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's
1.6 Programme of studies	Microelectronics, Optoelectronics and Nanotechnologies

2. Date despre disciplină

2.1 Course name (ro) (en)				Analiză matematică Mathematical Analysis			
2.2 Course Lecturer				Bercia Cristina			
2.3 Instructor for practical activities				Bercia Cristina			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		F	2.9 Course code	04.F.01.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	3	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	56	Out of which: 3.5 course	42	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.					54
Tutoring					10
Examinations					5
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	Knowledge of algebra, mathematical analysis, and geometry, according to the baccalaureate syllabus and the faculty admission syllabus.
4.2 Results of learning	-

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

5.1 Course	Lecture hall for approx. 150 seats, equipped with a board and video projector.
5.2 Seminary/ Laboratory/Project	Seminar room for approx. 30 seats, equipped with a board.

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)*

"Mathematical Analysis" is a fundamental discipline necessary for any specialized approach, also containing chapters with direct applications. The fundamental notions of mathematical analysis are presented (sets, countability, series, partial derivatives, differential, unconstrained and constrained extrema, improper integrals, line integrals, multiple integrals, surface integrals, elements of field theory, etc.). The types of exercises and problems addressed in the seminar follow the thread of the lecture. More difficult theoretical aspects are also discussed. In certain problems, specialized software (Mathematica, Matlab, Maple, etc.) is used, and problems with applications in physics are presented (computing mechanical work, determining the center of mass and mass of a wire or a surface, computing the volume of a body, determining moments of inertia, etc.).

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	• Understanding fundamental concepts of mathematical analysis required to model and solve problems in electronic engineering, telecommunications, and information technologies. • Applying techniques of mathematical analysis to analyze and optimize algorithms, estimate errors, and numerically model complex systems and phenomena. • Using tools of mathematical analysis to develop efficient algorithms and software solutions, including in circuit simulations, signal processing, and communication analysis. • Modeling dynamic phenomena using multivariable functions, with applications in telecommunications, artificial intelligence, signal processing, and numerical simulations. • Developing abstract thinking and logical reasoning needed to formulate, analyze, and implement mathematical solutions in electronic engineering, communications, and specialized software projects.
Transversal (General) Competences	• Mastering optimal learning methods, combining theoretical results, and developing the habit of teamwork. • Learning how to support an idea and conduct a scientific debate. • Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the profession's reputation. • Awareness of the need for continuous training; efficient use of resources and learning techniques for personal and professional development.

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.* • Explains domain-specific concepts. • Correlates the studied notions within and across disciplines. • Recognizes the studied notions in processes within the specialty courses. • Gives examples for the studied notions. • Compares certain studied notions, highlighting similarities and differences.
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. • Applies the studied theory in solving applications. • Uses specific results, with justification, to solve problems. • Combines various methods and arguments to solve problems. • Creates a scientific text. • Interprets a practical problem from a mathematical point of view. • Interprets a mathematical problem from a practical point of view, where applicable. • Identifies multiple approaches to solving a problem, where applicable, and proposes solution plans. • Formulates conclusions after applying the studied notions. • Anticipates stages/modes of solving.
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, correctly citing the bibliographic sources used. • Demonstrates receptiveness to new learning contexts. • Shows 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. • Promotes/contributes with new solutions in the field to improve the quality of social life. • Analyzes and interprets business/entrepreneurial development opportunities in the field. • Demonstrates management skills for real-life situations (time management, 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 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 (demonstration, modeling), as well as action-based methods such as exercises and problem solving. Each lecture will begin with a recap of the notions covered in the previous class. This discipline includes 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. Emphasis will be placed on practicing active listening and assertive communication skills, as well as mechanisms for constructing feedback as ways of regulating behavior in various situations and adapting the pedagogical approach to students' learning needs.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Sets. Sequences of real numbers	2
2	Numerical series	4
3	Sequences and series of functions, uniform convergence, term-by-term differentiation and integration	2
4	Power series, elementary functions. Taylor's formula	4
5	Fourier series (real form)	2
6	Elements of topology of R^n. Functions of several variables, continuity. Partial derivatives. Differential. Second differential. Unconstrained extrema. Constrained extrema (in R^2, R^3)	9
7	Improper integrals. Parameter-dependent integrals. Euler integrals	4
8	Curve length. Line integrals. Gradient fields	3
9	Double integrals. Triple integrals	4
10	Surfaces, surface area, surface integrals	4
11	Integral theorems (Green–Riemann, Gauss–Ostrogradsky, Stokes)	4
	Total:	42

