Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

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

2. Date despre disciplină

2.1 Course name (ro) (en)				Tehnici avansate de prelucrare digitală a semnalelor - Proiect Advanced Techniques in Digital Signal Processing - Project			
2.2 Course Lecturer				–			
2.3 Instructor for practical activities				Ş.L. dr. ing. Şerban MIHALACHE			
2.4 Year of studies	4	2.5 Semester	1	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		S	2.9 Course code	04.S.07.A.407		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	1	Out of which: 3.2 course	0.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	14	Out of which: 3.5 course	0	3.6 seminary/laboratory	14
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.					28
Tutoring					6
Examinations					2
Other activities (if any):					0

3.7 Total hours of individual study	36.00
3.8 Total hours per semester	50
3.9 Number of ECTS credit points	2

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Finishing the following courses: – Digital Signal Processing.
4.2 Results of learning	General knowledge of: – digital signal analysis and processing in the time and frequency domains; – knowledge of the MATLAB development environment.

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

5.1 Course	Not applicable.
5.2 Seminary/ Laboratory/Project	– The project will take place in a room with specific equipment, which must include: computers, video projector, specialized software (the MATLAB software suite).

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 “Electronic Engineering, Telecommunications, and Information Technologies” domain / “Microelectronics, Optoelectronics and Nanotechnologies” specialization, and primarily aims to deepen the understanding of phenomena and concepts associated with the chosen study direction, from the perspective of the system designer. It also aims to familiarize students with the stages involved in developing an electronic application (analysis and interpretation of the project specification, design and simulation of a high-performance electronic system, its software implementation, and testing its functionality under specific conditions) and to acquire the skills of developing and presenting a system documentation that justifies the adopted solutions and demonstrates the achievement of the reported performance and compliance with the project specification.

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	– Demonstrates a solid understanding of the chosen field of study: characterization of discrete signals in the time and frequency domains, design of analog, digital, or mixed-signal electronic systems, description of the operation and basic principles of a digital system architecture. – Demonstrates understanding of the project specification and the structuring of the electronic system into functional blocks. – Applies practical knowledge gained and the use of simulation and development environments for the analysis, design, implementation, and testing of functional blocks and the overall system. – Correlates theoretical knowledge acquired in specialized semester courses with the development of a practical application in the chosen field of study. – Justifies and analyzes coherently and correctly the context of application of basic knowledge, using key concepts of related courses and their specific methodologies. – Romanian oral and written communication: uses the scientific vocabulary specific to the chosen field of study for efficient and correct written and oral communication. – Oral and written communication in a foreign language (English): demonstrates understanding and correct application of the vocabulary related to the chosen field of study in a foreign language.

Transversal (General) Competences	– Works in a team and communicates effectively, coordinating efforts with others to solve medium-complexity problems. – Autonomy and critical thinking: The ability to think scientifically, to independently search for and analyze data, to identify solutions, and to draw and present conclusions. – Analytical and synthesis skills: Presents acquired knowledge in a concise manner, following a systematic analysis process. – Respects academic ethics: Correctly cites bibliographic sources in research activities. – Applies elements of emotional intelligence in the appropriate socio-emotional management of academic situations, demonstrating self-control and objectivity in decision-making or 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.* – Defines specific concepts and terms related to the DSP field, closely linked to the particularities of the electronic system being designed and its component blocks. – Describes appropriately the design and analysis techniques used for system development. – Understands and describes the phenomena involved in the operation of the system’s component blocks and their impact on the overall system. – Lists the most important stages of the adopted software solutions, highlighting their limitations, advantages, disadvantages, and applicability to the project topic. – Understands and describes appropriately the stages of a project realization according to the organization, requirements, and working methods used in industry.
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).* – Selects and groups relevant information in a given context, thus being able to adequately describe various theoretical or practical aspects of DSP. – Uses DSP concepts justifiably to address problems correctly. – Experimentally verifies the identified solutions for the practical resolution of a DSP application. – Formulates correct conclusions about the results of the experiments performed. – Justifies the methods and the solutions used to solve problems.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* – Selects appropriate bibliographic sources and analyzes them. – Respects academic ethics by correctly citing the bibliographic sources used. – Demonstrates receptiveness to new learning contexts. – Collaborates with peers and faculty in conducting educational activities. – Demonstrates autonomy in organizing the learning context and problems to be solved. – Recognizes the value of their contribution to the engineering field in identifying viable solutions to address social and economic problems. – Analyzes business opportunities or entrepreneurial development based on the knowledge acquired in the field of DSP. – Demonstrates time management skills and other real-life situation management abilities.

