Environmental system - BMEEOVKMI51

I. Subject Specification

1. Basic Data

1.1 Title

Environmental system

1.2 Code

BMEEOVKMI51

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	3

1.5 Evaluation

Exam

1.6 Credits

4

1.7 Coordinator

name	Dr. Koncsos László
academic rank	Professor
email	koncsos.laszlo@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKMI51
https://fiek2.mywire.org/course/view.php?id=3485

1.10 Language of instruction

english

1.11 Curriculum requirements

Compulsory in the Infrastructure Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2021

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to introduce the main questions and concepts of environmental system modelling: model identification, calibration, validation and sensitivity analysis. As part of this, different topics and various modelling approaches are presented, such as deterministic vs. empirical mathematical formulation of processes, distributed vs lumped parametrization, integrated hydrological modelling, soft computing methods for environmental problems, coupling of water and material flow models to describe complex pollution transport issues.
Air, surface and subsurface waters as well as artificial systems are among the described media. The introduced problems include the spread of air pollutants from point sources, hydrological processes of lowland watersheds, modelling of diffuse water pollution from nonpoint-sources, the design of infiltration beds in urban environment, the fate of groundwater pollution, etc.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. understands the main concepts and basic tools of environmental system modelling
2. knows the decomposition-aggregation method
3. knows the meaning and methods of calibration, validation and sensitivity analysis
4. knows the input data requirement of different models and can formulate initial and boundary conditions,
5. understands the governing equations of different material flow models, and the options for coupling them with hydraulic/hydrodynamic simulations
6. is familiar with the aims, methods, advantages and disadvantages of soft computing approach, knows examples of practical application
7. understands the system dynamics approach to describe complex systems,
8. knows the different analytical and numerical model types for various environmental media, and understands, how these can be combined through their boundary conditioncs.

B. Skills

1. is capable to formulate abstract models of real life environmental problems,
2. is capable to describe water and material flows of environmental systems by using the laws of movement and conservation
3. is capable to carry out multicriteria analysis of environmental problems
4. is capable to formulate the criteria of material transport between various media
5. can identify simpler environmental problems and can review the theoretical and practical background required for the problem solution
6. can solve computationally intensive problem by relying on the learnt IT competences
7. is capable to express (verbally and in writing) his/her ideas in a structured ad clear way.

C. Attitudes

1. cooperate with fellow students and with the lecturer in the learning process
2. deepens his/her knowledge with continuous learning
3. is willing to use IT tools
4. strives to get familiarized with the methodology of environmental system modelling
5. seeks appropriate and flawless solutions
6. promotes environmental awareness throughout the engineering problem solution

D. Autonomy and Responsibility

1. The student is capable to analyze and study environmental problem on his/her own
2. is open for critical remarks
3. can cooperate with colleagues/fellow students in order to solve problems
4. thinks in the system theory paradigm

2.3 Methods

Lectures, computational exercises, verbal and written communication, usage of IT tools, optional individual/group projects.

2.4 Course outline

Hét	**Előadások és gyakorlatok témaköre**
1.	Transport equation, aims of environmental modelling, some practical case studies, decomposition-aggregation method
2.	Fundamental concepts of mathematical modelling: identification, calibration, validation, uncertainty and sensitivity analysis
3.	Air pollution transport models, simulating the effects of a point source emission
4.	Permanent and dynamic pollution problems of surface water bodies: 2D analytical transport equation, conservative and non-conservative pollutants
5.	Complex 2D material-flow models (P-model for eutrophication, N-model)
6.	Complex 2D material-flow models (P-model for eutrophication, N-model) - cont. and Test
7.	Basics of soft computational methods in environmental moldeling, case studies
8.	Integrated hydrological modelling, simulation of lowland catchments, process based description with model coupling
9.	Non-point source pollutions and large scale methods for their description
10.	Water and material movement in the subsurface unsaturated zone (vadose zone) - theory and exercise

11.	Water and material movement in the subsurface Saturated zone (groundwater) - theory
12.	Water and material movement in the subsurface Saturated zone (groundwater) - exercise
13.	Water and material movement in the subsurface Saturated zone (groundwater) - exercise cont.
14.	Test

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

Lecture slides and recordings, additional resources published on the course moodle page.
Books:

- J. L. Schnoor (1996): Environmental modeling – Fate and transport of pollutants in water, air and soil. John Wiley & Sons, Inc., New York.
- R. V. Thomann, J. A. Mueller (1987): Principles of surface water quality modeling and control. Harper & Row Publishers, New York.
- S. C. Chapra (1997): Surface water-quality modeling. McGraw-Hill Book Co, Singapore.
- V. T. Chow (ed.) (1964): Handbook of applied hydrology. McGraw-Hill Book Co, New York.
- R. Frigg, S. Hartmann (2006): Models in Science. The Stanford Encyclopedia of Philosophy (Spring 2006 Edition), URL: http://plato.stanford.edu/entries/models-science/

2.6 Other information

Solution of the practical exercises is compulsory. It can be solved outside of lecture time in the computation lab of the department. Consultation is only available however in lecture time.

2.7 Consultation

According to the webpage of the department or via email

This Subject Datasheet is valid for:

2023/2024 semester I

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Grading will be based on the results of two tests and two homework assignments within the semester, and on a final exam in the exam period.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	**Jele**	**Értékelt tanulási eredmények**
1. First test	Test1	A.1-A.5; B.1
2. Second test	Test2	A.1-A.5; B.1
3. First homework assignment	HW1	A.1-A.8; B.1-B.6; C.1-C.6; D.1-D.4
4. Second homework assignment	HW2	A.1-A.2, A.6-A.8; B.1-B.6; C.2, C.4, C.5, C.6; D.1-D.2, D.4
Final exam	EX	A.1-A.8; B.1-B.5, B.7; C.6; D.1, D.2, D.4

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**
Test1	10%
Test2	10%
HW1	15%
HW2	15%
EX	50%
Összesen	**100%**

Test 1. 2., and the exam result in a fail if the achieved points are below 40%.

3.4 Requirements and validity of signature

The student most get at least 40% according to section 3.3 in order to get a signature. Handing in the completed two homework assignments and reaching the minimum 40% on the two tests (according to section 3.3) is required to get a signature.

3.5 Grading system

Érdemjegy	**Pontszám (P)**
jeles (5)	80<=P
jó (4)	70<=P<80%
közepes (3)	60<=P<70%
elégséges (2)	40<=P<60%
elégtelen (1)	P<40%

3.6 Retake and repeat

1. Separate retake attempts are required to complete missed midterm tests.
2. The homework assignments can be handed in electronically until 23:59 on the last day of the retake week - assuming that the retake fee is payed
3. Homework assignments can be modified without a fee until the deadline in point 2.
4. Test 1 and 2 can be retaken separately in the retake week without a fee for the first attemp
5. The second (joined) attempt to retake Tests 1 and/or 2 has a retake fee

3.7 Estimated workload

Tevékenység	**Óra/félév**
attendance of the contact lectures	14×3=42
preparation for the exercises	14×2=28
preparation for the midterm tests	15
homework assignments	6
reading the additional resources	10
exam preparation	19
Összesen	**120**

3.8 Effective date

1 September 2017

This Subject Datasheet is valid for:

2023/2024 semester I