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	Applied Mathematics

2. Information regarding the discipline

2.1 Name of the discipline	**Special topics of real and complex analysis (Capitole speciale de analizã realã şi complexã)**						
2.2 Course coordinator			Prof. Dr. Gabriela KOHR				
2.3 Seminar coordinator			Prof. Dr. Gabriela KOHR				
2.4 . Year of study	2	2.5 Semester	3	2.6. Type of evaluation	E	2.7 Type of discipline	**DF**

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 sem
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	46
Additional documentation (in libraries, on electronic platforms, field documentation)	46
Preparation for seminars/labs, homework, papers, portfolios and essays	46
Tutorship	11
Evaluations	9
Other activities:	-

3.7 Total individual study hours	158
3.8 Total hours per semester	200
3.9 Number of ECTS credits	8

4. Prerequisites (if necessary)

4.1 curriculum	• Mathematical analysis (Differential calculus in $\mathbf{R}^n$, integral calculus in $\mathbf{R}^n$) • Real functions; Complex analysis
4.2 competencies	• There are useful logical thinking and mathematical notions and results from the above mentioned fields

5. Conditions (if necessary)

5.1 for the course	• Classroom with blackboard/video projector
5.2 for the seminar /lab activities	• Classroom with blackboard/video projector

6. Specific competencies acquired

Professional competencies	• Ability to understand and manipulate concepts, results and advanced mathematical theories. • Ability to model and analyze from the mathematical point of view real processes from other sciences, economics, and engineering. • Ability to use the scientific language and to write scientific reports and papers. • Acquiring specific methods of real and complex analysis to study certain special problems in other areas of mathematics.
Transversal competencies	• Ability to inform themselves, to work independently or in a team in order to realize studies and to solve complex problems. • Ability to use advanced and complementary knowledge in order to obtain a PhD in Pure Mathematics, Applied Mathematics, or in other fields that use mathematical models. • Ability for continuous self-perfecting and study.

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

7.1 General objective of the discipline	• Knowledge, understanding and use of main concepts and advanced results in topology, measure theory and complex analysis. • Ability to use learned concepts to study of certain special problems in complex analysis, partial differential equations.
7.2 Specific objective of the discipline	• Acquiring basic and advanced knowledge in topology, measure theory and complex analysis. • The study of various classes of topological spaces and the connection between these classes. • Knowledge, understanding and use the notions of measurable function, convergence of measurable functions, L^p spaces, Fourier series, real or complex measures. • Knowledge, understanding the notions of semicontinuous function, absolutely continuous function, and use these notions to study certain special problems in complex analysis. • Application of fundamental results in complex analysis to study some modern problems in mathematics and applied mathematics. • Ability student involvement in scientific research

8. Content

8.1 **Course**	Teaching methods	Remarks
1. Connected topological spaces. Examples and applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of	

	alternative explanations.	
2. Regular topological spaces. Normal topological spaces. Examples.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
3. Baire spaces. Examples and applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
4. Metrizable topological spaces. Compact topological spaces. Applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
5. Convergence of sequences of measurable functions. Applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
6. L^p spaces. Fourier series. Fundamental results.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
7. Real and complex measures. The Radon and Nikodym theorem. The measurability and integrability on product spaces. Fubini’s theorem.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
8. Applications of residue theory in the study of certain problems in real analysis.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
9. Families of holomorphic functions. Compactness in the space $H(\Omega)$.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
10. Univalent functions. General results.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
11. Lipschitz and absolutely continuous functions. Applications in the study of certain special problems in complex analysis (I).	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
12. Lipschitz and absolutely continuous functions. Applications in the study of certain special problems in	Lectures, modeling, didactical demonstration, conversation.	

complex analysis (II).	Presentation of alternative explanations.	
13. Harmonic functions. Fundamental results. Examples and applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
14. Subharmonic functions. Fundamental results. Examples and applications.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	

