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	Computer science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Computer science / Engineer
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Special Mathematics in engineering***			Subject code	**20**
2.2 Course responsible / lecturer	Prof. dr. Rașa Ioan - Ioan.Rasa@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	II	2.5 Semester	3	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:	Course	2	Seminars	2	Laboratory	-	Project	-
3.2 Number of hours per semester	56	of which:	Course	28	Seminars	2	Laboratory	-	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										20
(b) Supplementary study in the library, online and in the field										20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										26
(d) Tutoring										-
(e) Exams and tests										3
(f) Other activities:										-

3.4 Total hours of individual study (suma (3.3(a)...3.3(f)))	69
3.5 Total hours per semester (3.2+3.4)	125
3.6 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	
4.2 Competence	Competences 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: - operations with complex numbers; properties of complex numbers; - complex integrals, series of complex numbers; Taylor and Laurent series; - residues of a function; - Laplace transform - Z transform - Fourier transform
Skills	Knows how to solve problems involving the theoretical concepts mentioned above. Calculates sums of series, expands functions in Taylor and Laurent series and and identifies the residue of a function at a point. Calculates complex and real integrals using the Residue theorem. Calculates the Laplace, Fourier and Z transform for various functions. Determines the solution of Cauchy proflems using Laplace transform. Determines sequences given by a reccurence using Z transform. Determines points of local and global extremum for functions.
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. Operations with complex numbers. Topology in C.	2	Explanation Demonstration Collaboration Interactive activities.	
2. Monogenic functions. The Cauchy-Riemann conditions.	2		
3. Holomorphic functions. Elementary functions.	2		
4. The complex integral. Cauchy's integral theorem and integral formula. Taylor and Laurent series. Singular points, classification.	2		

5. Taylor series. Laurent series.	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. Operations with complex numbers	2	Explanation Demonstration Collaboration Interactive activities.	
2. Monogenic functions. The Cauchy-Riemann conditions.	2		
3. Holomorphic functions. Elementary functions. Geometric aspects.	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, Matematici speciale: Analiza matematica in complex. Transformari integrale si discrete (curs + culegere de probleme) Ed. Mediamira, Cluj-Napoca, 2015.
3. M.L. Krasnov, A.I. Kiselev, G.I. Makarenko, Functions of a Complex Variable, Operational Calculus and Stability Theory, Mir Publishers, Moscow, 1984.

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

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: 30.04.2026	**Responsible**	**Title, First name Last name**	**Signature**
	Course	Prof.dr. Ioan RAȘA	
	Applications	Prof.dr. Daniela INOAN	
		Lecturer.dr. Diana OTROCOL	

Date of approval in the department	Head of Department of Mathematics, Prof.dr. Dorian Popa
Date of approval in the Faculty Council	Dean, Prof.dr.eng. Vlad Mureșan