SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University Cluj-Napoca
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Mathematics
1.4 Field of study	Mathematics
1.5 Study cycle	Master
1.6 Study programme / Qualification	Applied Mathematics

2. Information regarding the discipline

2.1 Name of the discipline	**Porous Media and Transfer Phenomena**						
2.2 Course coordinator	**Conf. Dr. Teodor Grosan**						
2.3 Seminar coordinator	**Conf. Dr. Teodor Grosan**						
2.4. Year of study	**2**	2.5 Semester	**4**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**O**

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	1+1
3.4 Total hours in the curriculum	48	Of which: 3.5 course	24	3.6 seminar/laboratory	12+12
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					27
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					30
Tutorship					30
Evaluations					10
Other activities:					

3.7 Total individual study hours	127
3.8 Total hours per semester	175
3.9 Number of ECTS credits	7

4. Prerequisites (if necessary)

4.1. curriculum	• Fluid Mechanics
4.2. competencies	• Matlab, Mathematical Software

5. Conditions (if necessary)

5.1. for the course	• Videoprojector
5.2. for the seminar /lab activities	•

6. Specific competencies acquired

Professional competencies	• Ability to understand and manipulate concepts, results and advanced mathematical theories. • Ability to model and analyze from the mathematical point of view real processes from other sciences, economics, and engineering. • Ability to use the scientific language and to write scientific reports and papers.
Transversal competencies	• Ability to inform themselves, to work independently or in a team in order to realize studies and to solve complex problems. • Ability to use advanced and complementary knowledge in order to obtain a PhD in Pure Mathematics, Applied Mathematics, or in other fields that use mathematical models. • Ability for continuous self-perfecting and study.

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

7.1 General objective of the discipline	• Knowledge, understanding and use of main concepts and results in fluid mechanics and heat transfer
7.2 Specific objective of the discipline	• Mathematical and numerical modelling of physical phenomena involving fluid flow through porous media and mass and heat transfer

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction in Continuum Mechanics	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
2. Introduction in Fluid Mechanics. Euler equations. Bernoulli's principle.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
2. Navier-Stokes equations. Dimensionless numbers.	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
3. Energy equation. Boussinesq approximation	Lectures, modeling, didactical demonstration, conversation. Presentation of	

	alternative explanations.	
4. Properties of porous media. Momentum equation. Darcy's law	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
4. Extensions of the Darcy's law. Boundary conditions	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
5. Averaging method (I)	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
6. Averaging method (II)	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
7.Boundary layer	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
8. Numerical methods for PDE (I)	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
9. Numerical methods for PDE (II)	Lectures, modeling, didactical demonstration, conversation. Presentation of alternative explanations.	
10. Natural convection in a rectangular porous cavity with internal heat generation	Lectures, modeling, didactical demonstration, conversation.	

	Presentation of alternative explanations.	
11. Lid-driven cavity problem		
12. Natural convection in a differentially heated square cavity		

Bibliografie

1. Groşan T., Transfer Convectiv şi Radiativ de Căldură în Medii Poroase, Casa Cărţii de Stiinţă, Cluj-Napoca, 2004
2. Nield D.A., Bejan A. Convection in Porous Media, Springer, 1998
3. Ene H., Polisevski D., Thermal Flow in Porous Media, Reidel, Dordrecht 1987
4. Gheorghiţă Ş., Introducere în hidrodinamica corpurilor poroase, Ed. Academiei RSR, Bucureşti 1969.
5. Ingham D.B., Pop I., Transport in Porous Media, Pergamon, 1998, 2002.
6. Patankar S.V., Numerical Heat Transfer and Fluid Flow, Hemisphere, 1980

8.2 Seminar / laborator	Teaching methods	Remarks
1. Analytical solutions of the Euler equations	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	
2. Beronuolli equation	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	
3. Analytical solutions of the Navier Stokes equations	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	
4. Blasius problem. Analytical solution	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	
5. Blasius problem. Numerical solution	Applications of course concepts. Description of arguments and proofs for solving problems.	

	Homework assignments. Direct answers to students.	
6. Numerical solutions for cavities problems.	Applications of course concepts. Description of arguments and proofs for solving problems. Homework assignments. Direct answers to students.	

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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 in accordance with the curricula of the most important universities in Romania and abroad, where the applied mathematics plays an essential role. This discipline is useful in preparing future teachers and researchers in applied mathematics, as well as those who use mathematical models and advanced methods of study in other areas.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge of concepts and basic results	Written exam at the end the semester	75%
	Ability to justify by proofs theoretical results		
10.5 Seminar/lab activities	Ability to apply concepts and results acquired in the course in mathematical modeling and analysis of problems in fluid mechanics	Seminar/lab activity	25%
10.6 Minimum performance standards			
➢ At least grade 5 (from a scale of 1 to 10) at both written exam and seminar activity during the semester.			

Date	Signature of course coordinator	Signature of seminar coordinator
.30.04.2015................	...Conf.dr. Teodor Grosan	Conf.dr. Teodor Grosan

Date of approval — Signature of the head of department

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