Bibliography

1. Kohr, G., Mocanu, P.T., *Special Topics in Complex Analysis*, Cluj University Press, Cluj-Napoca, 2005 (in Romanian).
2. Anisiu, V., *Topology and Measure Theory*, Babeş-Bolyai University, Cluj-Napoca, 1995 (in Romanian).
3. Graham, I., Kohr, G., *Geometric Function Theory in One and Higher Dimensions*, Marcel Dekker Inc, New York, 2003.
4. Folland, G.B. , *Real Analysis. Modern Techniques and their applications*, Wiley, 1999.
5. Royden, H.L., *Real Analysis*, third Ed., MacMillan, New York, 1988.
6. Rudin, W., *Real and Complex Analysis*, 3rd Ed., Mc. Graw-Hill, 1987.
7. Berenstein, C.A., Gay, R., *Complex Variables: An Introduction*, Springer-Verlag New York Inc., 1991.
8. Conway, J.B., *Functions of One Complex Variable,* Graduate Texts in Mathematics, 159, Springer Verlag, New York, 1996.
9. Taylor, M.E., *Measure Theory and Integration*, Amer. Math. Soc. Providence, Rhode Island, 2006.
10. Benedetto, J., Czaja, W., *Integration and Modern Analysis*, Birkhäuser, Boston, 2009.
11. Stein, E., Shakarchi, R., *Complex Analysis,* Princeton University Press, 2003.

8.2 **Seminar**	Teaching methods	Remarks
1. Connected topological spaces. Examples and applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
2. Regular and normal topological spaces. Examples and applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
3. Baire spaces. Examples and applications.	Applications of course concepts. Description of arguments and	1 hour/week

	proofs for solving problems. Homework assignments. Direct answers to students.	
4. Product topological spaces. Applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
5. Metrizable topological spaces. Compact topological spaces. Examples.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
6. Measurable functions. Types of convergence of measurable functions. Examples.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
7. Lebesgue integral. L^p-spaces. Fourier series. Examples. Applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
8. Applications of residues theory. The computation of some real integrals by using residues theory.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
9. Examples of compact families of holomorphic functions.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
10. Univalent functions. Diffeomorphism criteria. Applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
11. Loewner chains and their transition functions.	Applications of course	1 hour/week

Applications.	concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	
12. Loewner chains and the Loewner differential equation. Applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
13. Harmonic functions. Examples and applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week
14. Subharmonic functions. Examples and applications.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	1 hour/week

Bibliography

1. Kohr, G., Mocanu, P.T., *Special Topics in Complex Analysis*, Cluj University Press, Cluj-Napoca, 2005 (in Romanian).
2. Anisiu, V., *Topology and Measure Theory*, Babeş-Bolyai University, Cluj-Napoca, 1995 (in Romanian).
3. Graham, I., Kohr, G., *Geometric Function Theory in One and Higher Dimensions*, Marcel Dekker Inc, New York, 2003.
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7. Berenstein, C.A., Gay, R., *Complex Variables: An Introduction*, Springer-Verlag New York Inc., 1991.
8. Conway, J.B., *Functions of One Complex Variable*, Graduate Texts in Mathematics, 159, Springer Verlag, New York, 1996.

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 content of this discipline is in accordance with the curricula of the most important universities in Romania and abroad, where the applied mathematics plays an essential role. This discipline is useful in preparing future teachers and researchers in applied mathematics, as well as those who use mathematical models and advanced methods of study in other areas.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge of concepts and basic results	Written exam at the end the semester.	60%
	Ability to justify by proofs theoretical results		
10.5 Seminar/lab activities	Ability to apply concepts and results acquired in the course to solve certain problems.	Evaluation of reports and homework during the semester, and active participation in the seminar activity. A midterm control work.	40%
	There are valid the official rules of the faculty concerning the attendance of students to teaching activities.		
10.6 Minimum performance standards			
• At least grade 5 (from a scale of 1 to 10) at both written exam and seminar activity during the semester.			

Date	Signature of course coordinator	Signature of seminar coordinator
2.05.2015	Prof. Dr. Gabriela KOHR	Prof. Dr. Gabriela KOHR

Date of approval	Signature of the head of department
....	Prof. Dr. Octavian AGRATINI