COURSE DESCRIPTION

Partial Differential Equations

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-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-Computer Science	
1.7. Form of education	Full-time	

2. Course-related data

2.1. Course title	**Partial Differential Equations**			Course code	**MLE0011**
2.2. Course coordinator	Lect. Dr. Andrei-Florin Albisoru				
2.3. Seminar coordinator	Lect. Dr. Andrei-Florin Albisoru				
2.4. Year of study	3	2.5. Semester	5	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			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)					16
Additional research in the library, on subject-specific electronic platforms, and on-site					5
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					12
Tutoring (professional guidance)					3
Examinations					8
Other activities					
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**44**	
3.8. Total hours per semester				**100**	
3.9. Number of credits				**4**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Ordinary Differential Equations, Measure Theory
4.2 skills-related	

5. Specific conditions (where applicable)

5.1. course-related	blackboard, chalk, projector
5.2. seminar/laboratory-related	blackboard, chalk

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

[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.

Professional competencies	
Competency code	**Competency**
PC5	Synthesize information
PC8	Study relationships between quantities
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**
PC5, PC 8	8. The student/graduate defines the concepts from basic computer science and/or applied mathematics disciplines.	8. The student/graduate identifies and applies suitable techniques to solve exercises and problems from the major disciplines of mathematics.
PC5	9. The student/graduate formulates observations and differentiates notions, properties, and assertions from advanced mathematics disciplines through examples and counterexamples.	9. The student/graduate argues the role of elements found in the hypotheses of mathematical assertions, discusses how they articulate within the proof, and independently constructs correct proofs of mathematical assertions from major mathematical disciplines. The student/graduate translates a practical situation into mathematical language, solves the resulting problem, and interprets the obtained results.
TC4, TC5	2. The student/graduate compares and distinguishes related notions and their properties from the core disciplines of mathematics.	2. 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 basic concepts specific to the course, properties of harmonic functions, the concept of a weak solution, the Fourier series method for solving boundary value problems, and the Fourier transform method, with applications in physics.
2. The student is familiar with fundamental concepts in partial differential equations, as well as methods for applying them in scientific fields related to mathematics and physics.
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.
2. The student is able to prove theorems using mathematical language in theoretical courses and will be able to present these results both orally and in writing.

8. Contents

[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.

8.1. Course	Teaching and learning methods	Remarks[3]
1. Preliminaries. Classifications. Particular equations.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
2. Mathematical models expressed by partial differential equations	Interactive exposure, Explanation, Conversation, Didactical demonstration	
3. Green's formula. The fundamental solution of the Laplace equation.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
4. Mean value theorems for harmonic functions.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
5. The maximum principle. Uniqueness and continuous dependence on data for the Dirichlet problem.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
6. Green's functions of the Dirichlet problem. Poisson's formula.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
7. Dirichlet's principle. The generalized solution of the Dirichlet problem.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
8. Fourier Series. The eigenvalues and eigenfunctions of the Dirichlet problem.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
9. The maximum principle for the heat equation.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
10. The Cauchy-Dirichlet problem for the heat equation.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
11. The Cauchy-Dirichlet problem for the wave equation.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
12. The Cauchy problem for evolution equations. The Fourier transform.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
13. The Cauchy problem for the heat equation.	Interactive exposure, Explanation, Conversation, Didactical demonstration	
14. Nonhomogeneous equations: Duhamel's principle	Interactive exposure, Explanation, Conversation, Didactical demonstration	

Bibliography

1. R. Precup, Lectii de ecuatii cu derivate partiale, Presa Universitara Clujeana, 2004.
2. R. Precup, Linear and Semilinear Partial Differential Equations, De Gruyter, Berlin, 2012.
3. G. Kohr, P.T. Mocanu, Capitole speciale de analiză complexă, Presa Universitară Clujeană, 2005.
4. L.C. Evans, Partial Differential Equations, Amer. Math. Soc., Providence, 1998.

8.2. Seminar/ laboratory	Teaching and learning methods	Remarks
1. The canonical form of linear second-order PDEs.	Exercise, explanation, dialogue, team work.	
2. The method of separation of variables: cases of rectangular and circular domains	Exercise, explanation, dialogue, team work.	

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

3. Properties of the harmonic functions. Exercises.	Exercise, explanation, dialogue, team work.	
4. Mean value theorem. Exercises.	Exercise, explanation, dialogue, team work.	
5. The maximum principle. Applications.	Exercise, explanation, dialogue, team work.	
6. Green's function for particular domains.	Exercise, explanation, dialogue, team work.	
7. Dirichlet's principle. Generalized solutions. Examples.	Exercise, explanation, dialogue, team work.	
8. Elliptic equations in the divergence form.	Exercise, explanation, dialogue, team work.	
9. The generalized solution of Neumann's problem.	Exercise, explanation, dialogue, team work.	
10. The eigenvalues and eigenfunctions for particular domains.	Exercise, explanation, dialogue, team work.	
11. Mixed problems for the heat equation.	Exercise, explanation, dialogue, team work.	
12. Mixed problems for the wave equation.	Exercise, explanation, dialogue, team work.	
13. The Fourier transform. Examples.	Exercise, explanation, dialogue, team work.	
14. The Cauchy problem for the heat equation. Particular cases.	Exercise, explanation, dialogue, team work.	

Bibliography

1. R. Precup, Lectii de ecuatii cu derivate partiale, Presa Universitara Clujeana, 2004.
2. R. Precup, Linear and Semilinear Partial Differential Equations, De Gruyter, Berlin, 2012.
3. G. Kohr, P.T. Mocanu, Capitole speciale de analiză complexă, Presa Universitară Clujeană, 2005.
4. L.C. Evans, Partial Differential Equations, Amer. Math. Soc., Providence, 1998.
5. V.S. Vladimirov s.a., Culegere de probleme de ecuatiile fizicii matematice, Ed. St. Encicl., Bucuresti, 1981.

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	Knowledge of basic notions and results Knowledge of the proofs for main theoretical results	Written Exam	60%
9.5. Seminar/ laboratory	Application of the theoretical results to solving problems	Written Test	30%
		Seminar Activity	10%
9.6 Minimum standard for passing			
Final grade should be at least 5.			

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

[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.

[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."*

		Sustainable Development Generic Label

								
								X
								No label applies

Date of entry:
15.04.2026

Signature of course coordinator

Lect. dr. Andrei-Florin Albișoru

Signature of seminar coordinator

Lect. dr. Andrei-Florin Albișoru

Date of approval in the department:
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Signature of the head of department

Prof. dr. Andrei Mărcuș