SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Automation, Applied Informatics and Intelligent System
1.5 Cycle of study	Licence
1.6 Program of study / Qualification	Automation and Applied Informatics (in English Language)
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Mathematical Foundations of Control Systems***				Subject code	**9**
2.2 Course responsible / lecturer	Prof. dr. Rașa Ioan - Ioan.Rasa@math.utcluj.ro Prof. dr. Inoan Daniela - Daniela.Inoan@math.utcluj.ro					
2.3 Teachers in charge of seminars / Laboratory / project	Prof. dr. Inoan Daniela - Daniela.Inoan@math.utcluj.ro Lecturer dr. Otrocol Diana - Diana.Otrocol@math.utcluj.ro					
2.4 Year of study	I	2.5 Semester	2	2.6 Type of assessment (E - exam, C - colloquium, V – verification)		E
2.7 Subject category	Formative category: DF – fundamental, DS – speciality, DC – complementary					DF
	Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)					DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	3.2 Course	2	3.3 Seminar	2	3.3 Laboratory	0	3.3 Project	0
3.4 Total hours in the teaching plan	56	of which:	3.5 Course	28	3.6 Seminar	28	3.6 Laboratory	0	3.6 Project	0

3.7 Time distribution (hours per semester) for:	
(a) Manual, lecture material and notes, bibliography	10
(b) Supplementary study in the library, online and in the field	10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	21
(d) Tutoring	0
(e) Exams and tests	3
(f) Other activities:	0
3.8 Total hours individual study hours (sum of (3.3(a)...3.3(f)))	44
3.9 Total hours per semester (3.2+3.4)	100
3.10 Number of credits points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	
4.2 Competence	Competence in Mathematical Analysis (ability to calculate derivatives and real integrals), Linear Algebra, Analytic geometry.

5. Requirements (where appropriate)

5.1. For the course	
5.2. For the applications	

6. Specific competence

6.1 Professional competences	**C1 –** Operating with basic Mathematical, Engineering and Computer Science concepts • **C1.1 -** Recognizing and describing specific concepts to calculability, complexity, programming paradigms and modeling of computing and communication systems • **C1.2 -** Using specific theories and tools (algorithms, schemes, models, protocols, etc.) for explaining the structure and the functioning of hardware, software and communication systems • **C1.3 -** Building models for various components of computing systems • **C1.4 -** Formal evaluation of the functional and non-functional characteristics of computing systems • **C1.5 -** Providing theoretical background for the characteristics of the designed systems

6.2 Cross competences	N/A

7. Expected Learning Outcomes

Knowledge	Describes, identifies, and summarizes elementary concepts and methods related to: - probabilities and random variables; - complex integrals, series of complex numbers; Laurent series; - residues of a function; - Laplace transform - Z transform - Fourier transform
Skills	Knows how to solve problems involving the theoretical concepts mentioned above. Expands functions in Laurent series and and identifies the residue of a function at a point. Calculating complex and real integrals using the Residue theorem. Calculating the Laplace, Fourier and Z transform for various functions. Determines the solution of Cauchy problems using Laplace transform. Determines sequences given by a recurrence using Z transform. Applies classical probabilities models in various cases. Determines characteristic numbers related to random variables.
Responsibilities and autonomy	Displays honorable, responsible, and ethical conduct, in accordance with the law, in order to uphold the reputation of the profession.

8. Discipline objective (as results from the *key competences gained*)

8.1 General objective	Understanding and assimilation of concepts, principles, methods and fundamental techniques used in complex functions theory and integral transforms theory with applications in System Engineering.
8.2 Specific objectives	Operating with complex numbers, functions, series. Operating with integral and discrete transforms (Fourier, Laplace, z) Use of the complex functions theory and integral transforms theory for solving problems in engineering.

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
1. Basic probability notions.	2	Explanation Demonstration Collaboration Interactive activities	
2. Classical probability models.	2		
3. Random variables.	2		
4. The complex integral. Cauchy's integral theorem and integral formula.	2		
5. Taylor and Laurent series. Singular points, classification.	2		
6. The Residue Theorem. Applications.	2		
7. The integral Fourier transform. Definition and properties.	2		
8. Convolution product. Applications of the Fourier transform.	2		
9. The discrete Fourier transform. Definition and properties	2		
10. The Laplace transform. Definition and properties.	2		
11. The inverse Laplace transform. Properties.	2		
12. Applications of the Laplace transform.	2		
13. The z transform. Definition, properties. Applications.	2		
14. Notions of Distribution theory.	2		

Bibliography:

1. A.I. Mitrea, Matematici speciale: Analiza matematica in complex. Transformari integrale si discrete (curs + culegere de probleme) Ed. Mediamira, Cluj-Napoca, 2015.
2. B.G. Osgood: Lectures on Fourier Transforms and its Applications, American Mathematical Society, 2019
3. Urs Graf: Applied Laplace Transforms and z-Transforms for Scientists and Engineers, Birkhauser Verlag, Basel· Boston· Berlin, 2004
4. I. Rasa, D. Inoan – Lecture notes in special mathematics – available online on Microsoft Teams.

9.2 Applications - Seminars / Laboratory / Project	Hours	Teaching methods	Notes
1. Conditional probabilities	2	Explanation Demonstration Collaboration Interactive activities	
2. Applications of classical probability models	2		
3. Mean, variance and other characteristics of random variables	2		
4. Complex integrals. Taylor series.	2		
5. Laurent series. Residues.	2		
6. Applications of the Residue Theorem.	2		
7. The integral Fourier transform. Integral equations.	2		
8. Convolution product, applications of the Fourier transform	2		
9. Discrete Fourier transform: direct calculus, matrix form, Parseval's formula	2		
10. The Laplace transform: calculus, convolution product. The inverse Laplace transform	2		
11. Applications of the Laplace transform to differential equations.	2		
12. Applications of the Laplace transform to integral equations and improper integrals.	2		
13. The z transform. Calculus properties.	2		
14. Applications of the z transform.	2		

Bibliography:

1.D.M. Kerekes: Analiza matematica in complex (culegere de probleme), Editura UT Press, 2023, online.
2. A.I. Mitrea, Variabile si semnale aleatoare (curs + culegere de probleme) Ed. UTPress, Cluj-Napoca, 2006.
3. M.L. Krasnov, A.I. Kiselev, G.I. Makarenko, Functions of a Complex Variable, Operational Calculus and Stability Theory, Mir Publishers, Moscow, 1984.

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Collaboration with engineers in order to identify and solve problems raised by the market.

11. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Abilities of understanding and using creatively the basic concepts and proofs	Written examination	20%
Seminar	Practical abilities of solving problems and applying algorithms	Written examination. Seminar activity (20%)	80%
Laboratory	-	-	-
Project	-	-	-

Minimum standard of performance:
Ability to present coherently a theoretical subject and to solve problems with practical content. Minimum mark 5 at the written exam.

Date of filling in:	**Responsible**	**Title, First name Last name**	**Signature**
6.07.2026	Course	Prof.dr. Ioan RAȘA Prof.dr. Daniela INOAN	

	Applications	Prof.dr. Daniela INOAN	
		Lecturer.dr. Diana OTROCOL	

Date of approval in the department	Head of Department of Automation, Prof.dr. eng. Honoriu Vălean
Date of approval in the Faculty Council	Dean, Prof.dr.eng. Vlad Mureșan