vocabulary for the domain, in a foreign language.
Transversal (General) Competences	The students: Work in a team and communicate effectively, coordinating their efforts with the other students, for solving problem situations of medium complexity. Get autonomy and critical thinking: the ability to think in scientific terms, to seek and analyze given independently, as well as to detach and present conclusions or to identify solutions. Get the capacity of analysis and synthesis: they synthetically present the acquired knowledge, as a result of a systematic analysis process. Respect the principles of academic ethics: in the documentation activity, the bibliographic sources are used correctly. Put into practice elements of emotional intelligence in the adequate socio-emotional management of situations in real/academic/professional life, demonstrating self-control and objectivity in making decisions 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.)*

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.* The students: • List the most important stages that have marked the development of the domain. • Define the specific notions of the field. • Describe and classify notions, processes, phenomena, and structures. • Highlight consequences and relationships.
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).* The students: • Select and group relevant information in a given context. • Use argued specific principles for analysis, design, and evaluation of a computer system. • Work productively in a team. • Elaborate a scientific text. • Experimentally verify identified solutions. • Solve practical applications. • Adequately interpret causal relationships. • Analyze and compare various solutions for implementing the component blocks of a calculation system. • Identify solutions and elaborate solving plans and projects. • Formulate conclusions to the experiments. • Argue the solutions identified and the modes of resolution. • Shape real, simple, or medium complexity, complete analysis of the calculation systems and specifying the design methodology necessary to solve the given requirements; • Design, evaluate, and test the functioning of a specialized hardware and software solution for an imposed architecture problem and the performance characterization of the obtained system.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* The students: • Select the right bibliographic sources and analyze them. • Respect the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrate receptivity to new learning contexts. • Manifests collaboration with other colleagues and teachers in carrying out learning activities. • Demonstrates autonomy in organizing the situation and context of learning or the problem to be solved. • Manifest social responsibility by active involvement in social life and involvement in the events in the academic community. • Promote and contribute through new solutions, related to the specialized field to improve the quality of social life. • Are aware of the value of its contribution in the field of engineering to identifying viable and sustainable solutions, which will solve problems in social and economic life (social responsibility). • Apply principles of ethics and professional deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment. • Analyze and capitalize on business and entrepreneurial development opportunities in the specialty field. • Demonstrate skills of management of real-life situations (managing time 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 the learning characteristics of the students and their specific needs, the teaching process will explore teaching methods both exhibitions (lecture, exposure) and conversation-interactive, based on learning models, by discovering their facilities Direct and indirect exploration of reality, such as experiment, demonstration, and modeling, but also on action-based methods, such as exercise, practical activities and problem-solving.

In the teaching activity, lectures will be used, based on PowerPoint presentations, PDFs or various videos that will be made available to the students.

Each course will debut with the recapitulation of the chapter already (or in progress), with an emphasis on the notions presented in the last course. Presentations use images, diagrams, wave shapes, histograms, and schemes, so that the information presented is easy to understand and assimilate.

The teaching is based on the use of slide presentations, covering the communication and demonstrative function. The methods of oral communication used are the exhibition method and the problematization method, used in front.

The course materials are: course notes and presentations, electronic format handbooks, exercises, problems, simulations, and applications (theoretical and with computer resolution). All course materials are available in electronic format, on Teams, Moodle, and Easy-Learning platforms.

This subject covers information and practical activities meant to support students in learning and development efforts of optimal collaboration and communication relationships, in a favorable climate for discovery learning.

It will be considered the practice of active listening and assertive communication skills, as well as the mechanisms of construction of the feedback, as ways of behavioral regulation in different situations and of adapting the pedagogical approach to the student learning needs.

The teamwork ability will be practiced to solve the different learning tasks, through themes and tests.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	The multinive structure of computers, a short history of the evolution of the automatic, sequential, and parallel computers, classification of computers, and examples of architectures.	2
2	Paradigm change in system architectures: invisible and low-power computers, miniaturized, flexible, extensible, programmable. Combined hardware-software design.	2
3	Structure of a computer: central unit, memory, input devices, and connecting peripherals to the system. Serial, parallel, and wireless interfaces.	4
4	Architects of parallel computers and types of multiprocessors, levels of parallelism.	2

5	Processors and chips for central processing units in embedded systems and systems on a chip. The architects of the families Intel, AMD, Sun, AVR, and ARM. Examples and case studies.	4
6	Physical level: microprocessor, interruptions, bus, arbitration of the bus, types, families, and examples of buses.	2
7	Current communication protocols and their implementations. Performance assessment, architectural analysis and design principles. Examples and case studies.	2
8	Microprogramatical level: Examples of microprogrammed machines in horizontal, vertical, and mixed format, microinstructions and microcomings, nanoprogramming. Examples and case studies.	4
9	Operating system level: paging, page replacement policy, segmentation, segments replacement algorithms, virtual memory management solutions. Examples and case studies.	4
10	Applications of calculation systems in specific fields.	2
	Total:	28

