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)				Semnale şi sisteme 3 Signals and Systems 3			
2.2 Course Lecturer				Conf. Dr. Mircea Raducanu			
2.3 Instructor for practical activities				As. drd. Maria Sirbu - Dragan			
2.4 Year of studies	3	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.05.O.001		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	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	56	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.					65
Tutoring					0
Examinations					4
Other activities (if any):					0

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	Completion and/or passing of the following courses: Mathematical Analysis, Special Mathematics, Fundamentals of Electrotechnics, Signals and Systems 1, Signals and Systems 2
4.2 Results of learning	Acquisition of the following knowledge: Fourier series, Fourier transform, Laplace transform, Z transform, differentiation and integration of functions

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

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: signal generator, multimeter, oscilloscope, sweep generator (wobbulator) Attendance is mandatory for seminar and laboratory hours (in accordance with the university's internal rules).

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 course presents time-domain and frequency-domain analysis methods for linear time-invariant analog and discrete systems. It introduces matrix analysis of two-ports, analyzes ideal two-port models, and then presents interconnection methods of two-ports. Image parameters and operating parameters of two-ports are studied. The realizability and synthesis of passive one-ports and two-ports are presented, as well as the algebraic relations between parts of a system function. Next, approximation methods for transfer functions of the maximally flat, Butterworth, Bessel, and Chebyshev types are presented. Signal-flow graphs are studied, with applications to the study of circuits and systems. Active filter analysis is covered, presenting the types of transfer functions for second-order filter sections, sensitivity functions, and realizations of active filters with operational amplifiers, resistors, and capacitors.

Applications directly related to the concepts taught in the course are presented. In the seminar, problems concerning the analysis and synthesis of electrical circuits are addressed, and their solution requires knowledge of general methodologies for analysis, design, and synthesis of electrical circuits.

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 **knowledge** of the basics of analyzing linear time-invariant analog and discrete systems. **Correlates the knowledge assimilated in this course with those from other courses** **Applies in practice** the knowledge assimilated in the course. **Applies** methods and tools specific to the analysis of systems and circuits to **carry out the evaluation process** of a practical situation and **identifies** solutions. **Argues and analyzes** coherently and correctly the context for applying the basic knowledge of the field, using key concepts of the discipline and the specific methodology. **Oral and written communication in Romanian:** uses the scientific vocabulary specific to the field for effective written and oral communication. **Oral and written communication in a foreign language (English):** demonstrates understanding of the vocabulary of the field in a foreign language
Transversal (General) Competences	**Works in a team and communicates effectively,** coordinating efforts with others to **solve problem situations** of medium complexity**.** **Autonomy and critical thinking:** ability to think in scientific terms, to search for and analyze data independently, and to draw and present conclusions / identify solutions.

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** and understands notions specific to the analysis of linear time-invariant analog and discrete systems: is able to determine the response of a linear time-invariant system, to describe a two-port using matrix parameters, to determine the transfer function of a system by means of signal-flow graphs and Mason's rule, to identify the type of a filter and to determine the sensitivity of some filter parameters with respect to circuit elements, etc.
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. **Works in a team.** **Drafts a scientific text in the field of systems.** **Experimentally verifies identified solutions,** solves practical applications. **Selects** suitable bibliographic sources and analyzes them. **Respects academic ethics** by correctly citing the bibliographic sources used. **Demonstrates receptiveness** to new learning contexts. **Shows collaboration** with colleagues and teaching staff in carrying out didactic activities. **Applies principles of professional ethics/deontology in analyzing the technological impact of proposed solutions** in the specialty field on the environment
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* **Selects** suitable bibliographic sources and analyzes them. **Respects academic ethics,** correctly citing the bibliographic sources used. **Demonstrates receptiveness** to new learning contexts. **Shows collaboration** with colleagues and teaching staff in carrying out didactic activities.

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 exercise, practical activities, and problem solving.

Teaching will use lectures supported by PowerPoint presentations or various short videos 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 discipline covers information and practical activities designed to support students in their learning efforts and in developing optimal collaboration and communication relationships in a climate favorable to discovery learning.

Active listening and assertive communication skills will be practiced, as well as feedback-construction mechanisms, as ways of behavioral regulation in various situations and of adapting the pedagogical approach to students' learning needs.

Teamwork skills will be practiced for solving different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Modulated signals. Definitions and classifications. Modulation with harmonic carrier. Amplitude modulation. Frequency modulation. Phase modulation. AM–FM modulation. Principle of frequency-division multiplexing. Pulse modulation. Principle of time-division multiplexing. Examples.	4
2	Band-pass circuit response to modulated signals. Low-frequency equivalent. Methods: Fourier, Laplace, Harmonic, compact and quasi-stationary. Examples.	4
3	Signal-flow graphs. Elements of the flow graph. Definitions and graph-reduction methods. Mason's rule. Applications in the analysis of analog and discrete, linear time-invariant systems. Examples.	4
4	Ideal filters: Paley–Wiener criterion. Low-pass filter. Transfer function. Weighting function (impulse response). Unit-step response. Band-pass filter. High-pass and band-stop filter. Examples.	4
5	Approximation methods in linear circuits and systems theory. Introduction. Elements of approximation. Approximation criteria: maximally flat approximation, minimax approximation. Butterworth approximation, Bessel approximation, Chebyshev approximation. Use of approximation in linear circuits and systems theory. Examples.	4
6	Active filters: analysis with signal-flow graphs; principles of active filter implementation; prototype transfer functions of order 1 and 2; sensitivity of active filters; realization structures (Sallen–Key, biquad, multiple feedback, etc.). Examples.	4
7	Discrete-time simulation of analog systems. General concepts.	4
	Total:	

