SYLLABUS

1. Information regarding the programme

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

2. Information regarding the discipline

2.1 Name of the discipline	Complements of Mathematical Analysis						
2.2 Course coordinator		Lect. dr. Berinde Stefan					
2.3 Seminar coordinator		Lect. dr. Berinde Stefan					
2.4. Year of study	2	2.5 Semester	4	2.6. Type of evaluation	VP	2.7 Type of discipline	Op.

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	• Mathematical Analysis I
4.2. competencies	• Understanding calculus on the real axis

5. Conditions (if necessary)

5.1. for the course	• Class room with an overhead projector and a blackboard
5.2. for the seminar /lab activities	• Class room with an overhead projector, computer and a blackboard

6. Specific competencies acquired

Professional competencies	• C1.5 Elaborarea unor proiecte si lucrari de prezentare a unor rezultate si metode matematice. • C5.4 Evaluarea comparativa si utilizarea eficienta a diferitelor metode de demonstratie

Transversal competencies	•	CT2. Desfasurarea eficienta si eficace a activitatilor organizate in echipa

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

7.1 General objective of the discipline	• Complementary results from the field of classical analysis on the real axis
7.2 Specific objective of the discipline	• introduction to theory of continued fractions • solving linear recurrences by methods of characteristic equation and generating function • computational techniques based on operations with power series • study of some remarcable series and products, and their connection with Riemann zeta function • applications to number theory and combinatorics

8. Content

8.1 Course	Teaching methods	Remarks
1. A short history of mathematical analysis	interactive exposure, explanation, didactical demonstration	
2. Real numbers – irrationality and transcendence	interactive exposure, explanation, didactical demonstration	
3. Real numbers – continued fractions	interactive exposure, explanation, didactical demonstration	
4. Applications of continued fractions	interactive exposure, explanation, didactical demonstration	
5. Linear homogenous recurrent sequences	interactive exposure, explanation, didactical demonstration	
6. Linear nonhomogenous recurrent sequences	interactive exposure, explanation, didactical demonstration	
7. Nonlinear recurrent sequences. Techniques of linearisation	interactive exposure, explanation, didactical demonstration	
8. Extreme limits of a sequence	interactive exposure, explanation, didactical demonstration	
9. Operations with power series (I)	interactive exposure, explanation, didactical demonstration	
10. Operations with power series (II)	interactive exposure, explanation, didactical demonstration	
11. The method of generating function	interactive exposure, explanation, didactical demonstration	
12. Applications of recurrences to combinatorics	interactive exposure, explanation, didactical demonstration	
13. From counting problems to combinatorial games	interactive exposure, explanation, didactical demonstration	

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 methods	Remarks
1. Classic inequalities	project exposure by student team	2-3 students
2. Remarcable numbers as limits of sequences	project exposure by student team	2-3 students
3. Irrationality and transcendence of some remarcable 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. Remarcable 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	conversation, exercise and didactic proof	selection
13. Proofs from the lists	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. 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 lecture is useful for teacher and research candidates in mathematics, enriching their knowledge in classical mathematical analysis. More specifically, we address new methods and results which might be useful later for a master degree preparation in mathematics or a related field.

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 concepts and results, problem solving	Written exam	50
10.5 Seminar/lab activities	Individual project evaluation	Continous observation, dialogue	50
10.6 Minimum performance standards			
➢ Grade 5			

Date   Signature of course coordinator   Signature of seminar coordinator

24 april 2023   lect.dr. Stefan Berinde   lect.dr. Stefan Berinde

Date of approval   Signature of the head of department

....   prof.dr. Andrei Marcus