COURSE DESCRIPTION

Computational fluid Dynamics

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University Cluj-Napoca
1.2. Faculty	Faculty of Mathematics and Computer Science
1.3. Doctoral Shool	Doctoral School of Mathematics and Computer Science
1.4. Field of study	Mathematics
1.5. Level of study	PhD (Doctor of Philosophy)

2. Course-related data

2.1. Course title	**Computational Fluid Dynamics**		Course code	**MDE3137**
2.2. Course coordinator	Prof. Dr. Teodor GROSAN			
2.3. Seminar coordinator	Prof. Dr. Teodor GROSAN			
2.4. Year of study	1	2.5. Semester	1	2.6. Type of assessment	Exam
2.7. Course status	Optional		2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	3	of which: 3.2. course	2	3.3. seminar/ laboratory/ project	1
3.4. Total of hours in the curriculum	42	of which: 3.5. course	28	3.6. seminar/ laboratory	14
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					52
Additional research in the library, on subject-specific electronic platforms, and on-site					52
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					52
Tutoring (professional guidance)					42
Examinations					10
Other activities					
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**208**	
3.8. Total hours per semester				**250**	
3.9. Number of credits				**10**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Numerical Analysis, Fluid Mechanics
4.2 skills-related	Basic Programming, Matlab

5. Specific conditions (where applicable)

5.1. course-related	Videoprojector
5.2. seminar/laboratory-related	Matlab Software

6. Subject-specific learning outcomes

Knowledge	

1. ... Knows the basic concepts of mathematical theory and models.
2. Can interpret mathematical models.
3. Identifies the most appropriate mathematical models for solving problems.
Skills
1. Uses effective and rigorous working rules, demonstrates responsible attitudes towards work in teaching and research, respects ethical and professional principles.
2. Uses effective methods and techniques for information, learning, research, and development, adapting them to the needs of a dynamic society.
Responsibility and autonomy
1. Makes informed decisions about selecting appropriate mathematical and numerical models for applications in fluid mechanics.
2. Independently applies mathematical and numerical theories and methods effectively.

7. Contents

7.1. Course	Teaching and learning methods	Remarks[1]
1. Introduction to Fluid Mechanics	lecture, guided problem discussion, illustrative examples	
2. Governing Equations of Fluid Mechanics	lecture, guided problem discussion, illustrative examples	
3. Governing Equations of Heat Transfer	lecture, guided problem discussion, illustrative examples	
4. Numerical Methods for Ordinary Differential Equations (ODEs)	lecture, guided problem discussion, illustrative examples	
5. Numerical Methods for Boundary Value Problems (BVPs)	lecture, guided problem discussion, illustrative examples	
6. Finite Difference Methods for Partial Differential Equations (PDEs) I	lecture, guided problem discussion, illustrative examples	
7.Case Study	guided problem discussion, illustrative examples, case-based analysis	
8. Finite Difference Methods for Partial Differential Equations (PDEs) II	lecture, guided problem discussion, illustrative examples	
9.Case Study	guided problem discussion, illustrative examples, case-based analysis	
10. Finite Volume Method: Introduction	lecture, guided problem discussion, illustrative examples	
11. Finite Volume Method I	lecture, guided problem discussion, illustrative examples	
12. Finite Volume Method II	lecture, guided problem discussion, illustrative examples	
13. Application: Lid-Driven Cavity Flow	guided problem discussion, illustrative examples, case-based analysis	
14. Application: Differentially Heated Cavity	guided problem discussion, illustrative examples, case-based analysis	
Bibliography Kundu, Pijush K.; Cohen, Ira M. (2008), Fluid Mechanics (4th revised ed.), Academic Press, ISBN 978-0-12-373735-9 Currie, I. G. (1974), Fundamental Mechanics of Fluids, McGraw-Hill, Inc., ISBN 0-07-015000-1 White, Frank M. (2003), Fluid Mechanics, McGraw–Hill, ISBN 0-07-240217-2		

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[1] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

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

7.2. Seminar/ laboratory	Teaching and learning methods	Remarks
1. Fundamental Equations of Fluid Mechanics	problem-based discussion, individual study, teamwork	
2. Numerical Methods for Ordinary Differential Equations (ODEs)	problem-based discussion, individual study, teamwork	
3. Numerical Methods for Boundary Value Problems (BVPs)	problem-based discussion, individual study, teamwork	
4. Finite Difference Method I	problem-based discussion, individual study, teamwork	
5. Finite Difference Method II	problem-based discussion, individual study, teamwork	
6. Finite Volume Method	problem-based discussion, individual study, teamwork	
7. Applications	problem-based discussion, individual study, teamwork	

Bibliography

Kundu, Pijush K.; Cohen, Ira M. (2008), Fluid Mechanics (4th revised ed.), Academic Press, ISBN 978-0-12-373735-9

Currie, I. G. (1974), Fundamental Mechanics of Fluids, McGraw-Hill, Inc., ISBN 0-07-015000-1

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

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8. Evaluation

Type of activity	8.1 Evaluation criteria[2]	8.2 Evaluation methods[3]	8.3 Percentage in the final grade
8.4. Course	Knowledge of fundamental concepts and basic results	Final project	70%
8.5. Seminar/ laboratory	Ability to apply theory in mathematical modeling and in solving specific fluid mechanics problems	Midterm project	30%
8.6 Minimum standard for passing			
At least grade 5 (on a scale from 1 to 10).			

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[2] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[3] Both final evaluation methods and ongoing evaluation strategies should be established.

9. SDG labels (Sustainable Development Goals)[4]

⊙	Sustainable Development Generic Label	

1 FĂRĂ SĂRĂCIE	2 FOAMETE „ZERO"	3 SĂNĂTATE ŞI BUNĂSTARE	4 EDUCAŢIE DE CALITATE	5 EGALITATE DE GEN	6 APĂ CURATĂ ŞI SANITAŢIE	7 ENERGIE CURATĂ ŞI LA PREŢURI ACCESIBILE	8 MUNCĂ DECENTĂ ŞI CREŞTERE ECONOMICĂ	9 INDUSTRIE, INOVAŢIE ŞI INFRASTRUCTURĂ
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
10 INEGALITĂŢI REDUSE	11 ORAŞE ŞI COMUNITĂŢI DURABILE	12 CONSUM ŞI PRODUCŢIE RESPONSABILE	13 ACŢIUNE CLIMATICĂ	14 VIAŢA ACVATICĂ	15 VIAŢA TERESTRĂ	16 PACE, JUSTIŢIE ŞI INSTITUŢII EFICIENTE	17 PARTENERIATE PENTRU REALIZAREA OBIECTIVELOR	No label applies
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙

Date of entry:
10.02.2026

Signature of course coordinator

Grozan Teodor

Signature of seminar coordinator

Grozan Teodor

Date of approval in the department:
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Signature of the head of department

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[4] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*