**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 | **Applied Electronics and Information Engineering** |
| 1.4 Domain of studies | Computers and Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Information Engineering |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Semnale şi sisteme 3 | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Ing. Radu Mihnea Udrea, Conf. Dr. Ing. Ionuţ Pirnog | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Ing. Radu Mihnea Udrea, Conf. Dr. Ing. Ionuţ Pirnog | | | |
| 2.4 Year of studies | 3 | 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.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 | 2.00 | 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<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | 65 |
| Tutoring | | | | | 0 |
| Examinations | | | | | 4 |
| Other activities (if any): | | | | | 0 |

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|---|---|
| 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)

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| 4.1 Curriculum | Completion and/or promotion of the following subjects: Mathematical Analysis, Special Mathematics, Fundamentals of Electrical Engineering, Signals and Systems 1, Signals and Systems 2 |

| | |
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| 4.2 Results of learning | Accumulation of the following knowledge: Fourier series, Fourier transform, Laplace transform, Z transform, derivation and integration of functions |

**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. |
| 5.2 Seminary/ Laboratory/Project | The laboratory will be held in a room with specific equipment, which must include: signal generator, multimeter, oscilloscope, wobulator.<br>Mandatory attendance at seminar and laboratory classes (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 modulated signals (linear, exponential) with harmonic carrier. Next, the methods of approximating transfer functions of the flat maximum type, Butterworth type, Bessel type and Chebyshev type are presented. Fluence graphs of signals with applications in the study of circuits and systems are studied. Active filters are analyzed, 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. The seminar aims to solve problems related to the analysis and synthesis of electrical circuits, and their solution requires knowledge of general methodologies for analysis, design and synthesis for 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 basic knowledge in the field of analog and discrete-time systems analysis.<br>Correlates the knowledge acquired in this course with that from other courses<br>Applies the knowledge acquired in the course in practice.<br>Applies methods and tools specific to the field of systems and circuits analysis, to carry out the process of evaluating a situation encountered in practice and identifies solutions.<br>Argues and analyzes coherently and correctly the context of application of 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, in order to communicate effectively, in writing and orally.<br>Oral and written communication in a foreign language (English): demonstrates understanding of the vocabulary related to 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.<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 |

**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>Defines and understands notions specific to the field of analog and discrete-time systems analysis: is able to determine the response of a linear and time-invariant system, is able to determine the transfer function of a system through signal graphs and Mason's rule, is able to identify the type of a filter and determine the sensitivity of some filter parameters depending on the elements of the scheme, 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).*<br>Selects and groups relevant information in a given context.<br>Works in a team.<br>Develops a scientific text in the field of systems.<br>Experimentally verifies identified solutions, solves practical applications.<br>Selects appropriate bibliographic sources and analyzes them.<br>Respects the principles of academic ethics, correctly citing the bibliographic sources used.<br>Demonstrates receptivity to new learning contexts.<br>Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities<br>Applies principles of professional ethics/deontology in analyzing the technological impact of solutions proposed in the specialized field on the environment |
| **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 receptivity to new learning contexts.<br>Demonstrates collaboration with other colleagues and teachers in carrying out teaching 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 the 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 and indirect exploration of reality (experiment, demonstration, modeling), but also on action-based methods, such as exercise, practical activities and problem solving.

Lectures will be used in the teaching activity, based on Power Point presentations or various videos that will be made available to students. Each course will begin with a recap of the chapters already covered, with an emphasis on the notions covered in the last 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 collaborative and communication relationships in a climate favorable to discovery learning.

The practice of active listening and assertive communication skills, as well as feedback construction mechanisms, will be considered, as ways of regulating behavior in various situations and adapting the pedagogical approach to the learning needs of students.

The ability to work in a team will be practiced to solve various learning tasks.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Modulated signals. Definitions and classifications. Harmonic carrier modulation. Amplitude modulation. Frequency modulation. Phase modulation. MA-MF modulation. Principle of frequency multiplexing of signals. Pulse modulation. Examples. | 8 |
| 2 | Bandpass circuit response to modulated signals. Low frequency equivalent. Methods: Fourier, Laplace, Harmonic, compact. Examples. | 4 |
| 3 | Signal flow graphs. Elements of the flow graph. Definitions and methods of graph reduction. Mason's rule. Applications in the analysis of analog and discrete, linear and time-invariant systems. Examples. | 2 |
| 4 | Ideal filters: Low-pass filter. Transfer function. Weight function. Response to the unit step function. Band-pass filter. High-pass filter and band-stop filter. Examples. | 4 |
| 5 | Approximation methods in the theory of circuits and linear systems. Introduction. The elements of approximation. Approximation criteria: flat maximum approximation, mini-max approximation. Butterworth approximation, Bessel approximation, Chebyshev approximation. Use of approximation in the theory of circuits and linear systems. Examples. | 6 |
| 6 | Synthesis of infinite impulse response filters: General properties, Indirect synthesis methods, Direct synthesis methods. | 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 | Harmonic carrier signals. Amplitude modulated signals | 4 |
| 2 | Harmonic carrier signals. Frequency modulated signals | 2 |
| 3 | Biquad active filters made with integrated circuits | 2 |
| 4 | LC filters | 2 |
| 5 | Infinite impulse response filters | 2 |
| 6 | Practical exam | 2 |
| | **Total:** | |

**SEMINARY**

| Crt. no. | Content | No. hours |
|---|---|---|
| 1 | Amplitude modulated signals | 2 |
| 2 | Frequency modulated signals | 2 |
| 3 | Response of bandpass circuits to modulated signals | 2 |
| 4 | Signal graphs | 2 |
| 5 | Ideal filters | 2 |
| 6 | Approximation methods in the theory of circuits and linear systems | 2 |
| 7 | Synthesis of infinite impulse response filters | 2 |
| | **Total:** | |

**Bibliography:**

1I. 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.
8C. Negrescu, D. Stanomir, ”Semnale şi sisteme-Probleme şi soluţii”, Ed. Politehnica, 2013, Bucureşti.
9T. Petrescu, S. Halunga-Fratu, O. Fratu, I. Marcu, C. Voicu, R. Crăciunescu, ”Analiza şi sinteza circuitelor. Teorie şi aplicaţii”, Ed. POLIEHNICA PRESS, Bucureşti, 2016
10. https://www.telecom.pub.ro/discipline/semnale-si-sisteme-3/laborator/

**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 | Exam | 50 |
| 11.5 Seminary/laboratory/project | The practical component is verified by assessing the skills of measuring the spectrum of a signal. Knowledge of how to compare experimental results with theoretical ones | laboratory sheets (10p) and end-of-semester colloquium (10p) | 20 |
| | Appreciation in independent individual solving of proposed problems | 2 tests | 30 |
| 11.6 Passing conditions | | | |
| Obtaining 50% of the total score. Modeling a simple real signal analysis problem and specifying the processing chain necessary to solve it; Implementing and demonstrating the operation of a simple solution for a spectral analysis problem of signals of interest. | | | |

**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, but also includes the design and analysis of analog and digital filters. The first part of the course presents the theory and the second part of the course exemplifies the theory through their implementation. The course has a similar content to the courses held at universities in Europe and the United States of the same profile.

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| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 21.09.2026 | Conf. Dr. Ionuţ Pirnog | Conf. Dr. Ionuţ Pirnog |



| Date of department approval | Head of department |
|---|---|

| Date of approval in the Faculty Council | Dean |
|---|---|
| 22.09.2026 | Prof. Dr. Mihnea Udrea |

