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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Telecommunications

2. Date despre disciplină

2.1 Course name (ro) (en)				Prelucrarea digitală a semnalelor			
2.2 Course Lecturer				Prof. Dr. Constantin Paleologu			
2.3 Instructor for practical activities				Prof. Dr. Constantin Paleologu			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	2		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2.5	Out of which: 3.2 course	1.50	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	35.00	Out of which: 3.5 course	21	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.					41
Tutoring					7
Examinations					10
Other activities (if any):					0

3.7 Total hours of individual study	40.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	
4.2 Results of learning	Not applicable

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

5.1 Course	Not applicable
5.2 Seminary/ Laboratory/Project	Mandatory laboratory activity (according to the universitary studies rules in PUB).

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)*

The main objective of this discipline is having students understand the basic principles of random processes, adaptive systems and their applications, spectral estimation algorithms and their applications. Laboratory applications aim to determine the students to develop advances digital processing techniques, starting from the specifications list and going to the execution, debugging and results interpretation.

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 main purpose of this subject is to develop the student abilities to apply the general knowledge of video and multimedia processing and to develop specific projects using a given object-oriented language.
Transversal (General) Competences	Honourable, responsible and etic behaviour to ensure the profession reputation.

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.* • Lists the most important stages that marked the development of the field. • Defines domain-specific notions. • Describes/classifies notions/processes/phenomena/structures. • Highlights 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).* • Selects and groups relevant information in a given context. • Work productively in a team. • Elaborate a scientific text. • Experimentally verifies identified solutions. • Solve practical applications. • Adequately interpret causal relationships. • Identifies solutions and develops solution/project plans. • Formulates conclusions to the experiments carried out. • Argue the identified solutions/solutions.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Select appropriate bibliographic sources and analyze them. • Respect the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates responsiveness to new learning contexts. • Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities. • Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved.

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 (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration and indirect of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving. In the teaching activity, lectures will be used, based on some Power Point presentations that will be made available to the students. Each course will start with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course. Presentations use images and diagrams so that the information presented is easy to understand and assimilate. This discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning. It will be considered the practice of active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of regulating behavior in various situations and adapting the pedagogical approach to the students' learning needs. Teamwork skills will be practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Continuous Time Signals and Systems. Fundamentals: Course Objectives; Continuous Time Signals: Definitions and General Properties; Fourier Series; Continuous Time Signals Frequency Analysis: Fourier Transform, Laplace Transform; Continuous Time Systems: Definitions and General Properties.	8

2	Discrete Time Signals and Systems. Fundamentals: Discrete Time Signals: Definitions and General Properties; Discrete Time Signals Frequency Analysis: Fourier Transform, Z Transform; Fast Fourier Transforms; Discrete Time Systems: Definitions and General Properties; Discrete Time Systems Impulse Response; Discrete Time Systems Transfer Function; Stability Considerations; Sampling Theorem; Applications.	4
3	Digital Filters: Digital Filters Types: Finite Impulse Response (FIR) and Infinite Impulse Response (IIR); Linear-Phase Digital FIR Filters: Characteristics, Design Methods, Implementation Structures; Digital IIR Filters: Characteristics, Design Methods, Implementation Structures; Finite Precision Implementation Effects; Applications.	6
4	Multirate Signal Processing: Introduction; Sampling Rate Decreasing (Decimation); Sampling Rate Increasing (Interpolation); Sampling Rate Changing by a Ration Factor; Applications.	4
5	Discret Time Random Signals. Fundamentals: General Properties: Mean Function, Correlation Function, Ergodic Process, Stationary Process, Spectral Properties; Discrete Time Systems Response to Discrete Time Random Signals; Applications.	2
6	Adaptive Filters: General Characteristics, Adaptive Systems Configurations; Linear Optimum Filtering: Statement of the Problem; Gradient-Based Adaptive Algorithms; Least-Squares Adaptive Algorithms; Applications.	4
	Total:	28

Bibliography:

1. Paleologu Constantin, Udrea Radu-Mihnea, Enescu Andrei-Alexandru, „Prelucrarea digitala a semnalelor”, Editura „Electronica 2000”, 2001.
"Digital Signal Processing - Fundamentals and Applications" (Third Edition), Authors: Lizhe Tan and Jean Jiang, Publisher: Academic Press, 2019.
“Adaptive Filter Theory (5th Edition)”, Author: Simon Haykin, Publisher: Pearson, 2014.

