# Computational hydraulics - BMEEOVVDT72

## I. Subject Specification

1. Basic Data

1.1 Title

Computational hydraulics

1.2 Code

BMEEOVVDT72

1.3 Type

Module with associated contact hours

1.4 Contact hours

| Type | Hours/week / (days) |
|---|---|
| Lecture | 2 |

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

| | |
|---|---|
| name | Dr. Krámer Tamás |
| academic rank | Professor |
| email | kramer.tamas@emk.bme.hu |

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT72
https://edu.epito.bme.hu/course/view.php?id=2497

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

You will understand the basics of classical numerical methods for modelling the motion of water in hydraulic and environmental engineering problems. General topics: governing equations, discretisation, and criteria for judging the quality of various solvers (accuracy, stability). In the context of free-surface flows, we look at the finite difference, finite volume and finite element methods. The topics will be theoretical, considering practical applications but independent of software implementations. The course aims to be valuable to programmers and model users.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. You will understand the governing equations and numerical methods for solving flow and transport phenomena.
2. You will be aware of the limitations and common difficulties in using different numerical methods in solving flow and transport problems

B. Skills

1. You will be able to develop a simple algorithm for the solution of the advection equation
2. You will be be confident in using computational hydraulics software to solve engineering problems

C. Attitudes

1. You will learn how to

D. Autonomy and Responsibility

1.

2.3 Methods

Weekly lectures, focusing on the theory. Questions will be given to be answered by email until the next class.

Solution to these will be discussed on request at the beginning of the lecture.

2.4 Course outline

| Hét | Előadások és gyakorlatok témaköre |
|---|---|
| 1. | Introduction |
| 2. | Governing equations. |
| 3. | Discretisation in space and time. Mesh types. |
| 4. | Basic properties of numerical solvers: convergence, stability, monotonicity, conservation |
| 5. | Principles of the finite difference method |
| 6. | Principles of the finite difference method -- continued |
| 7. | The finite difference method applied to the St Venant equations (1D) |
| 8. | The finite difference method applied to the St Venant equations (1D) -- continued |
| 9. | The finite difference method applied to the shallow water equations (2D) |
| 10. | The finite difference method applied to the Navier Stokes equations (3D) |
| 11. | Wave propagation and characteristics – the Riemann problem and its solution |
| 12. | Principles of the finite volume method for the shallow water equations |
| 13. | Principles of the finite element method for flow problems |
| 14. | Summary |

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

1. Ferziger and Peric - Computational Fluid Dynamics
2. J. Cunge-F. Holly-R. Verwey: Practical aspects of computational river hydraulics
3. P. Novak, V. Guinot, A. Jeffrey, D.E. Reeve: Hydraulic modelling - an Introduction
4. PPT slides

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

2024/2025 semester II

## II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

| Teljesítményértékelés neve (típus) | Jele | Értékelt tanulási eredmények |
|---|---|---|
| | | |

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

| Jele | Részarány |
|---|---|
| | |
| **Összesen** | **100%** |

3.4 Requirements and validity of signature

3.5 Grading system

| Érdemjegy | Pontszám (P) |
|---|---|
| jeles (5) | |
| jó (4) | |
| közepes (3) | |
| elégséges (2) | |
| elégtelen (1) | |

3.6 Retake and repeat

3.7 Estimated workload

| Tevékenység | Óra/félév |
|---|---|
| | |
| **Összesen** | |

3.8 Effective date

1 September 2022

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