SYLLABUS

Partial Differential Equations

University year 2025-2026

1. Information regarding the programme

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

2. Information regarding the discipline

2.1. Name of the discipline	**Partial Differential Equations**					Discipline 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 evaluation	E	2.7. Discipline regime	Compulsory

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/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					32
Additional documentation (in libraries, on electronic platforms, field documentation)					15
Preparation for seminars/labs, homework, papers, portfolios and essays					32
Tutorship					9
Evaluations					10
Other activities:					
3.7. Total individual study hours	**98**				
3.8. Total hours per semester	**154**				
3.9. Number of ECTS credits	**4**				

4. Prerequisites (if necessary)

4.1. curriculum	Ordinary Differential Equations, Measure Theory
4.2. competencies	

5. Conditions (if necessary)

5.1. for the course	blackboard, chalk, projector
5.2. for the seminar /lab activities	blackboard, chalk

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 competencies	• Use of concepts and mathematical methods. • Demonstration of mathematical results using different mathematical concepts and reasoning.
Transversal competencies	• Application of rigorous and efficient work rules, manifestation of responsible attitudes towards the didactic-scientific field, to bring optimal and creative values to own potential in specific situations, with respect to professional ethics principles and norms.

6.2. Learning outcomes

Knowledge	The student knows: - fundamental notions related to Partial Differential Equations and methods of applying them to areas of science related to Mathematics and Computer Science
Skills	The student is able to -ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments. -communicate mathematics in both oral and written from with precision, clarity and organization
Responsibility and autonomy:	The student has the ability to work independently - to explore some mathematical content, drawing on ideas and tools from previous coursework to extend their understanding

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

7.1 General objective of the discipline	• Basic theory of linear second-order partial differential equations
7.2 Specific objective of the discipline	• Properties of harmonic functions. • The notion of weak solution. • Fourier series method for solving boundary value problems. • Fourier transform method.

8. Content

8.1 Course	**Teaching methods**	**Remarks**

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. L.C. Evans, Partial Differential Equations, Amer. Math. Soc., Providence, 1998.

8.2 Seminar / laboratory	**Teaching 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. 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. L.C. Evans, Partial Differential Equations, Amer. Math. Soc., Providence, 1998.
4. V.S. Vladimirov s.a., Culegere de probleme de ecuatiile fizicii matematice, Ed. St. Encicl., Bucuresti, 1981.

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 content of this subject is in accordance with the curricula of the most important universities in Romania and abroad.
- This discipline is useful in preparing future teachers/researchers in view of further master and doctoral studies.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Knowledge of basic notions and results	Written Exam	60%
	Knowledge of the proofs for main theoretical results		
10.5 Seminar/laboratory	Application of the theoretical results to solving problems	Written Test	30%
		Seminar Activity	10%
10.6 Minimum standard of performance			
Final grade should be at least 5.			

11. Labels ODD (Sustainable Development Goals)[2]

	General label for Sustainable Development

[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*.".

								

Date:
11.04.2025

Signature of course coordinator

Lect. dr. Andrei-Florin Albişoru

Signature of seminar coordinator

Lect. dr. Andrei-Florin Albişoru

Date of approval:
25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuş