COURSE DESCRIPTION

Category theory

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. Doctoral Shool	Mathematics and Computer Science
1.4. Field of study	Mathematics
1.5. Level of study	Ph.D.

2. Course-related data

2.1. Course title	**Special chapters of catgory theory**			Course code	**MDE3136**
2.2. Course coordinator	Prof. PhD. Septimiu Crivei				
2.3. Seminar coordinator	Prof. PhD. Septimiu Crivei				
2.4. Year of study 1	2.5. Semester	1	2.6. Type of assessment	Exam	
2.7. Course status	Optional		2.8. Course type	Specialisation subject	

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

3.1. Number of hours per week	**3**	of which: 3.2. course	**2**	3.3. seminar/ laboratory/ project	**1**
3.4. Total of hours in the curriculum	36	of which: 3.5. course	24	3.6. seminar/ laboratory	**12**
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					42
Additional research in the library, on subject-specific electronic platforms, and on-site					42
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					42
Tutoring (professional guidance)					28
Examinations					40
Other activities: two-way communication with the course coordinator					20
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**214**	
3.8. Total hours per semester				**250**	
3.9. Number of credits				**10**	

4. Prerequisites (where applicable)

4.1. curriculum-related	
4.2 skills-related	

5. Specific conditions (where applicable)

5.1. course-related	
5.2. seminar/laboratory-related	

6. Subject-specific learning outcomes

Knowledge
1. The student is able to ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments.

2. The student knows fundamental notions related to Category theory, and methods of applying them to areas of science related to Mathematics.
3. The student is able to define/identify/understand research problems in Mathematics.
Skills
1. The student will construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing.
2. The student will prove theorems using the language of mathematics in theoretical senior level courses and present those results both orally and in writing.
3. The student will interpret articles or books from the mathematical literature and incorporate ideas and results from the literature in their written and oral presentations.
Responsibility and autonomy
1. The student is able explore some mathematical content independently, drawing on ideas and tools from previous coursework to extend their understanding.
2. The student will independently extend mathematical ideas and arguments from previous coursework to a mathematical topic not previously studied.

7. Contents

7.1. Course	**Teaching and learning methods**	**Remarks[1]**
1. Categories - definition and examples	Exposition, proof, examples	
2. Products and coproducts	Exposition, proof, examples	
3. Equalizers and coequalizers	Exposition, proof, examples	
4. Pullbacks and pushouts	Exposition, proof, examples	
5. Limits and colimits	Exposition, proof, examples	
6. Natural transformations	Exposition, proof, examples	
7. Equivalence of categories	Exposition, proof, examples	
8. Yoneda Lemma	Exposition, proof, examples	
9. Adjoint functors	Exposition, proof, examples	
10. Grothendieck categories	Exposition, proof, examples	
11. Abelian categories	Exposition, proof, examples	
12. Exact categories	Exposition, proof, examples	

Bibliography

1. S. Awodey, *Category theory*, Oxford University Press, 2010.
2. S. Mac Lane, *Categories for the working mathematician*, Springer, 1998.
3. B. Mitchell, *Theory of categories*, Academic Press, New York, London, 1965.
4. C. Nastasescu, *Inele, module, categorii* (in Romanian), Editura Academiei, Bucuresti, 1976.
5. I. Purdea, *Tratat de algebra moderna*, vol. II (in Romanian), Editura Academiei, Bucuresti, 1982.

7.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
1. Categories - definition and examples	Explanation, problematization, examples	
2. Products and coproducts	Explanation, problematization, examples	

3. Equalizers and coequalizers	Explanation, problematization, examples	
4. Pullbacks and pushouts	Explanation, problematization, examples	
5. Limits and colimits	Explanation, problematization, examples	
6. Natural transformations	Explanation, problematization, examples	
7. Equivalence of categories	Explanation, problematization, examples	
8. Yoneda Lemma	Explanation, problematization, examples	
9. Adjoint functors	Explanation, problematization, examples	
10. Grothendieck categories	Explanation, problematization, examples	
11. Abelian categories	Explanation, problematization, examples	
12. Exact categories	Explanation, problematization, examples	

Bibliography

1. S. Awodey, *Category theory*, Oxford University Press, 2010.
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8. Evaluation

Type of activity	8.1 Evaluation criteria[2]	8.2 Evaluation methods[3]	8.3 Percentage in the final grade
8.4. Course	Use of basic concepts, examples	Project, presentation.	1/2 of the grade
8.5. Seminar/ laboratory	Problem solving	Assignments, presentation	1/2 of the grade
8.6 Minimum standard for passing			
The final grade must be at least 5.			

9. SDG labels (Sustainable Development Goals)[4]

	○	Sustainable Development Generic Label

								
○	○	○	○	○	○	○	○	○

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

Date:
11.02.2026

Signature of course coordinator

Prof. PhD. Septimiu Crivei

Signature of seminar coordinator

Prof. PhD. Septimiu Crivei

Date of approval:
16.02.2026

Signature of the head of department

Prof. PhD. Andrei Mărcuş