Bibliography:

1. Course page on the platform https://curs.upb.ro/.
2. Paul Flondor, Octavian Stănăşilă, *Lessons in Mathematical Analysis and Solved Exercises*, 2nd ed., Editura ALL, Bucharest, 1996.
3. Paul Flondor (coord.), *Differential and Integral Calculus*, course developed under Project POSDRU/56/1.2/S/32768, 2012.
4. Andrei Halanay, Radu Gologan, Dan Timotin, *Elements of Mathematical Analysis*, vols. 1 and 2, Matrix Rom, Bucharest, 2008.
5. Octavian Stănăşilă, *Mathematical Analysis*, Didactic and Pedagogical Publishing, Bucharest, 1981.
6. James Stewart, *Calculus: Early Transcendentals*, 7th ed., Brooks/Cole, Cengage Learning, 2012.
7. https://activecalculus.org/

SEMINARY

Crt. no.	Content	No. hours
1	Sets. Sequences of real numbers	1
2	Numerical series	2
3	Sequences and series of functions, uniform convergence, term-by-term differentiation and integration	1
4	Power series, elementary functions. Taylor’s formula	2
5	Fourier series (real form)	1
6	Elements of topology of R^n. Functions of several variables, continuity. Partial derivatives. Differential. Second differential. Unconstrained extrema. Constrained extrema (in R^2, R^3)	2
7	Improper integrals. Parameter-dependent integrals. Euler integrals	1
8	Curve length. Line integrals. Gradient fields	1
9	Double integrals. Triple integrals	1
10	Surfaces, surface area, surface integrals	1
11	Integral theorems (Green–Riemann, Gauss–Ostrogradsky, Stokes)	1
	Total:	14

Bibliography:

1. Course page on the platform https://curs.upb.ro/.
2. Cristina Bercia, Octavian Stănăşilă, *Mathematical Analysis: Problems and Applications in MAPLE*, Politehnica Press, 2011.
3. Mircea Cimpoeaş, *Chapters of Mathematical Analysis for Engineers*, Politehnica Press, Bucharest, 2021.
4. Tania-Luminiţa Costache, *Mathematical Analysis: Problem Collection*, Printech, Bucharest, 2009.
5. Alexandru Negrescu, *Differential Calculus: A Friendly Approach*, 3rd ed., Politehnica Press, Bucharest, 2021.
6. Alexandru Negrescu, *Integral Calculus: A Friendly Approach*, 2nd ed., Politehnica Press, Bucharest, 2021.
7. Mircea Olteanu, *Mathematical Analysis: Theoretical Notions and Solved Problems*, Printech, Bucharest, 2004.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowledge of fundamental theoretical notions. Ability to apply theoretical knowledge to problem solving.	Verification test	40%
	Knowledge of fundamental theoretical notions. Ability to apply theoretical knowledge to problem solving.	Final exam	50%
11.5 Seminary/laboratory/project	Applying the theoretical notions presented in the course to exercises and problems.	Systematic observation of students' activity during the seminar.	10%
11.6 Passing conditions			
• Participation in the final exam, face to face, during the scheduled time window. • 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 "Mathematical Analysis" plays an essential role in developing students' analytical, logical, and modeling skills, addressing current labor-market demands that value the ability to mathematically model dynamic systems, optimize algorithms, and perform quantitative analysis of technical phenomena.

The content aligns with employer expectations in fields such as electronics, telecommunications, IT, digital signal and image processing, numerical simulations, and automation, where analytical methods and techniques of differential and integral calculus are indispensable for system design, performance evaluation, and the development of efficient solutions. Such disciplines are also supported by international organizations and professional associations (e.g., IEEE, ACM, SIAM), which promote the integration of applied mathematics into modern engineering education.

The course is aligned with the practices and standards of study programs in SEIS institutions, emphasizing the development of applied mathematical competencies, understanding concepts of limits, continuity, differentiation, integration, series, and multivariable functions, as well as their application to concrete problems in electronics, telecommunications, numerical simulations, and signal and data processing.

By completing this course, students acquire the ability to analyze and solve complex mathematical problems, apply analytical methods in the development of algorithms and technical systems, interpret numerical results, and integrate this knowledge into applied projects. This preparation supports careers in research, the electronics and telecommunications industry, software development, signal processing, or applied/scientific master's programs.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Bercia Cristina	Bercia Cristina

Date of department approval	Head of department Prof. Dr. Claudius Dan
Date of approval in the Faculty Council	Dean Prof. Eng. Dr. Radu Mihnea Udrea