SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	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. Estimated total time

2.1 Subject name	***Mathematical Analysis I (Differential calculus)***			Subject code	**1**
2.2 Course responsible / lecturer	Prof. dr. Popa Dorian - Popa.Dorian@math.utcluj.ro Prof. dr. Inoan Daniela - Daniela.Inoan@math.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Conf. dr. Baias Alina-Ramona - Baias.Alina@math.utcluj.ro Prof. dr. Inoan Daniela - Daniela.Inoan@math.utcluj.ro				
2.4 Year of study	I	2.5 Semester	1	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	applications	2
3.4 Total hours in the teaching plan	56	of which:	Course	28	applications	28
3.3 Individual study						
a) Manual, lecture material and notes, bibliography						28
b) Supplementary study in the library, online, and in the field						4
c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays						8
d) Tutoring						2
e) Exams and tests						2
f) Other activities						-

3.4 Total hours of individual study	44
3.5 Total hours per semester	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Basic knowledge of Differential Calculus and Set Theory
4.2 Competence	Competences in mathematics: elements of set theory, limits, sequences and series, derivatives.

5. Requirements (where appropriate)

5.1 For the lectures	Blackboard, whiteboard, projector
5.2 For the applications	Blackboard, whiteboard, projector

6. Specific competences

6.1 Professional competences	**C1 -** Operating with basic Mathematical, Engineering, and Computer Science concepts • Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems • Building models for various components of computing systems • Providing a theoretical background for the characteristics of the designed systems • Knowledge of the fundamentals of mathematical analysis with a view to applying them in the practice of the discipline
6.2 Cross competences	N/A

7. Expected Learning Outcomes

Knowledge	The student/graduate identifies and describes basic concepts, principles and methods in mathematics, physics, chemistry, technical drawing, economics and computer science.
Skills	The student/graduate operates with basic concepts, principles and methods from mathematics, physics, chemistry, technical drawing, economics and computer science. The student/graduate solves problems in mathematics, physics and chemistry with applicability in engineering and validates the solution obtained. The student/graduate performs engineering and economic calculations of medium complexity and associates them with graphical representations or specific computer-aided design. The student/graduate describes physico-chemical and economic phenomena and processes.
Responsibilities and autonomy	The student/graduate applies the values of ethics and deontology of the engineering profession. The student/graduate practices logical reasoning, evaluation and self-evaluation in decision-making. The student/graduate communicates effectively about engineering activities with a wide range of audiences. The student/graduate is engaged in lifelong learning to acquire and implement knowledge, as needed, using appropriate learning strategies. The student/graduate promotes dialogue, cooperation, respect for others and interculturality. The student/graduate works effectively as a team member or leader.

8. Discipline objectives (as results from the *key competencies gained*)

8.1 General objective	A presentation of the concepts, notions, methods, and fundamental techniques used in differential calculus.
8.2 Specific objectives	Use of differential calculus to solve problems in engineering. Use of differential calculus in modelling and solving practical problems concerning spatial forms.

9. Contents

8.1. Lecture (syllabus)	Teaching methods	Notes
1. Sequences of real numbers. Series of real numbers	Explanation Demonstration Collaboration Interactive activities.	
2. Series of Numbers. Convergence tests for series		
3. Functional Sequences and Series. Power series.		
4. Differential Calculus for Functions of One Variable. Taylor's formula for real functions of one variable.		
5. Taylor series		
6. Trigonometric and Fourier series.		
7. Functions of Several Variables. Continuity, partial derivatives.		
8. Derivatives of composite functions. Differential operators		

9. The differential of functions of several variables. Taylor's formula for functions of several variables. Directional derivative.		
10. Extrema of Functions of several real variables.		
11. Implicit Functions. Existence theorems for implicit functions.		
12. Conditional extrema. Change of coordinates and variables.		
13. Metric spaces. Sequences in metric spaces. Banach fixed point theorem.		
14. Topology of a metric space		

Bibliography:

1. Dumitru Mircea Ivan, Dorian Popa et al.,: *Calcul diferenţial*, Editura Mediamira, Cluj-Napoca, 2004. ISBN 973- 713-008-1
2. Dumitru Mircea Ivan: *Calculus*, Editura Mediamira, Cluj-Napoca, 2002. ISBN 973-9358-88-8
3. Dorian Popa, Calculus, Editura Mediamira, 2005.
4. Daniela Inoan, Problems in differential and integral calculus, Editura Mediamira, Cluj-Napoca, 2007. ISBN 978-973-7131-92-8

8.2. Applications (Seminars)	Teaching methods	Notes
1. Limits of real number sequences. Cesaro-Stolz theorem.	Explanation Demonstration Collaboration Interactive activities.	
2. Exercises concerning sums of series.		
3. Convergence tests for series		
4. Exercises related to power series.		
5. Exercises related to Taylor series		
6. Exercises related to Fourier series.		
7. Partial derivatives. Gradient, divergence.		
8. Derivatives of composite functions. Chain rule.		
9. Exercises related to Extrema of Functions of several real variables.		
10. Exercises related to implicit functions.		
11. Conditional extrema. Change of coordinates and variables.		
12. Exercises related to changes of variables.		
13. Examples of metrics.		
14, Exercises related to metric spaces.		

Bibliography:

1. Dumitru Mircea Ivan, et al. *Analiză matematică - Culegere de probleme pentru seminarii, examene şi concursuri.* Editura Mediamira, Cluj-Napoca, 2002. ISBN 973-9357-20-2.
2. Dorian Popa (colectiv), Calcul diferential, Editura Mediamira, 2004.
3. Alina Sîntămărian, Ovidiu Furdui: *Sharpening Mathematical Analysis Skills.* Problem Books in Mathematics, Springer, Cham, 2021. (xx+536 pagini) ISBN: 978-3-030-77138-6
4. Daniela Inoan, Problems in differential and integral calculus, Editura Mediamira, Cluj-Napoca, 2007. ISBN 978-973-7131-92-8

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
Lectures	Ability to understand and use the concepts and proofs creatively	Written/oral examination	40%
Applications	Ability to solve problems and apply algorithms	Written/oral examination	60%
Minimum standard of performance: Ability to present a theoretical subject coherently and to solve problems with practical content.			

Date of filling in: 13.05.2026	Responsible	Title, First name Last name	Signature
	Course	Prof. dr. Dorian POPA	
		Prof. dr. Daniela INOAN	
	Applications	Prof. dr. Daniela INOAN	
		Conf. dr. Alina Ramona BAIAS	

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