COURSE DESCRIPTION

Complements of Mathematical Analysis

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Mathematics
1.4. Field	Mathematics
1.5. Level of study	Bachelor
1.6. Degree programme / Qualification	Mathematics and Computer Science
1.7. Form of education	full-time

2. Course-related data

2.1. Course title	Complements of Mathematical Analysis			Course code	**MLE0033**
2.2. Course coordinator	Lect. dr. Stefan Berinde				
2.3. Seminar coordinator	Lect. dr. Stefan Berinde				
2.4. Year of study	2	2.5. Semester	4	2.6. Type of assessment	VP
2.7. Course status	Opțional			2.8. Course type	DS

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory/ project	**2**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**28**
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					30
Additional research in the library, on subject-specific electronic platforms, and on-site					10
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					20
Tutoring (professional guidance)					14
Examinations					20
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**94**	
3.8. Total hours per semester				**150**	
3.9. Number of credits				**6**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Mathematical Analysis I
4.2 skills-related	Understanding calculus on the real axis

5. Specific conditions (where applicable)

5.1. course-related	Class room with an overhead projector and a blackboard
5.2. seminar/laboratory-related	Class room with an overhead projector and a blackboard

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

Professional competencies	
Competency code	**Competency**
PC2	*perform analytical mathematical calculations*
PC6	*think abstractly*
PC8	*study relationships between quantities*
Transversal competencies	
Competency code	**Competency**
TC4	*Solve problems*
TC5	*Think analytically*

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC5	*9. The student/graduate formulates observations and differentiates notions, properties, and assertions from advanced mathematics disciplines through examples and counterexamples.*	*9. The student/graduate argues the role of elements found in the hypotheses of mathematical assertions, discusses how they articulate within the proof, and independently constructs correct proofs of mathematical assertions from major mathematical disciplines. The student/graduate translates a practical situation into mathematical language, solves the resulting problem, and interprets the obtained results.*

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The student has acquired the skills specific to the discipline (complementary notions of the theory of real numbers, real number sequences and power series).
Specific academic skills
1. The student is able to: - explain theoretical notions, problem-solving methods, paradigms, etc. used in different branches of mathematics related to secondary education. - independently explore certain mathematical contents, based on the ideas and tools already acquired, in order to expand their knowledge.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks[3]**
1. A short history of mathematical analysis	interactive exposure, explanation, examples	
2. Real numbers – irrationality and	interactive exposure, explanation,	

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

transcendence	examples	
3. Real numbers – continued fractions	interactive exposure, explanation, examples	
4. Applications of continued fractions	interactive exposure, explanation, examples	
5. Linear recurrent sequences	interactive exposure, explanation, examples	
6. Nonlinear recurrent sequences	interactive exposure, explanation, examples	
7. Notable recurrent sequences and applications	interactive exposure, explanation, examples	
8. Limit points of a sequence	interactive exposure, explanation, examples	
9. Operations with power series	interactive exposure, explanation, examples	
10. Formal series	interactive exposure, explanation, examples	
11. Generating functions	interactive exposure, explanation, examples	
12. Applications to combinatorics	interactive exposure, explanation, examples	
13. Various applications	interactive exposure, explanation, examples	
14. *Due examination*		

Bibliography

1. Hardy G.H. et al.: An introduction to the theory of numbers, Oxford University Press, 2008

2. Mickens R.E.: Difference equations. Theory, applications and advanced topics, CRC Press, 2015

3. Wilf H.S.: generatingfunctionology, A.K. Peters Ltd., Massachusetts, 2006

4. Zorich V.A.: Mathematical Analysis I, Springer, 2004

5. ***: Pagina cursului Complemente de analiza matematica (notite de curs ale titularului), *http://math.ubbcluj.ro/~sberinde/comp/*

8.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
1. Classic inequalities	project exposure by student team	2-3 students
2. Important numbers as limits of sequences	project exposure by student team	2-3 students
3. Irrationality and transcendence of some important numbers	project exposure by student team	2-3 students
4. Toeplitz theorem and applications	project exposure by student team	2-3 students
5. Arithmetic-geometric mean. Gauss formula	project exposure by student team	2-3 students
6. Stirling formula	project exposure by student team	2-3 students
7. Notable recurrences and applications	project exposure by student team	2-3 students
8. Infinite products	project exposure by student team	2-3 students
9. Bernoulli polynomials and numbers	project exposure by student team	2-3 students
10. Riemann Zeta function	project exposure by student team	2-3 students

11. Euler Gamma function	project exposure by student team	2-3 students
12. *Proofs from the lists I*	conversation, exercise and didactic proof	selection
13. *Proofs from the lists II*	conversation, exercise and didactic proof	selection
14. *Due examination*		

Bibliography

1. Cobzas S.: Analiza matematica (Calcul diferential), Presa Universitara Clujeana, 1997

2. Duren P.: Invitation to Classical Analysis, AMS, 2012

3. Kaczor W.J., Nowak M.T.: Problems in Mathematical Analysis, vol. I si II, AMS, 2001

4. Mercer P.R.: More calculus of a single variable, Springer, 2014

5. Siretchi, Gh.: Calcul diferential si integral, vol. I si II, Editura Stiintifica si Enciclopedica, 1985

*6. ***: Pagina cursului Complemente de analiza matematica (notite de curs ale titularului), http://math.ubbcluj.ro/~sberinde/comp/*

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	Knowledge of basic concepts and results, problem solving	Written exam	50%
9.5. Seminar/ laboratory	Individual project evaluation	Continous observation, dialogue	50%
9.6 Minimum standard for passing			
Grade 5 (on a scale from 1 to 10)			

10. SDG labels (Sustainable Development Goals)[6]

	○	Sustainable Development Generic Label

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

								
○	○	○	○	○	○	○	○	◉
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
10.04.2026

Signature of course coordinator

Lect. dr. Stefan Berinde

Signature of seminar coordinator

Lect. dr. Stefan Berinde

Date of approval in the department:
24.04.2026

Signature of the head of department

Prof. dr. Andrei Mărcuş