SYLLABUS

Category theory

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeş-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Mathematics
1.4. Field of study	Mathematics
1.5. Study cycle	Master
1.6. Study programme/Qualification	Advanced Mathematics
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the dis	scipli	ne Category	Category theory				Discipline code	MME3123
2.2. Course coordinator Prof. PhI). Septimi	iu Crivei		
2.3. Seminar coordinator			Prof.	PhE). Septimi	iu Crivei		
2.4. Year of study 1 2.5. Semester 1 2.6. Type of evaluation			on	E	2.7. Disc	cipline regime	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
3.4. Total hours in the curriculum	42	of which: 3.5 course	28	3.6 seminar/laborator	14
Time allotment for individual study (ID) and self-study activities (SA)					
Learning using manual, course support,	bibliograp	ohy, course notes (SA)			28
Additional documentation (in libraries,	on electroi	nic platforms, field docu	mentatio	n)	28
Preparation for seminars/labs, homework, papers, portfolios and essays					42
Tutorship					
Evaluations					32
Other activities:					
3.7. Total individual study hours 158					
3.8. Total hours per semester200					
3.9. Number of ECTS credits 8					

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	

5. Conditions (if necessary)

5.1. for the course	
5.2. for the seminar /lab activities	

6.1. Specific competencies acquired ¹

¹ One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Professional/essential	Ability to operate with abstract concepts.
competencies	Ability to apply the acquired knowledge to subdomains of mathematics.
Transversal	Development of abstract thinking.
competencies	Ability to perform research.

6.2. Learning outcomes

Knowledge	The student is able to ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments. The student knows fundamental notions related to Category theory, and methods of applying them to areas of science related to Mathematics. The student is able to define/identify/understand research problems in Mathematics.
Skills	The student will construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing. The student will prove theorems using the language of mathematics in theoretical senior level courses and present those results both orally and in writing. 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:	The student is able explore some mathematical content independently, drawing on ideas and tools from previous coursework to extend their understanding. The student will independently extend mathematical ideas and arguments from previous coursework to a mathematical topic not previously studied.

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

7.1 General objective of the discipline	To acquire the basic knowledge on category theory	
7.2 Specific objective of the discipline	To acquire specific working techniques.	

8. Content

8.1 Course	Teaching methods	Remarks
1. Categories - definition and examples	Exposition, proof, examples	

2. Special objects and morphisms	Exposition, proof, examples	
3. Constructions on categories	Exposition, proof, examples	
4. Products and coproducts	Exposition, proof, examples	
5. Equalizers and coequalizers	Exposition, proof, examples	
6. Pullbacks and pushouts	Exposition, proof, examples	
7. Limits and colimits	Exposition, proof, examples	
8. Natural transformations	Exposition, proof, examples	
9. Equivalence of categories	Exposition, proof, examples	
10. Yoneda Lemma	Exposition, proof, examples	
11. Adjoint functors	Exposition, proof, examples	
12. Grothendieck categories	Exposition, proof, examples	
13. Abelian categories	Exposition, proof, examples	
14. 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.

8.2 Seminar / laboratory		Teaching methods	Remarks
1.	Categories - definition and examples	Explanation, problematization, examples	
2.	Special objects and morphisms	Explanation, problematization, examples	
3.	Constructions on categories	Explanation, problematization, examples	
4.	Products and coproducts	Explanation, problematization, examples	
5.	Equalizers and coequalizers	Explanation, problematization, examples	
6.	Pullbacks and pushouts	Explanation, problematization, examples	
7.	Limits and colimits	Explanation, problematization, examples	
8.	Natural transformations	Explanation, problematization, examples	
9.	Equivalence of categories	Explanation, problematization, examples	
10.	Yoneda Lemma	Explanation, problematization, examples	
11.	Adjoint functors	Explanation, problematization, examples	
12.	Grothendieck categories	Explanation, problematization, examples	
13.	Abelian categories	Explanation, problematization, examples	
14.	Exact categories	Explanation, problematization, 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.

1. I. Purdea, Tratat de algebra moderna, vol. II (in Romanian), Editura Academiei, Bucuresti, 1982.

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 contents is directed towards theory and applications of categories. The topic is present in many master programs from other universities.

10. Evaluation.

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade		
10.4 Course	Use of basic concepts, examples	Project, presentation.	1/2 of the grade		
10 E Cominer /leherotory	Problem solving	Assignments, presentation	1/2 of the grade		
10.5 Seminar/laboratory					
10.6 Minimum standard of performance					
The final grade must be at	least 5.				

11. Labels ODD (Sustainable Development Goals)²

General label for Sustainable Development							
							9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Date: 11.04.2025 Signature of course coordinator Prof. PhD. Septimiu Crivei Signature of seminar coordinator

Prof. PhD. Septimiu Crivei

Date of approval: 25.04.2025

Signature of the head of department

Prof. PhD. Andrei Mărcuș

² Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write *"Not applicable."*.