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 oral communication, primarily using the expository method and the problem-based learning method, applied frontally. A projector is used, serving both communication and demonstration purposes, as well as interactive tools based on question-and-answer sessions and student feedback.
– During project sessions, students are guided in analyzing, interpreting, and understanding the project specification, analyzing and designing the system's component blocks according to the specification, iteratively redesigning and validating them, as well as implementing the software and testing the final system.
– Students work in teams and are monitored and guided in appropriately dividing the design, simulation, implementation, and testing tasks, as well as in creating the final documentation for the project presentation.
– A complete package of materials necessary for project completion (project specification, block diagrams and detailed diagrams of component blocks, auxiliary files - libraries, script files, databases) is available in electronic format on the faculty's Moodle platform.

10. Contents

PROJECT		
Crt. no.	**Content**	**No. hours**
1	Familiarization with the software development environment and the project specification. Identifying the system's functional elements	2
2	Analyzing the system's sub-blocks, identifying critical parameters and/or performance measures. Determining analysis, processing, implementation, and testing techniques for the system's sub-blocks	2
3	Designing the system's sub-blocks and experimental validation of their functionality	4
4	Implementing the system's functional sub-blocks, integration, and testing the system's functionality	4
5	Final presentation	2
	Total:	14

Bibliography:
1. Ş. Mihalache, D. Burileanu, *Tehnici avansate de prelucrare digitală a semnalelor – Temă şi materiale proiect*, project specification and package available in electronic form on the Moodle platform of the ETTI faculty: https://curs.upb.ro/
2. Ş. Mihalache, D. Burileanu, *Prelucrarea digitală a semnalelor: aplicaţii fundamentale şi avansate folosind MATLAB*, MATRIX ROM, Bucureşti, 2024, ISBN: 978-606-25-0933-0.
3. D. Burileanu, Ş. Mihalache, *Prelucrarea digitală a semnalelor: concepte fundamentale, tehnici avansate, aplicaţii*, MATRIX ROM, Bucureşti, 2022, ISBN: 978-606-25-0767-1.
4. S.V. Vaseghi, *Advanced Digital Signal Processing and Noise Reduction*, 4th Ed., John Wiley & Sons, 2008.
5. U. Zolzer, *Digital Audio Signal Processing*, 3rd Ed., John Wiley & Sons, 2022.

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	Knowledge of fundamental theory and concepts relating to advanced DSP techniques.	Continuous evaluation (practical and oral evaluation)	50%
	Applying DSP algorithms and processing techniques. Understanding how to simulate and implement (software) the studied methods using an advanced development environment (MATLAB).	Final presentation (oral evaluation)	50%
11.6 Passing conditions			
– Obtaining a grade of at least 50%.			

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)

Over the last two decades, the field of digital signal processing (DSP) has undergone a remarkable development, both theoretically and technologically. The increasing market demand for products utilizing DSP techniques can be attributed to the fundamental advantage of using the power of numerical computation for the mathematical manipulation of signals, and to the fact that manufacturers of digital integrated circuits now offer inexpensive and highly performant circuits capable of efficiently implementing complex processing functions. Considered a cutting-edge field at the turn of the century and millennium, DSP consistently demands engineers with solid theoretical and practical knowledge.
This course directly addresses the current development and evolution needs of the European economy in the field of Electronic Engineering, providing advanced knowledge of digital signal processing: modern methods used in the statistical processing of random signals, adaptive filtering, artificial neural networks and machine learning methods, techniques for processing audio and speech signals, etc. In the context of the current progress of information technology and electronic devices, the target areas of activity are extremely

numerous: communications, medical engineering, instrumentation, space research, multimedia technologies, consumer electronics, robotics and intelligent human-machine interfaces, autonomous machines, biometric technologies, forensic expertise of digital audio/video recordings, etc.
Thus, students are provided with competencies that are adequate to the needs of current qualifications and a modern, quality, and competitive scientific and technical training, which allows them to be quickly employed after graduation. The course is perfectly integrated into the policy of the National University of Science and Technology POLITEHNICA Bucharest, both in terms of content and structure, and in terms of the skills and international openness offered to students. Potential employers target both the academic environment (teaching and research profile) and the research and development environment in state and private institutions that utilize advanced methods and techniques of digital signal processing.
The content of the course is largely similar to that of others with the same objectives taught in universities in the European Union and is continuously updated and adapted following consultations with representatives of the business environment.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	–	Ş.L. dr. ing. Şerban MIHALACHE

Date of department approval	Head of department
26.09.2025	Prof. Dr. Claudius Dan

Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea