SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Mathematics
1.4 Field of study	Computer Science
1.5 Study cycle	Bachelor
1.6 Study programme / Qualification	Computer Science

2. Information regarding the discipline

2.1 Name of the discipline	**Sobolev spaces and partial differential equations**						
2.2 Course coordinator	Conf. dr. Adriana Buica						
2.3 Seminar coordinator	Conf. dr. Adriana Buica						
2.4. Year of study	**1**	2.5 Semester	**1**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**DC**

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/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					28
Additional documentation (in libraries, on electronic platforms, field documentation)					28
Preparation for seminars/labs, homework, papers, portfolios and essays					35
Tutorship					28
Evaluations					4
Other activities:					-

3.7 Total individual study hours	133
3.8 Total hours per semester	175
3.9 Number of ECTS credits	7

4. Prerequisites (if necessary)

4.1. curriculum	Real Functions; Functional Analysis; Partial Differential Equations
4.2. competencies	Logical thinking, as well mathematical notions and properties from the above mentioned fields (at introductory level).

5. Conditions (if necessary)

5.1. for the course	Classroom with blackboard.
5.2. for the seminar /lab activities	Classroom with blackboard.

6. Specific competencies acquired

Professional competencies	• Ability to understand and manipulate advanced concepts, results and theories in the fields of mathematics.
Transversal competencies	• Ability to inform themselves, to work independently or in a team in order to realize studies and to solve complex problems. • Ability for continuous self-perfecting and study.

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

7.1 General objective of the discipline	• To know the main concepts and results in Distribution Theory • To know the notions and properties of Sobolev Spaces • To understand the utility of Sobolev Spaces Theory in the theory of Partial Differential Equations
7.2 Specific objective of the discipline	• To understand the difference between regular and singular distributions, in particular to know the properties of the Dirac distribution • To recognize a Sobolev function • To use properly the Sobolev Spaces in the approach of the Dirichlet problem for the Lapace equation

8. Content

8.1 Course	Teaching methods	Remarks
• The fundamental spaces of the Distribution Theory	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The notion of distribution. Classification	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Operations with distributions	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Operations with distributions (continuation)	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Singular distributions. The Dirac distribution	• Interactive exposure • Explanation	

	• Conversation • Didactical demonstration	
• The notion of Fundamental solution. Examples for ordinary differential equations, the Laplace equation, the heat equation, the waves equation	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The main Sobolev spaces	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The dual of a Sobolev space	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The Sobolev continuous embedding theorem	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The Rellich-Kondrachov compact embedding theorem	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The variational method for elliptic boundary value problems	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The weak maximum principle in a Sobolev space for the Laplace operator	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• The eigenvalues and eigenfunctions for the Laplace operator	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Free discussion. Conclusions.	• Interactive exposure • Conversation	

Bibliography

1. Robert Adams, John Fournier, Sobolev Spaces (second edition), Pure and Applied Mathematics vol. 140, Academic Press, 2003.
2. Haim Brezis, Analyse fonctionelle. Theorie et applications, Masson, Paris, 1983; Analiza functionala. Teorie si aplicatii}, Editura Academiei Romane, Bucuresti, 2002.
3. G. Eskin, Lectures on linear partial differential equations, AMS, 2011.
4. L.C. Evans, Partial differential equations (second edition), AMS, 2010.
5. Radu Precup, Lectii de ecuatii cu derivate partiale, Presa Universitara Clujana, 2004.

8.2 Seminar / laboratory	Teaching methods	Remarks
• The fundamental spaces of the Distribution Theory	• Explanation • Conversation • Didactical demonstration	
• The notion of distribution. Classification	• Explanation • Conversation	

	• Didactical demonstration	
• Operations with distributions	• Explanation • Conversation • Didactical demonstration	
• Operations with distributions (continuation)	• Explanation • Conversation • Didactical demonstration	
• Singular distributions. The Dirac distribution	• Explanation • Conversation • Didactical demonstration	
• The notion of Fundamental solution. Examples for ordinary differential equations, the Laplace equation, the heat equation, the waves equation	• Explanation • Conversation • Didactical demonstration	
• The main Sobolev spaces	• Explanation • Conversation • Didactical demonstration	
• The dual of a Sobolev space	• Explanation • Conversation • Didactical demonstration	
• The Sobolev continuous embedding theorem	• Explanation • Conversation • Didactical demonstration	
• The Rellich-Kondrachov compact embedding theorem	• Explanation • Conversation • Didactical demonstration	
• The variational method for elliptic boundary value problems	• Explanation • Conversation • Didactical demonstration	
• The weak maximum principle in a Sobolev space for the Laplace operator	• Explanation • Conversation • Didactical demonstration	
• The eigenvalues and eigenfunctions for the Laplace operator	• Explanation • Conversation • Didactical demonstration	
• Review	• Interactive exposure • Conversation	

Bibliography

1. Robert Adams, John Fournier, Sobolev Spaces (second edition), Pure and Applied Mathematics vol. 140, Academic Press, 2003.
2. Haim Brezis, Analyse fonctionelle. Theorie et applications, Masson, Paris, 1983; Analiza functionala. Teorie si aplicatii}, Editura Academiei Romane, Bucuresti, 2002.
3. G. Eskin, Lectures on linear partial differential equations, AMS, 2011.
4. L.C. Evans, Partial differential equations (second edition), AMS, 2010.
5. Radu Precup, Lectii de ecuatii cu derivate partiale, Presa Universitara Clujana, 2004.

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 discipline is synchronized with the curriculum of most of the important universities from our country and from abroad where the applied mathematics plays an important role.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	• To know the notions and their properties by examples or counterexamples. To be able to prove the main theoretical results.	Exam	60%
	• To develop a specific subject by reading the bibliography.	Report	20%
10.5 Seminar/lab activities	• Solving problems skills	Evaluation of the homeworks	20%
	• Active participation in the classroom		
10.6 Minimum performance standards			
• The minimum passing grade is 5.			

Date	Signature of course coordinator	Signature of seminar coordinator
30-04-2014	Conf. dr. Adriana Buica	Conf. dr. Adriana Buica

Date of approval	Signature of the head of department
30-04-2014	Prof. dr. Octavian Agratini