# 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 | Mathematics for Computer Science |

## 2. Information regarding the discipline

| 2.1 Name of the discipline (en) (ro) | | | **Introduction in Computational Fluid Dynamics** **Introducere în mecanica fluidelor calculatorie** | | | | |
|---|---|---|---|---|---|---|---|
| 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 | **3** | 2.6. Type of evaluation | **E** | 2.7 Type of discipline | **DS/Optional** |
| 2.8 Code of the discipline | MME3405 | | | | | | |

## 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 | 33 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | 30 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | 20 |
| Tutorship | 30 |
| Evaluations | 20 |
| 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 | • Numerical analysis, Fluid Mechanics |
|---|---|
| 4.2. competencies | • Matlab, programming |

## 5. Conditions (if necessary)

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

| activities | |
|---|---|

## 6. Specific competencies acquired

| | |
|---|---|
| **Professional competencies** | C4.1 Defining basic concepts, theory and mathematical models<br>C4.2 Interpretation of mathematical models<br>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.<br><br>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, discussion of case. | |
| 2. Fluid Mechanics. Basic equations. | Lecture, discussion, discussion of case. | |
| 3. Heat transfer. Basic equations. | Lecture, discussion, discussion of case. | |
| 4. Numerical methods for ODE | Lecture, discussion, discussion of case. . | |
| 5.Numerical methods for BVP | Lecture, discussion, discussion of case. | |
| 6. Finite difference method for PDE I. | Lecture, discussion, discussion of case. | |
| 7. Case study | Lecture, discussion, discussion of case. | |
| 8. Finite difference method for PDE II. | Lecture, discussion, discussion of case. | |
| 9. Case study | Lecture, discussion, discussion of case. | |
| 10. Finite volume method | Lecture, discussion, discussion of case.. | |
| 11. Case study | Lecture, discussion, discussion of case. | |
| 12. Finite elements method. | Lecture, discussion, discussion of case. | |
| 13. Application. Lid driven fluid flow | Lecture, discussion, | |

| | discussion of case. | |
|---|---|---|
| 14. Application. Differentially heated cavity | Lecture, discussion, discussion of case. | |
| | | |

Bibliografie

*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*

*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.*

| 8.2 Seminar / laborator | 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 | |

Bibliografie
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
 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.

**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 | 50% |
| | Ability to apply theory in modeling and solving problems | | |
| 10.5 Seminar/lab activities | | Mid Term Project | 50% |
| | | | |
| 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 |
|---|---|---|
| .14.04.2021................ | ...Conf.dr. Teodor Grosan | Conf.dr. Teodor Grosan |

Date of approval                                        Signature of the head of department

28.04.2021                                        Professor Octavian AGRATINI