COURSE DESCRIPTION

Special chapters of ordinary differential equations

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. Department	Mathematics
1.4. Field	Mathematics
1.5. Level of study	Bachelor
1.6. Degree programme / Qualification	Mathematics (in Romanian)
1.7. Form of education	Full attendance

2. Course-related data

2.1. Course title	**Special chapters of ordinary differential equations**			Course code	**MLE0038**
2.2. Course coordinator	Conf. Dr. Adriana Buică				
2.3. Seminar coordinator	Conf. Dr. Adriana Buică				
2.4. Year of study	2	2.5. Semester	4	2.6. Type of assessment	Progress check
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	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory/ project	**2**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**28**

Time allocation for individual study (IS) and self-taught activities (ST)	**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)	40
Additional research in the library, on subject-specific electronic platforms, and on-site	16
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays	40
Tutoring (professional guidance)	8
Examinations	7
Other activities	8
3.7. Total hours of individual study (IS) and self-taught activities (ST)	**119**
3.8. Total hours per semester	**175**
3.9. Number of credits	**7**

4. Prerequisites (where applicable)

4.1. curriculum-related	Mathematical Analysis I, II (Continuous, Lipschitz, class C^n functions, rules for derivation and integration), Linear Algebra I (eigenvalues and eigenvectors), Differential Equations I (, separable differential equations, the fundamental theorems for linear differential systems, the characteristic equation method in the case of constant coefficients)
4.2 skills-related	Ability to perform symbolic calculations ability to operate with abstract concepts. Ability to do logical deductions. Ability to solve math problems based on aquired notions

5. Specific conditions (where applicable)

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

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC1	develop problem-solving strategies
PC5	synthesize information
PC6	think abstractly
Transversal competencies	
Competency code	**Competency**
TC4	Solve problems
TC5	Think analytically

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC1	1. The student/graduate compares and distinguishes related notions and their properties from the core disciplines of mathematics.	1. The student/graduate recognizes and analyzes the necessary and/or sufficient conditions in the statements of mathematical assertions and specifies their role in the proof.
PC5	2. The student/graduate defines the concepts from basic mathematics disciplines.	2. The student/graduate identifies and applies suitable techniques to solve exercises and problems from the major disciplines of mathematics.
PC6	3. The student/graduate defines the basic concepts from advanced mathematics disciplines in the curriculum.	3. The student/graduate answers questions and correctly and rigorously formulates the statements of mathematical assertions (lemmas, propositions, theorems) from the disciplines in the curriculum.
TC4 and TC5	The student/graduate compares and distinguishes related notions and their properties from the core disciplines of mathematics.	The student/graduate recognizes and analyzes the necessary and/or sufficient conditions in the statements of mathematical assertions and specifies their role in the proof.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The student has acquired the knowledge specific to the discipline studied necessary for solving problems.
2. The student knows fundamental notions and theorems of dynamical systems as well as methods of applying them in fields of science.
Specific academic skills
1. The student is able to construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

2. The student is able to solve exercises and problems using theoretical results and will be able to present the solutions both orally and in writing.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks**[3]
1.Qualitative study of scalar autonomous equations. (2 lectures)	Exposition, proofs, examples	
2.Introduction to the qualitative study of planar autonomous systems. (2 lectures)	Exposition, proofs, examples	
3. Qualitative study of planar linear autonomous systems. (3 lectures)	Exposition, proofs, examples	
4. Stability of equilibria of planar autonomous systems. (3 lectures)	Exposition, proofs, examples	
5.Phase portraits of uncoupled planar systems in cartesian or polar coordinates. (1 lecture)	Exposition, proofs, examples	
6. Phase portraits of planar systems with a global first integral. (1lecture)	Exposition, proofs, examples	
7. Phase portraits of planar systems by analysing the direction field. (1 lecture)	Exposition, proofs, examples	
8.Phase portraits of the pendulum equation, SIR model, van der Pol equation, … (1 lecture)	Exposition, proofs, examples	
Bibliography 1. A. Buică, *Introduction to the qualitative theory of ordinary differential equations*, Notiţe de curs postate în Teams. 2. J. Hale, H. Koçak, *Dynamics and bifurcations*, Springer-Verlag, 1991. 3. M.W. Hirsch, S. Smale, *Differential equations, dynamical systems, and linear algebra*, Academic Press, 1974. 4. R. Precup, *Ecuaţii diferenţiale*, Risoprint, Cluj-Napoca, 2011. *Ordinary Differential Equations*, De Gruyter, 2018. 5. Ioan A. Rus, *Ecuatii diferentiale, ecuatii integrale si sisteme dinamice*, Transilvania Press, 1996.		
8.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
Exercise and problems related to the subject discussed in the previous lecture.	Examples, dialogue, explanations, proofs, critical thinking	
Bibliography 1. A. Buică, *Introduction to the qualitative theory of ordinary differential equations*, Notiţe de curs postate în Teams. 2. J. Hale, H. Koçak, *Dynamics and bifurcations*, Springer-Verlag, 1991. 3. M.W. Hirsch, S. Smale, *Differential equations, dynamical systems, and linear algebra*, Academic Press, 1974. 4. R. Precup, *Ecuaţii diferenţiale*, Risoprint, Cluj-Napoca, 2011. *Ordinary Differential Equations*, De Gruyter, 2018. 5. Ioan A. Rus, *Ecuatii diferentiale, ecuatii integrale si sisteme dinamice*, Transilvania Press, 1996.		

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	The evaluation of the knowledges and the competencies to apply them	2 tests, the first one in the 7th week, and the second one in the 14th week	60%
9.5. Seminar/ laboratory	The in-class activity; small seminar tests; projects	Problem solving, Conversation, team and individual work	30%

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

	Homeworks	Problems solving	20%
9.6 Minimum standard for passing			
Each test is conditioned by the prior attendance to at least 6 seminars. At least 12 points (from the maximum of 30) on each test, at least 12 points (from the maximum of 30) on the seminar evaluation, the final mark to be at least 5.			

10. SDG labels (Sustainable Development Goals)[6]

	○	Sustainable Development Generic Label						
								
○	○	○	○	○	○	○	○	X
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
11/04/2026

Signature of course coordinator

Conf. dr. Adriana Buică

Signature of seminar coordinator

Conf. dr. Adriana Buică

Date of approval in the department:
26/04/2026

Signature of the head of department

Prof. dr. Andrei Mărcuş

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*