Modelling of Hydrosystems - BMEEOVVMV-1

I. Tantárgyleírás

1. Alapadatok

1.1 Tantárgy neve

Modelling of Hydrosystems

1.2 Azonosító (tantárgykód)

BMEEOVVMV-1

1.3 Tantárgy jellege

Kontaktórás tanegység

1.4 Óraszámok

Típus	Óraszám / (nap)
Előadás (elmélet)	2
Gyakorlat	1

1.5 Tanulmányi teljesítményértékelés (minőségi értékelés) típusa

Vizsga

1.6 Kreditszám

4

1.7 Tárgyfelelős

név	Dr. Krámer Tamás
beosztás	Egyetemi docens
email	kramer.tamas@emk.bme.hu

1.8 Tantárgyat gondozó oktatási szervezeti egység

Vízépítési és Vízgazdálkodási Tanszék

1.9 A tantárgy weblapja

https://epito.bme.hu/BMEEOVVMV-1
https://edu.epito.bme.hu/course/view.php?id=3475

1.10 Az oktatás nyelve

angol

1.11 Tantárgy típusa

Kötelező az Infrastruktúra-építőmérnök (MSc) szakon

1.12 Előkövetelmények

Recommended prerequisites:

- Civil Engineering Informatics (BMEEOFTAT42)
- Geoinformatics (BMEEOFTAT43)

1.13 Tantárgyleírás érvényessége

2021. szeptember 1.

2. Célkitűzések és tanulási eredmények

2.1 Célkitűzések

The objective of the course is to introduce students to methods of numerical modelling to analyse physical conditions in watercourses, lakes and reservoirs, and to predict the consequences of various measures or hydraulic structures. We define the scope of numerical models with various physical content or dimensionality, illustrated with practical examples. We devote classes to the coupling of models of interacting processes, modelling uncertainties, as well as post-processing and analysis informatics procedures that support water management planning effectively. It is also our objective that the students improve their practical skills and their complex thinking, making them more open to learn new software.

2.2 Tanulási eredmények

A tantárgy sikeres teljesítése utána a hallgató

A. Tudás

1. Knows the general principles, rules and methods of mathematics, natural sciences and information technology required to practice engineering tasks supporting the design and operation of facilities,
2. Has knowledge in 3D modeling of the natural or built environment,
3. Knows and understands information and communication technologies required for the analysis of facilities,
4. Knows the main types of simulation methods used in water management,
5. Is able to describe lumped methods for rainfall runoff over hydrological catchments, their calibration procedures and data demand,
6. Is familiar with geoinformatics procedures that support the modelling of surface runoff,
7. Can identify the principles of constructing 1D river network models, their data input and their sources of uncertainty, and how these aspects vary with the purpose of the models,
8. Knows the principles of evaluating flood hazard via numerical simulations, and how to apply these to lowland or hilly catchments,
9. Understands the principles of the equations governing 3D river hydrodynamics, their calibration data input, boundary conditions, and can give examples of flow phenomena that can be studied with 3D modelling,
10. Knows the main elements of model systems of lake hydrodynamics and the variables that connect them,
11. Can explain the objective of accelerating numerical solutions and the principles of implicit solvers, parallel computation and adaptive mesh resolution;

B. Képesség

1. Is able to apply the necessary principles of natural sciences and information technology in the analysis of the elements of the natural and built environment,
2. Selects and effectively applies the appropriate information technology tools to support the design of facilities,
3. Produces a 3D model of the natural or built environment,
4. Applies and develops processes, models and information technologies used by various trades in the design, construction, and operation of facilities,
5. Can calibrate and validate a lumped catchment model,

6. Is able to model the flood conveyance of a river reach in 2D and analyse results on a map,
7. Can construct a boundary-fitted unstructured computational mesh, keeping numerical accuracy in consideration,
8. Can operate a 1D-2D linked hydrodynamic model,
9. Can summarize their results in writing, with a logical structure and precise charts / figures;

C. Attitűd

1. Is open to solve the tasks individually and cooperate with other participants of the project,
2. Is willing to acquire the ability of self-learning and self-development,
3. Is open to apply new IT tools, methods and procedures related to a particular field,
4. Collaborates with the lecturer and classmates during learning,
5. Expands their knowledge on their specialization with continuous acquisition, and reaches out to reputable online sources in addition to the compulsory teaching materials to answer their questions,
6. Is open to learn new software,
7. Strives to solve assigned tasks precisely and error free;

D. Önállóság és felelősség

1. Takes responsibility for her/his decisions and work as well as for those of the professional team under their supervision,
2. Contributes to the team's mission by taking responsibility for their own tasks

2.3 Oktatási módszertan

Lectures on the theoretical knowledge. Practices to show the steps of solving modelling problems, to demonstrate software applied in homework assigments and to offer consultations. Homework is based on group collaboration, each group consulting on own laptop. Communication in email and orally.

2.4 Részletes tárgyprogram

Week	**Topics of lectures and/or exercise classes**
1.	Modelling methods in water management; scales and dimensions
2.	Modelling rainfall runoff at catchment scale (methods, input, GIS aspects). Part I
3.	Modelling rainfall runoff at catchment scale. Part II
4.	1D model structure of river networks.
5.	River flood conveyance modelling in 2D (calibration, uncertainty).
6.	Evaluation of flood hazard in steep and lowland river floodplains.
7.	Efficient computational methods, application of finite volume solvers on adaptive and irregular meshes,

	parallel computing. 1D-2D model coupling.
8.	3D modelling of river reaches and hydraulic structures (governing equations).
9.	3D Reynolds-averaged Navier-Stokes (RANS) models in practice, ecohydraulic studies.
10.	Modelling morphodynamics in rivers.
11.	Modelling systems for lake hydrodynamics (meteorology, waves, flows, sediment and thermodynamics). Part I
12.	Modelling systems for lake hydrodynamics. Part II.
13.	Modelling the interaction of surface and subsurface waters.
14.	Probabilistic modelling to estimate design loads of hydraulic structures, including design flood levels.

A félév közbeni munkaszüneti napok miatt a program csak tájékoztató jellegű, a pontos időpontokat a tárgy honlapján elérhető "Részletes féléves ütemterv" tartalmazza.

2.5 Tanulástámogató anyagok

1. N.R.B. Olsen: Numerical Modelling and Hydraulics. NTNU, Norway. ISBN-82-7598-074-7 (NTNU weblapjáról szabadon letölthető)
2. Pavel Novak, Vincent Guinot, Alan Jeffrey, Dominic E. Reeve: Hydraulic Modelling – An Introduction: Principles, Methods and Applications. CRC Press, 2010.

2.6 Egyéb tudnivalók

2.7 Konzultációs lehetőségek

Consultation: in the office of the lecturers, at their individual hours as published on the department www homepage and on the information display outside the department. No appointment necessary.

Jelen TAD az alábbi félévre érvényes:

2024/2025 semester I

II. Tárgykövetelmények

3. A tanulmányi teljesítmény ellenőrzése és értékelése

3.1 Általános szabályok

The learning outcomes in section 2.2. are evaluated based on homework and on the assessment in the exam period.

3.2 Teljesítményértékelési módszerek

Evaluation form	Abbreviation	Assessed learning outcomes
Homework 1 (small homework)	HW1	B.5, B.9; C.1-C.7; D.1-D.2
Homework 2 (small homework)	HW2	B.1-B.4, B.6-B.9; C.1-C.7; D.1-D.2
Exam (oral or written)	E	A.1-A.11; C.2, C.5

A szorgalmi időszakban tartott értékelések pontos idejét, a házi feladatok ki- és beadási határidejét a "Részletes féléves ütemterv" tartalmazza, mely elérhető a tárgy honlapján.

3.3 Teljesítményértékelések részaránya a minősítésben

Abbreviation	Score
HW1	25%
HW2	25%
Total in instruction period	**50%**
E	50%
Total	**100%**

3.4 Az aláírás megszerzésének feltétele, az aláírás érvényessége

The condition to obtain the signature is that the student achieves at least**40%** of the maximum mark for each homework under section 3.2 individually.
For those that (1) already have the signature in the subject and (2) are studying in a regular, non-exam course, their results obtained in the instruction period will overwrite any previous one.

3.5 Érdemjegy megállapítása

A mark of less than **40%** of the maximum at the exam will result in a failed exam grade.
The grade is calculated according to this table based on the total marks (see Section 3.3):

Grade	Marks (P)
excellent (5)	85%<=P
good (4)	70<=P<85 %
satisfactory (3)	55<=P<70 %
pass (2)	40<=P<55 %
fail (1)	P<40%

3.6 Javítás és pótlás

1. All homework can be submitted late - along with payment of a fee according to regulations - until the date specified in the detailed semester schedule.

3.7 A tantárgy elvégzéséhez szükséges tanulmányi munka

Activity	Hours/semester
attendance of contact lessons	14×3=42
midterm preparation to practices	4
preparation of homework	52
individual acquisition of the written study material	6
preparation to the exam	16
Sum	**120**

3.8 A tárgykövetelmények érvényessége

2021. szeptember 1.

Jelen TAD az alábbi félévre érvényes:

2024/2025 semester I