SYLLABUS

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**

2. Information regarding the discipline

2.1 Name of the discipline	**Partial Differential Equations**						
2.2 Course coordinator	**Prof. Dr. Radu Precup**						
2.3 Seminar coordinator	**Prof. Dr. Radu Precup**						
2.4. Year of study	**3**	2.5 Semester	**5**	2.6. Type of evaluation	**Exam**	2.7 Type of discipline	**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/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					10
Additional documentation (in libraries, on electronic platforms, field documentation)					6
Preparation for seminars/labs, homework, papers, portfolios and essays					10
Tutorship					4
Evaluations					14
Other activities:					

3.7 Total individual study hours	44
3.8 Total hours per semester	100
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	•
5.2. for the seminar /lab activities	•

6. Specific competencies acquired

Professional competencies	• Basic theory of linear second-order partial differential equations • Capacity to frame physical models in one of the following classes of PDEs: elliptic, parabolic, and hyperbolic.
Transversal competencies	**CT3** Utilizarea unor metode şi tehnici eficiente de învăţare, informare, cercetare şi dezvoltare a capacităţilor de valorificare a cunoştinţelor, de adaptare la cerinţele unei societăţi dinamice şi de comunicare în limba română și într-o limbă de circulație internațională

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 theorems. 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

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10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course		Continuous observations	10%
		Written exam	50%
10.5 Seminar/lab activities		Continuous observations	10%
		Practical examination	30%
10.6 Minimum performance standards			
• Method of separation of variables. • Properties of the harmonic functions (mean value theorem; maximum principle). • Solving of mixed problems for evolution equations. • Fourier transform.			

Date	Signature of course coordinator	Signature of seminar coordinator
20 Aprilie 2021	..Radu Precup	Radu Precup.....

Date of approval	Signature of the head of department
28 Aprilie 2021	Octavian Agratini.....