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	Mathematics
1.5 Study cycle	Master
1.6 Study programme / Qualification	Modern Methods in Mathematics Teaching

2. Information regarding the discipline

2.1 Name of the discipline			Topics in Mathematical Analysis III				
2.2 Course coordinator			Prof. Octavian Agratini, Ph.D.				
2.3 Seminar coordinator			Prof. Octavian Agratini, Ph.D.				
2.4. Year of study	2	2.5 Semester	4	2.6. Type of evaluation	Exam	2.7 Type of discipline	Optional

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

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/~~laboratory~~	1
3.4 Total hours in the curriculum	36	Of which: 3.5 course	24	3.6 seminar/~~laboratory~~	12
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					56
Additional documentation (in libraries, on electronic platforms, field documentation)					48
Preparation for seminars/labs, homework, papers, portfolios and essays					40
Tutorship					10
Evaluations					35
Other activities					-
3.7 Total individual study hours	189				
3.8 Total hours per semester	225				
3.9 Number of ECTS credits	9				

4. Prerequisites (if necessary)

4.1. curriculum	• Mathematical Analysis 1 (on R) • Mathematical Analysis 2 (Calculus on R^n)
4.2. competencies	Ability to use abstract notions, theoretical results and practical methods of Mathematical Analysis.

5. Conditions (if necessary)

5.1. for the course	• Lecture hall equipped with blackboard and beamer
5.2. for the seminar /lab activities	• Classroom equipped with blackboard

6. Specific competencies acquired

Professional competencies	To use appropriate theoretical results and methods for solving different classes of mathematical analysis problems.
Transversal competencies	To apply rigorous and efficient work rules, by adopting a responsible attitude towards the scientific and didactic activities. To develop the own creative potential in specific areas, following the professional ethical norms and principles.

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

7.1 General objective of the discipline	Enhanced understanding of some special topics in Mathematical Analysis useful to high-school teachers.
7.2 Specific objective of the discipline	Students should acquire solving skills for challenging problems, by an in-depth study of key notions and fundamental theoretical results.

8. Content

8.1 Course	Teaching methods	Remarks
1. Sequences defined by linear recurrences with constant coefficients.	Direct instruction, mathematical proof, exemplification	
2. Special classes of sequences defined by nonlinear recurrences.	Direct instruction, mathematical proof, exemplification	
3.Techniques to solve equations.	Direct instruction, mathematical proof, exemplification	
4. Series of real numbers: Cauchy and Riemann theorems concerning the permutations of absolutely convergent and of conditionally convergent series, respectively.	Direct instruction, mathematical proof, exemplification	
5. Abel, Cauchy and Mertens theorems concerning the product of two series.	Direct instruction, mathematical proof, exemplification	
6. The Darboux property. Applications.	Direct instruction, mathematical proof, exemplification	
7. Uniformly continuous functions and their sequential characterization; Lipschitz and Hölder continuous functions.	Direct instruction, mathematical proof, exemplification	
8. Computing methods for the primitives.	Direct instruction, mathematical proof, exemplification	
9. Riemann integrable functions.	Direct instruction, mathematical proof, exemplification	
10. Convex functions (one variable);	Direct instruction, mathematical	

characterizations and regularity properties (continuity, onesided derivability).	proof, exemplification	
11. Characterizations of convexity by means of tangent lines, first and second order derivatives.	Direct instruction, mathematical proof, exemplification	
12. Approximation of functions.	Direct instruction, mathematical proof, exemplification	

Bibliography

1. BRECKNER, B.E., POPOVICI, N.: Convexity and Optimization. An Introduction. Editura EFES, Cluj-Napoca, 2006.
2. BRECKNER, W.W., TRIF, T.: Convex Functions and Related Functional Equations. Selected Topics. Presa Universitară Clujeană, 2008.
3. COBZAŞ, Şt.: Analiză matematică (Calcul diferenţial). Presa Universitară Clujeană, Cluj-Napoca,1997.
4. ROBERTS, A.W., VARBERG, D.E.: Convex Functions. Academic Press, 1973.
5. RUDIN, W.: Principles of Mathematical Analysis. 2nd Edition, McGraw-Hill, New York, 1964.
6. SIREŢCHI, Gh.: Calcul diferenţial şi integral. Vol. 1: Noţiuni fundamentale. Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1985.

8.2 Seminar	Teaching methods	Remarks
1. Sequences defined by linear recurrences. Examples.	Problem-based instruction, debate, mathematical proofs	
2. Sequences defined by nonlinear recurrences. Examples.	Problem-based instruction, debate, mathematical proofs	
3.The chord and tangent method for solving equations.	Problem-based instruction, debate, mathematical proofs	
4. The fixed point method for solving equations.	Problem-based instruction, debate, mathematical proofs	
5. Remarkable series of real numbers.	Problem-based instruction, debate, mathematical proofs	
6. Mean values theorems. Applications.	Problem-based instruction, debate, mathematical proofs	
7. Wallis and Stirling formulae.	Problem-based instruction, debate, mathematical proofs	
8. Taylor series.	Problem-based instruction, debate, mathematical proofs	
9. Uniform continuity; Lipschitz continuous functions.	Problem-based instruction, debate, mathematical proofs	
10. The Darboux property and antiderivability.	Problem-based instruction, debate, mathematical proofs	
11. Applications of convexity. Inequalities.	Problem-based instruction, debate, mathematical proofs	
12. Classes of linear operators.	Problem-based instruction, debate, mathematical proofs	

Bibliography

1. APOSTOL, T. M.: Modular functions and Dirichlet series in number theory. Springer-Verlag, New

York, 1990.
2. BORWEIN, J.M., LEWIS, A.S.: Convex Analysis and Nonlinear Optimization. Theory and Examples. CMS Books in Mathematics, Springer, 2000.
3. BRECKNER, B.E., POPOVICI, N.: Probleme de analiză convexă în R^n. Casa Cărţii de Ştiinţă, Cluj-Napoca, 2003.
4. COBZAŞ, Şt.: Analiză matematică (Calcul diferenţial). Presa Universitară Clujeană, Cluj-Napoca,1997.
5. SIREŢCHI, Gh.: Calcul diferenţial şi integral. Vol. 2: Exerciţii, Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1985.

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

The 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 theoretical concepts and theoretical results; - Ability to solve practical exercises and theoretical problems	Written exam	70%
10.5 Seminar/lab activities	Active participation to tutorials (problem solving).	Continuous evaluation	30%
10.6 Minimum performance standards			
The final grade should be greater than or equal to 5.			

Date: 22.04.2024

Signature of course coordinator: Prof. Octavian Agratini, Ph.D.

Signature of seminar coordinator: Prof. Octavian Agratini, Ph.D.

Date of approval: 30.04.2024

Signature of the head of department: Prof. Andrei Mărcuş, Ph.D.