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	Bachelor of Science
1.6 Study programme / Qualification	Mathematics and Computer Science

2. Information regarding the discipline

2.1 Name of the discipline	Topology						
2.2 Course coordinator	Conf. dr. Adriana Nicolae						
2.3 Seminar coordinator	Conf. dr. Adriana Nicolae						
2.4. Year of study	2	2.5 Semester	3	2.6. Type of evaluation	VP	2.7 Type of discipline	Optional

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)					14
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					10
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	• Calculus 1, 2
4.2. competencies	• Analytic thinking

5. Conditions (if necessary)

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

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	• CT1 Application of efficient and rigorous working rules by adopting responsible attitudes towards the scientific and didactic fields for the development of the own creative potential respecting professional and ethical principles.

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

7.1 General objective of the discipline	• To acquire fundamental knowledge about general topology and to apply it in solving problems.
7.2 Specific objective of the discipline	• To acquire knowledge about elements of general topology (e.g., metric spaces, topological spaces, continuity, separation axioms, connectedness, compactness) and about important results in topology (e.g., the Urysohn Lemma, the Tietze Extension Theorem, the Arzelà-Ascoli Theorem, the Stone-Weierstrass Theorem).

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction: fundamental problems in topology. Metric spaces, examples. Open sets in metric spaces	Lecture, discussion, didactical demonstration, problematisation	
2. Topological spaces, examples. Neighborhoods, convergent sequences	Lecture, discussion, didactical demonstration, problematisation	
3. Bases of neighborhoods, bases of topologies. Countability properties	Lecture, discussion, didactical demonstration, problematisation	
4. Generated topology, subspace, product space, quotient space, examples. Interior, closure, and boundary of a set	Lecture, discussion, didactical demonstration, problematisation	
5. Continuous functions. Homeomorphisms	Lecture, discussion, didactical demonstration, problematisation	
6. Product topologies. Separation axioms	Lecture, discussion, didactical demonstration, problematisation	
7. Other examples of metric space. The uniform topology	Lecture, discussion, didactical demonstration, problematisation	
8. Uniformly continuous and Lipschitz functions. Complete metric spaces	Lecture, discussion, didactical demonstration, problematisation	
9. Connected topological spaces	Lecture, discussion, didactical demonstration, problematisation	
10. Compact topological spaces	Lecture, discussion, didactical demonstration, problematisation	
11. Compactness in metric spaces	Lecture, discussion, didactical demonstration, problematisation	
12. The Tychonoff Theorem. Local compactness and the one-point compactification	Lecture, discussion, didactical demonstration, problematisation	
13. The Urysohn Lemma. The Tietze Extension Theorem. The Urysohn Metrization Theorem	Lecture, discussion, didactical demonstration, problematisation	
14. Spaces of continuous functions. The Arzelà - Ascoli Theorem	Lecture, discussion, didactical demonstration, problematisation	

Bibliography

1. V. Anisiu, Topologie şi teoria măsurii, Universitatea “Babeş-Bolyai”, Cluj-Napoca, 1993.
2. R. Engelking, General topology, 2nd ed., Heldermann Verlag, Berlin, 1989.
3. G. B. Folland, Real analysis. Modern techniques and their applications, 2nd ed., John Wiley & Sons, Inc., New York, 1999.
4. J. L. Kelley, General topology. Reprint of the 1955 edition [Van Nostrand, Toronto, Ont.], Springer, New York-Berlin, 1975.
5. J. R. Munkres, Topology, 2nd ed., Prentice Hall, Inc., Upper Saddle River, NJ, 2000.
6. B. Simon, A comprehensive course in analysis. Part 1: Real analysis, American Mathematical Society,

Providence, RI, 2015. 7. S. Willard, General topology, Addison-Wesley Publishing Co., Reading, Mass.-London-Don Mills, Ont., 1970.		
8.2 Seminar	Teaching methods	Remarks
1. Introduction: fundamental problems in topology. Metric spaces, examples. Open sets in metric spaces	Discussion, problem solving, didactical demonstration	
2. Topological spaces, examples. Neighborhoods, convergent sequences	Discussion, problem solving, didactical demonstration	
3. Bases of neighborhoods, bases of topologies. Countability properties	Discussion, problem solving, didactical demonstration	
4. Generated topology, subspace, product space, quotient space, examples. Interior, closure, and boundary of a set	Discussion, problem solving, didactical demonstration	
5. Continuous functions. Homeomorphisms	Discussion, problem solving, didactical demonstration	
6. Product topologies. Separation axioms	Discussion, problem solving, didactical demonstration.	
7. Other examples of metric space. The uniform topology	Discussion, problem solving, didactical demonstration	
8. Uniformly continuous and Lipschitz functions. Complete metric spaces	Discussion, problem solving, didactical demonstration	
9. Connected topological spaces	Discussion, problem solving, didactical demonstration	
10. Compact topological spaces	Discussion, problem solving, didactical demonstration	
11. Compactness in metric spaces	Discussion, problem solving, didactical demonstration	
12. The Tychonoff Theorem. Local compactness and the one-point compactification	Discussion, problem solving, didactical demonstration	
13. The Urysohn Lemma. The Tietze Extension Theorem. The Urysohn Metrization Theorem	Discussion, problem solving, didactical demonstration	
14. Spaces of continuous functions. The Arzelà - Ascoli Theorem	Discussion, problem solving, didactical demonstration	
Bibliography (in addition to the books mentioned before which also contain exercises) 1. A. V. Arkhangelʹskiĭ, V. I. Ponomarev, Fundamentals of general topology: Problems and exercises, D. Reidel Publishing Co., Dordrecht, 1984. 2. O. Ya. Viro, O. A. Ivanov, N. Yu. Netsvetaev, V. Kharlamov, Elementary topology. Problem textbook, American Mathematical Society, Providence, RI, 2008.		

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. This discipline is useful in preparing future teachers and researchers in mathematics, but is also addressed to those who use various modern mathematical methods and techniques 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 basic	- Two tests	- Mid-semester test:

<table>
<tr><td></td><td>notions, examples and results
- Ability to prove theoretical results</td><td rowspan="2">- Lecture and seminar activity</td><td rowspan="2">35%
- Test at the end of the semester: 65%
- Lecture and seminar activity: bonus max. 10%</td></tr>
<tr><td>10.5 Seminar/lab activities</td><td>- Problem solving using concepts and results acquired during the lecture classes</td></tr>
<tr><td colspan="4">10.6 Minimum performance standards</td></tr>
<tr><td colspan="4">- The accumulation of at least 10 attendances at the seminar.
- Both the test grade at the end of the semester and the final grade should be at least 5. The bonus points are only awarded in this case.</td></tr>
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Date	Signature of course coordinator	Signature of seminar coordinator
30.04.2024	Conf. dr. Adriana Nicolae	Conf. dr. Adriana Nicolae

Date of approval

Signature of the head of department
Prof. dr. Andrei Mărcuş