Bibliography:

- Radu Rădescu, *Computer Architecture*, electronic course support.
- Radu Rădescu, *Computer Architecture*, Politehnica Press, Bucharest, 2021.
- Radu Rădescu, *The Easy-Learning Platform: Concept and Solution – An Educational Online System*, Lambert Academic Publishing, Germany-USA, 2011.
- Andrew Tanenbaum, Todd Austin – *Structured Computer Organization*, 6th edition, Pearson Education Inc., Prentice Hall, 2013.
- John Shen, *Modern Processor Design: Fundamentals of Superscalar Processors*, 1st edition, McGraw-Hill Series in Electrical and Computer Engineering, 2015.

LABORATORY

Crt. no.	**Content**	**No. hours**
1	Testing methods (benchmark) for microprocessors	2
2	Testing methods (benchmark) for buses	2
3	Hardware and software mechanisms of parallel processing	2
4	Multithreading technology and central processing unit performance evaluation	2
5	Comparative study of static and dynamic RAM	2
6	Study of cache memory	2
7	Study of synchronous and asynchronous serial transmissions	2
8	Management of I/O transactions by DMA and IRQ transfers, and design of I/O systems	2
9	Study of synchronous and asynchronous	2
10	Bus arbitration mechanisms by centralized and decentralized schemes	2
11	Horizontal and vertical microprogramming, Tanenbaum Mic-1 microprogrammed machine	2
12	Virtual memory management through paging mechanisms, page replacement policies	2
13	Virtual memory management through segmentation mechanisms, replacement of segments	2

14	Final checking by laboratory test	2
	Total:	28

Bibliography:
Radu Rădescu, *Computer Architecture*, electronic course support.
Radu Rădescu, *Computer Architecture*, Politehnica Press, Bucharest, 2021.
Radu Rădescu, *Computer Architectures – Practical Works*, Politehnica Press, Bucureşti, 2019.
Radu Rădescu, *The Easy-Learning Platform: Concept and Solution – An Educational Online System*, Lambert Academic Publishing, Germany-USA, 2011.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowing the fundamental theoretical notions and the way of applying theory in specific fields	Questions, dialog, assignments, course tests	15
	Knowing the methods of analyzing and evaluating the component elements of a computer system	Exercises and problems	15
	Knowing the methods of designing the component elements of a computer system and specific applications	Design themes	20
11.5 Seminary/laboratory/project	Knowing the methods of analyzing, evaluating performance, and designing a system of calculation, at all levels	Questions and exercises	15
	Knowing the types of technologies and algorithms used in the construction and operation of a computer system	Individual observations and assignments	15
	Knowing the functioning of a scheme and the relationships between blocks at the technological, physical, microprogrammed levels and operating system	Final checking by laboratory test	20
11.6 Passing conditions			
• Obtaining 50% of the total score. • Obtaining 50% of the score related to the activity during the semester (promotion of the laboratory, according to the Regulation of the Bachelor Studies in UNTSPB).			

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 to provide solutions to problems and to propose ideas to improve the situation in the IT field.

• This discipline tries to outline the basic lines of the structural and functional organization of computing equipment, the approach assuming the main, constructive, operational, and relational aspects between the component blocks of a modern calculation system. Matter points to the landmarks of a fundamental field in the field of electronic engineering, telecommunications, and information technologies, following the drawing of a bridge between software & hardware and technology, being addressed to future specialist engineers and designers in this field.

• In the development of the content of the discipline, knowledge, aspects, and phenomena described in the specialized literature were considered, in their own published and presented research at specialized scientific events.

• The course has equivalent content to the specialized courses carried out by similar universities in the European Union and the United States. The program of the course responds concretely to the current requirements of development and evolution, subscribed to the European economy of the applied electronic specialization of the field of electronic engineering, telecommunications, and information technologies. In the context of the current technological progress of electronic devices, the fields of activity concerned are very numerous, the practical applications being particularly different.

• Through the course and laboratory activities, it is considered the development of the graduate's abilities to manage practical situations that he may face in real life to increase his contribution to improving the socio-economic environment.

• Thus, the graduates are provided with the appropriate competencies for the needs imposed by the current qualifications and modern, quality, and competitive scientific and technical training, which will allow them to engage quickly after graduation, this discipline being well framed in the Politehnica policy, both from the point of view of content and structure, as well as from the point of view of skills and opening on the labor market offered to students.

Date	Course lecturer	Instructor(s) for practical activities
30.09.2025	Prof. Dr. Radu RĂDESCU	Prof. Dr. Radu RĂDESCU
Date of department approval	Head of department	
Date of approval in the Faculty Council	Dean	