Bibliography:

1. I. Constantin, "Semnale şi răspunsul circuitelor", Bucureşti, Editura BREN, 1999
2. Ad. Mateescu, N. Dumitriu, L. Stanciu, “Semnale şi sisteme. Aplicaţii în filtrarea semnalelor”, Editura Teora, 2001.
3. I. Constantin, "Semnale", Tipografia Institutului Politehnic Bucureşti, 1992
4. D. Stanomir, "Semnale şi sisteme analogice", Editura Politehnica Press, 2005.
5. D. Stanomir, "Semnale şi sisteme discrete", Editura Athena, 1997.
6. Ad. Mateescu, Al. Şerbănescu, N. Dumitriu, L. Stanciu, "Semnale, circuite şi sisteme-probleme", Editura Militară, Bucureşti, 1998.
7. I. Constantin, S. Halunga, I. Marcu, "Semnale şi sisteme-probleme", Editura Electronica 2000, Bucureşti, 2007.
8. C. Negrescu, D. Stanomir, ”Semnale şi sisteme-Probleme şi soluţii”, Ed. Politehnica, 2013, Bucureşti.
9. T. Petrescu, S. Halunga-Fratu, O. Fratu, I. Marcu, C. Voicu, R. Crăciunescu, ”Analiza şi sinteza circuitelor. Teorie şi aplicaţii”, Ed. POLIEHNICA PRESS, Bucureşti, 2016

LABORATORY

Crt. no.	Content	No. hours
1	Spectral analysis of signals with harmonic carrier and amplitude modulation	2
2	Spectral analysis of signals with harmonic carrier and frequency modulation	2
3	Band-pass amplifier response to AM signals	2
4	RC active filters	3
5	Measuring elementary second-order transfer functions using active filters	3
6	Final laboratory colloquium	2
	Total:	14

SEMINARY

Crt. no.	Content	No. hours
1	AM-modulated signals	2
2	FM-modulated signals	2
3	System response to modulated signals	2
4	Signal graphs	2
5	Approximation methods for circuits	2
6	Active filters. Sensitivity calculation.	4
	Total:	14

Bibliography:

. I. Constantin, "Semnale şi răspunsul circuitelor", Bucureşti, Editura BREN, 1999
2. Ad. Mateescu, N. Dumitriu, L. Stanciu, “Semnale şi sisteme. Aplicaţii în filtrarea semnalelor”, Editura Teora, 2001.
3. I. Constantin, "Semnale", Tipografia Institutului Politehnic Bucureşti, 1992
4. D. Stanomir, "Semnale şi sisteme analogice", Editura Politehnica Press, 2005.
5. D. Stanomir, "Semnale şi sisteme discrete", Editura Athena, 1997.
6. Ad. Mateescu, Al. Şerbănescu, N. Dumitriu, L. Stanciu, "Semnale, circuite şi sisteme-probleme", Editura Militară, Bucureşti, 1998.
7. I. Constantin, S. Halunga, I. Marcu, "Semnale şi sisteme-probleme", Editura Electronica 2000, Bucureşti, 2007.
8. C. Negrescu, D. Stanomir, ”Semnale şi sisteme-Probleme şi soluţii”, Ed. Politehnica, 2013, Bucureşti.
9. T. Petrescu, S. Halunga-Fratu, O. Fratu, I. Marcu, C. Voicu, R. Crăciunescu, ”Analiza şi sinteza circuitelor. Teorie şi aplicaţii”, Ed. POLIEHNICA PRESS, Bucureşti, 2016

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowledge of the fundamental notions of signal and systems theory	Midterm test held on the date set at the beginning of the semester.	20
	Assessment of independent individual resolution of theoretical notions and proposed problems	Final exam held during the examination session	50
11.5 Seminary/laboratory/project	Assessment of understanding fundamental notions and concepts of spectral analysis of signals	Final laboratory colloquium including a practical component and a theoretical component	20
	Assessment of independent individual resolution of proposed problems	Verification paper at the seminar.	10
11.6 Passing conditions			
obtaining 50% of the total score.			

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 course presents the theory of analog and discrete systems from the perspective of signal processing, and also includes the design and analysis of analog and digital filters. The first part of the course presents the theory, and the second part exemplifies the theory through its implementation. The course content is similar to courses conducted at European and U.S. universities of the same profile.

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Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Conf. Dr. Mircea Raducanu	As. drd. Maria Sirbu Dragan

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