SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University Cluj-Napoca
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Mathematics
1.4 Field of study	Computer Science
1.5 Study cycle	Bachelor of Science
1.6 Study programme / Qualification	Computer Science

2. Information regarding the discipline

2.1 Name of the discipline			Mathematical Analysis				
2.2 Course coordinator			Lect. dr. Adriana Nicolae				
2.3 Seminar coordinator			Lect. dr. Adriana Nicolae				
2.4. Year of study	1	2.5 Semester	1	2.6. Type of evaluation	E	2.7 Type of discipline	Compulsory

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					30
Additional documentation (in libraries, on electronic platforms, field documentation)					10
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					14
Evaluations					20
Other activities					-
3.7 Total individual study hours	94				
3.8 Total hours per semester	150				
3.9 Number of ECTS credits	6				

4. Prerequisites (if necessary)

4.1. curriculum	• High-school calculus
4.2. competencies	• Computing limits, derivatives, and antiderivatives • Analytic thinking

5. Conditions (if necessary)

5.1. for the course	
5.2. for the seminar /lab activities	

6. Specific competencies acquired

Professional competencies	• C1.1 Identification of notions, description of theories and use of specific language. • C1.4 Recognition of main classes/types of mathematical problems and of appropriate techniques for solving them. • C5.2 Use of mathematical arguments to prove mathematical results.
Transversal competencies	• CT3 Use of efficient methods and techniques for learning, information, research and development of abilities for the valorization of acquired knowledge, for adapting to the needs of a dynamic society and for communication in Romanian as well as in a widely used foreign language

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• To acquire elementary knowledge about differential and integral calculus for real-valued functions of one and several real variables and to apply it in solving concrete problems
7.2 Specific objective of the discipline	• To know and use the following specific notions: sequences and series of real numbers, limits of functions, directional derivatives, partial derivatives, extremum points, improper integrals, multiple integrals

8. Content

8.1 Course	Teaching methods	Remarks
1. The real numbers: some basic concepts	Lecture, discussion, didactical demonstration, problematisation	
2. Sequences of real numbers	Lecture, discussion, didactical demonstration, problematisation	
3. Series of real numbers. Series with nonnegative terms (I)	Lecture, discussion, didactical demonstration, problematisation	
4. Series with nonnegative terms (II). Alternating series	Lecture, discussion, didactical demonstration, problematisation	
5. Growth of functions. Applications	Lecture, discussion, didactical demonstration, problematisation	
6. Limits, continuity and differentiation of real-valued functions of one real variable	Lecture, discussion, didactical demonstration, problematisation	
7. Higher order derivatives. Taylor series	Lecture, discussion, didactical demonstration, problematisation	
8. The Euclidean space $\mathbb{R}^n$. Sequences in $\mathbb{R}^n$	Lecture, discussion, didactical demonstration, problematisation	
9. Limits and continuity of real-valued functions of several variables	Lecture, discussion, didactical demonstration, problematisation	
10. Directional and partial derivatives	Lecture, discussion, didactical demonstration, problematisation	
11. Local and global extremum points for real-valued functions	Lecture, discussion, didactical demonstration, problematisation	
12. Riemann integrals. Improper integrals	Lecture, discussion, didactical demonstration, problematisation	

13. Multiple integrals	Lecture, discussion, didactical demonstration, problematisation	
14. Change of coordinates in the plane	Lecture, discussion, didactical demonstration, problematisation	

Bibliography

1. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, 4th ed., John Wiley & Sons Inc., New York, 2011.
2. W.W. Breckner, Analiză matematică. Topologia spaţiului $\mathbb{R}^n$, Universitatea din Cluj-Napoca, Cluj-Napoca, 1985.
3. Ş. Cobzaş, Analiză matematică - Calculul diferenţial, Presa Universitară Clujeană, Cluj-Napoca, 1997.
4. M. Mureşan, A Concret Approach to Classical Analysis, Springer, New York, 2008.
5. M. Oberguggenberger, A. Ostermann, Analysis for Computer Scientists, Foundations, Methods, and Algorithms, Springer, London, 2011.
6. W. Rudin, Principles of Mathematical Analysis, 3rd ed., McGraw-Hill Inc., New York, 1976.
7. P. Straffin ed., Applications of Calculus, Mathematical Association of America, Washington, DC, 1993.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Classical inequalities	Discussion, problem solving, didactical demonstration	
2. Properties of real numbers. Sequences of real numbers (I)	Discussion, problem solving, didactical demonstration	
3. Sequences of real numbers (II)	Discussion, problem solving, didactical demonstration.	
4. Computing the sum of some series of real numbers	Discussion, problem solving, didactical demonstration	
5. Convergence/divergence of some series of real numbers	Discussion, problem solving, didactical demonstration	
6. Limits, continuity, and differentiation of real-valued functions of one real variable	Discussion, problem solving, didactical demonstration	
7. Higher order derivatives. Taylor series	Discussion, problem solving, didactical demonstration	
8. The Euclidean space $\mathbb{R}^n$. Sequences in $\mathbb{R}^n$	Discussion, problem solving, didactical demonstration	
9. Limits and continuity of real-valued functions of several variables	Discussion, problem solving, didactical demonstration	
10. Directional and partial derivatives	Discussion, problem solving, didactical demonstration	
11. Extremum problems	Discussion, problem solving, didactical demonstration	
12. Riemann integrals. Improper integrals	Discussion, problem solving, didactical demonstration	
13. Multiple integrals	Discussion, problem solving, didactical demonstration	
14. Change of coordinates in the plane	Discussion, problem solving, didactical demonstration	

Bibliography

1. D.I. Duca, E. Duca, Exerciţii şi probleme de analiză matematică, vol. I, II, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2007, 2009.

2. W.J. Kaczor, M.T. Nowak, Problems in Mathematical Analysis, vol. I, II, III, American Mathematical Society, 2000, 2001, 2003.
3. T. Trif, Probleme de calcul diferenţial şi integral în $\mathbb{R}^n$, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2003.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course ensures a solid theoretical background, according to national and international standards.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge of basic notions, examples, and results	- Homework assignments containing exercises on the discussed topics - Open book and open notes exam covering the whole material - Lecture and seminar activity	- Homework assignments: 40% - Exam: 60% - Lecture and seminar activity: bonus 6%
10.5 Seminar/lab activities	Problem solving using concepts and results acquired during the lecture classes		
10.6 Minimum performance standards			
Both the grade at the exam and the final average should be at least 5.			

Date	Signature of course coordinator	Signature of seminar coordinator
27.09.2020	Lect. dr. Adriana Nicolae	Lect. dr. Adriana Nicolae

Date of approval	Signature of the head of department
.....	Prof. dr. Octavian Agratini