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)				Complemente de matematici Mathematics Complements			
2.2 Course Lecturer				Prof. Dr. Mircea Cimpoeaş			
2.3 Instructor for practical activities				N/A			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	F
2.8 Course type		F	2.9 Course code	04.F.02.L.031		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2	Out of which: 3.2 course	2	3.3 seminary/laboratory	0
3.4 Total hours in the curricula	28	Out of which: 3.5 course	28	3.6 seminary/laboratory	0
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.					6
Tutoring					10
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	22.00
3.8 Total hours per semester	50
3.9 Number of ECTS credit points	2

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Knowledge of algebra, mathematical analysis and geometry, according to the baccalaureate syllabus and the faculty entrance syllabus. The courses “Mathematical Analysis” and “Linear Algebra, Analytic and Differential Geometry”.
4.2 Results of learning	Not applicable

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

5.1 Course	Lecture hall for approximately 150 seats, equipped with a blackboard and a video projector.
5.2 Seminary/ Laboratory/Project	Not applicable

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)*

"Special Mathematics" is one of the core subjects that introduces fundamental notions and techniques used in the mathematical modeling of engineering problems. It presents fundamental notions of differential equations, partial differential equations, equations of mathematical physics, complex analysis, and integral transforms (Fourier, Laplace), with an emphasis on developing reasoning. Using the knowledge acquired in this course, the results of processes specific to the field of specialization can be explained and interpreted. For example, the study of certain electrical circuits reduces to solving systems of linear differential equations. Furthermore, the Laplace transform reduces solving a system of differential equations to solving a system of algebraic equations. Then, the Fourier transform allows a systematic transition from time-domain signals to their frequency spectra and back, and further examples in this sense may continue.

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 the fundamental concepts required for modeling and solving engineering problems and dynamic phenomena in the field of electronics, telecommunications, and information technologies. • Applying differential equations and partial differential equations in the analysis of dynamic systems and in the simulation of technical and IT processes specific to the field. • Using complex analysis and integral transforms to move systematically between the time and frequency domains, optimize algorithms, and process signals and data in engineering applications. • Developing abstract thinking and logical reasoning, necessary for formulating, analyzing, and implementing complex mathematical solutions in technical projects, electronic systems, and software applications.
Transversal (General) Competences	• Acquiring optimal learning methods, combining theoretical results, and the habit of teamwork. • Learning how to argue 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 learning resources and 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 notions specific to the field. • Provides examples of the studied notions. • Correlates the studied notions intra- and interdisciplinarily. • Recognizes the studied notions in the processes within specialized disciplines. • 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 to solving applications. • Uses specific results with arguments 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 steps/modes of resolution.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Selects suitable bibliographic sources and analyzes them. • Respects the principles of 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. • Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved. • Promotes/contributes with new solutions, related to the specialty field, to improve the quality of social life. • Analyzes and interprets business/entrepreneurial development opportunities in the specialty 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 exercise and problem solving. Each lecture will begin with a recap of the notions covered in the previous lecture. This course 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. Emphasis will be placed on practicing active listening and assertive communication skills, as well as feedback-building mechanisms, as means of behavioral regulation in diverse situations and of adapting the pedagogical approach to students' learning needs.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	First-order differential equations. Existence and uniqueness of the solution under given initial conditions. Examples. Linear differential equations and linear differential systems. Notions of qualitative theory: equilibrium, periodic solution, stability, phase portrait.	6
2	Autonomous systems. Trajectories and first integrals. Field lines, field surfaces, first-order quasilinear equations. Second-order partial differential equations. Reduction to canonical form and classification. Solution methods for hyperbolic- and parabolic-type equations. The Dirichlet problem	6
3	Complex functions: limit, continuity, holomorphy. Cauchy–Riemann relations. Complex integral. Cauchy's theorem. Cauchy's integral formula. Laurent series. Residue theorem. Computing real integrals using the residue theorem	6
4	Laplace transform. Applications	4
5	Z-transform. Applications	4
6	Fourier series (complex form). Fourier transform. Applications	2
	Total:	28

Bibliography:

1. Pagina cursului de pe platforma https://curs.upb.ro/.
2. Cristina Bercia, Romeo Bercia, Matematici speciale. Teorie şi aplicaţii, Editura Printech, Bucureşti, 2010.
3. Mircea Cimpoeaş, Capitole de algebră liniară, geometrie şi ecuaţii diferenţiale pentru ingineri, Editura Politehnica Press, Bucureşti, 2021.
4. Tania-Luminița Costache, Lecții de Matematici speciale, Editura Politehnica Press, București 2017.
5. Ioana Luca, Gheorghe Oprişan, Matematici avansate, Editura Printech, Bucureşti, 2001.
6. Ana Niță, Alina Niță, Ecuaţii şi sisteme diferenţiale, Editura Matrix Rom, Bucureşti, 2000.
7. Antonela Toma, Vladimir Slesar, Advanced Mathematics. Problems and exercises, Editura Politehnica Press, București, 2019.

Bibliography:

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 in problem solving.	Verification test in week VII	80%
	Knowledge of fundamental theoretical notions. Ability to apply theoretical knowledge in problem solving.	Verification test in week XIV	20%
11.5 Seminary/laboratory/project			
11.6 Passing conditions			

- Participation in exams, face-to-face, within the scheduled time interval.
- 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 “Special Mathematics” course plays an essential role in developing students’ analytical, logical, and modeling skills, responding to current labor market requirements that value the ability to mathematically model dynamic phenomena, solve complex equations, and develop efficient technical algorithms and solutions.

The course content is aligned with employers’ expectations in fields such as electronics, telecommunications, IT, digital signal and image processing, numerical simulations, and automation, where analytical methods, differential and partial differential equations, complex analysis, and integral transforms (Fourier, Laplace) are indispensable for system design, algorithm optimization, and performance analysis. At the same time, such courses are 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 within SEÎS institutions, where emphasis is placed on developing applied mathematical skills, understanding concepts of differential and partial differential equations, complex analysis and integral transforms, as well as applying them 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 and integral transforms in the development of algorithms and technical systems, interpret numerical results, and integrate this knowledge into practical projects. This preparation supports career development 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	Prof. Dr. Mircea Cimpoeaş	N/A

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