LABORATORY

Crt. no.	Content	No. hours
1	Introduction in MATLAB: Main Commands and Functions in MATLAB; Matrix and Vectors Operations; Logical Instructions and Operators; Commands Files in MATLAB; Functions Files in MATLAB; Mathematical Functions; Graphic Representations.	4
2	Systems: Introduction in MATLAB Signal Processing Toolbox; Continuous Time Systems Frequency Analysis; MATLAB Functions for Continuous Time Filters Design (Butterworth, Chebyshev); Discrete Time Signals; MATLAB Functions for Convolution; Discrete Time Fourier Transform; Discrete Time Systems Impulse Response; Discrete Time Systems Frequency Analysis; Poles-Zeros Diagrams; Applications.	2
3	Digital Filters: MATLAB Functions for Finite Impulse Response (FIR) Digital Filters Design; MATLAB Functions for Infinite Impulse Response (IIR) Digital Filters Design; MATLAB Functions for Transversal and Lattice Implementation Structures; Finite Precision Implementation Effects; Applications.	4
4	Multirate Signal Processing: MATLAB Functions for Sampling Rate Decreasing (Decimation); MATLAB Functions for Sampling Rate Increasing (Interpolation); MATLAB Functions for Sampling Rate Changing by a Ration Factor; Applications.	1

5	Discrete Time Random Signals: MATLAB Functions for Mean, Variance and Correlation Computation; MATLAB Functions for Power Spectral Density Estimation; MATLAB Functions for Eigenvalues and Eigenvectors Computation; Discrete Time Systems Response to Discrete Time Random Signals; Applications.	1
6	Adaptive Filters: MATLAB Implementation of Gradient-Based Adaptive Algorithms (LMS) and Least-Squares Adaptive Algorithms (RLS); Applications.	2
	Total:	14

Bibliography:

Paleologu Constantin, Udrea Radu-Mihnea, Enescu Andrei-Alexandru, „Prelucrarea digitala a semnalelor”, Editura „Electronica 2000”, 2001.

"Digital Signal Processing - Fundamentals and Applications" (Third Edition), Authors: Lizhe Tan and Jean Jiang, Publisher: Academic Press, 2019.

“Adaptive Filter Theory (5th Edition)”, Author: Simon Haykin, Publisher: Pearson, 2014.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Clarity, consistency, and brevity of exposure Coverage of issues requested by topics Proper use of concepts The ability of illustration Activities and interventions during the course	The topics for the exams consist of problems of the same type as the examples presented during the course and theoretical topics.	80%
11.5 Seminary/laboratory/project	Active participation in laboratory Application of specific methods for solving data problems Using software tools and explaining the results	An individual test on the computer to test the ability to use MATLAB.	20%
11.6 Passing conditions			
scoring 50% out of lab; scoring 50% out of total.			

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)

- The subject meets national and international requirements in the domain of electronics and its economic-financial impact, being correlated with similar subjects in and outside Romania;

- In the present development context the domain electronics offers a wide range of activity, potential employers belonging to the industry, to education and research and development with NGOs and national, international and multinational enterprises from the field of electronics;

- The students aquire competencies that meet the present requirements and allow them a rapid insertion on the labour market after graduation, as well as the chance to continue to study various master and doctoral programms, this program being well integrated in the policies and strategies of the university POLITEHNICA Bucharest regarding its content and its structure, as well as the skills and the international perspective offered to the students.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Prof. Dr. Constantin Paleologu	Prof. Dr. Constantin Paleologu

Date of department approval	Head of department Conf. Dr. Ing. Serban-Georgica Obreja
Date of approval in the Faculty Council	Dean Prof. Dr. Ing. Radu-Mihnea Udrea