SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University of Cluj-Napoca**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Doctoral School in Mathematics and Computer Science**
1.4 Field of study	**Mathematics**
1.5 Study cycle	**Doctoral studies**
1.6 Study programme	**TRAINING PROGRAM BASED ON ADVANCED ACADEMIC STUDIES**

2. Information regarding the discipline

2.1 Name of the discipline	**Computational fluid dynamics**						
2.2 Course coordinator	**Conf. dr. Grosan Teodor**						
2.3 Seminar coordinator	**Conf. dr. Grosan Teodor**						
2.4. Year of study	**1**	2.5 Semester	**1**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Optional**

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 sem
3.4 Total hours in the curriculum	36	Of which: 3.5 course	24	3.6 seminar/laboratory	12
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					54
Additional documentation (in libraries, on electronic platforms, field documentation)					54
Preparation for seminars/labs, homework, papers, portfolios and essays					54
Tutorship					42
Evaluations					10
Other activities:					

3.7 Total individual study hours	214
3.8 Total hours per semester	250
3.9 Number of ECTS credits	10

4. Prerequisites (if necessary)

4.1. curriculum	Numerical analysis, Fluid Mechanics
4.2. competencies	Matlab, programming

5. Conditions (if necessary)

5.1. for the course	Video projector
5.2. for the seminar /lab activities	Matlab software

6. Specific competencies acquired

Professional competencies	C4.1 Defining basic concepts, theory and mathematical models C4.2 Interpretation of mathematical models C4.3 Identifying the appropriate models and methods for solving problems
Transversal competencies	CT1 Application of efficient and rigorous working rules, manifest responsible attitudes towards the scientific and didactic fields, respecting the professional and ethical principles. CT3 Use of efficient methods and techniques for learning, information, research and development of abilities for knowledge acquiring, for adapting to the needs of a dynamic society and for communication in a widely used foreign language

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 related to numerical methods for fluid dynamics equations.
7.2 Specific objective of the discipline	Mathematical manipulation of mathematical theories, concepts and numerical methods.

8. Content

8.1 Course	Teaching methods	Remarks
1. Fluid Mechanics. Introduction	Lecture, discussion	
2. Fluid Mechanics. Basic equations.	Lecture, discussion	
3. Heat transfer. Basic equations.	Lecture, discussion	
4. Numerical methods for ODE	Lecture, discussion	
5.Numerical methods for BVP	Lecture, discussion	
6. Finite difference method for PDE I.	Lecture, discussion	
7. Case study	Lecture, discussion, discussion of case.	
8. Finite difference method for PDE II.	Lecture, discussion	
9. Case study	Lecture, discussion, discussion of case.	
10. Finite volume method	Lecture, discussion	
11. Case study	Lecture, discussion, discussion of case.	
12. Finite elements method.	Lecture, discussion	
13. Application. Lid driven fluid flow	Lecture, discussion, discussion of case.	
14. Application. Differentially heated cavity	Lecture, discussion, discussion of case.	
8.2 Seminar	Teaching methods	Remarks
1. Fluid Mechanics. Basic Equations	Discussion, problem solving, self-study, team work.	
2. Numerical methods for ODE	Discussion, problem solving, self-study, team work.	
3. Numerical methods for BVP	Discussion, problem solving, self-study, team work. .	

4. Finite difference method I.	Discussion, problem solving, self-study, team work.	
5. Finite difference method II.	Discussion, problem solving, self-study, team work.	
6. Finite volumes method	Discussion, problem solving, self-study, team work.	
7.Applications	Discussion, problem solving, self-study, team work	

Bibliography

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White, Frank M. (2003), Fluid Mechanics, McGraw–Hill, ISBN 0-07-240217-2

Anderson, John D. (1995). Computational Fluid Dynamics: The Basics With Applications. Science/Engineering/Math. McGraw-Hill Science. ISBN 0-07-001685-2

Patankar, Suhas (1980). Numerical Heat Transfer and Fluid Flow. Hemisphere Series on Computational Methods in Mechanics and Thermal Science. Taylor & Francis. ISBN 0-89116-522-3

Petrila, T; Trif, D. (2005) BASICS OF FLUID MECHANICS AND INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS, Springer.

Hoffmann, K.A; Chiang, S.T. (2000) Computational Fluid Dynamics, EES.

H K Versteeg and W Malalasekera (2007), An Introduction to Computational Fluid Dynamics, Pearson Education Limited

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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. This discipline is useful in preparing future teachers and researchers in, 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	Final Project	75%
10.5 Seminar	Ability to apply theory in modeling and solving problems	Mid Term Project	25%
10.6 Minimum performance standards			
At least grade 5 (from a scale of 1 to 10).			

Date	Signature of course coordinator	Signature of seminar coordinator
30.06.2021	Conf.dr. Teodor Grosan	Conf.dr. Teodor Grosan

Date of approval	Signature of the head of doctoral school
07.07.2021	Prof. dr. Gabriela Czibula