# Modeling of public water network systems - BMEEOVKMV63

## I. Subject Specification

1. Basic Data

1.1 Title

Modeling of public water network systems

1.2 Code

BMEEOVKMV63

1.3 Type

Module with associated contact hours

1.4 Contact hours

| Type | Hours/week / (days) |
|---|---|
| Lecture | 2 |
| Seminar | 1 |

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

| | |
|---|---|
| name | Dr. Fülöp Roland |
| academic rank | Associate professor |
| email | fulop.roland@emk.bme.hu |

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKMV63
https://edu.epito.bme.hu/course/view.php?id=3527

1.10 Language of instruction

english

1.11 Curriculum requirements

Recommended elective in the Specialization in Water and Hydro-Environmental Engineering (MSc) programme

1.12 Prerequisites

Recommended prerequisites:

- Hydrology II. (BMEEOVVAI41)
- Hydraulics II. (BMEEOVVAI42)
- Public Works II. (BMEEOVKAI41)

1.13 Effective date

1 September 2022

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2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to introduce students to the theoretical foundations of modern urban stormwater management that go beyond the traditional knowledge of urban stormwater drainage, taking into account the expected consequences of climate change. Introduce students to international good practice methods and related design procedures based on simulation modelling. The course also aims to equip students with the network modelling skills required for the design and operation of pressurised and gravity utility networks. To prepare students to use network modelling software at a skill level. Key topics include: modelling of pressurised systems; hydraulic modelling of gravity sewer networks; model building and calibration; optimisation for design and operations management.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. understands the basic processes of urban hydrology
2. knows the methods of calibration of the model
3. understand the levels of modelling and the rules for their creation
4. is familiar with the methodology for determining rainfall loads and the resulting load model
5. understanding of the methodology for determining water demand
6. understands simple elements of the physical (hydraulic) model
7. knowledge of the basic elements of a topological model and its application
8. knowledge of the different types of models (topological, physical, consumption)
9. knowledge of the mathematical modelling possibilities of water supply and stormwater drainage networks
10. knowledge of the range of pollutants that can be washed from the urban surface by precipitation, their generation and leaching processes,
11. knowledge of the principles for the design of a monitoring network for calibration of runoff and flow processes in an urban catchment and its stormwater drainage system,
12. knowledge of the theoretical principles of seepage hydraulics and their practical application in an urban environment,
13. is familiar with the theoretical context of dynamic network surge calculation and the limitations of at least one practical software calculation method applicable to urban stormwater management,
14. understands the applicability of time-varying model precipitation and measured historical precipitation events in modelling,

B. Skills

1. building a simulation model to describe a real urban environment,
2. evaluating the results provided by the simulation software,
3. designing a monitoring network for a given municipality/section of a municipality (urban catchment) to calibrate the runoff and flow processes of the stormwater drainage system located in the municipality/section,
4. being able to apply one of the spatial information software tools in the modelling of urban stormwater

management,
5. being able to produce a consumption model,
6. preparing mathematical models of real water networks and stormwater drainage networks,
7. modelling the processes of networks described by mathematical models,
8. performing complex analyses of water supply and stormwater networks,
9. expressing his/her ideas in an organised way, orally and in writing.

C. Attitudes

1. collaborates with the teacher and fellow students to develop their knowledge,
2. expands their knowledge through continuous learning,
3. is open to the use of information technology tools,
4. seeks solutions that are different from the routine,
5. strives to apply the principles of energy efficiency and environmental, awareness in the solution of modelling problems in water supply networks.

D. Autonomy and Responsibility

1. independently interprets stormwater management tasks under supervision
2. independently carries out modelling of water supply and stormwater drainage networks based on available data,
3. is open and able to participate in group work,
4. the student is committed to the principles and methods of systematic thinking and problem solving.

2.3 Methods

Lectures, computational exercises, written and oral communication, use of IT tools and techniques, optional independent and group work, work organisation techniques.

2.4 Course outline

| **Week** | **Topics of lectures and/or exercise classes** |
|---|---|
| 1. | The principle of stormwater management, its necessity, current obstacles to its application in domestic legal, technical and economic regulation. The consequences of climate change on urban stormwater drainage. |
| 2. | The role of integrated urban water management, including urban stormwater management. Differences between new and old traditional stormwater drainage. The limitations of rational method. Simulation modelling of stormwater drainage systems: theory (Storm Water Management Model (SWMM) by US EPA) |
| 3. | Good practice I: methods for modifying the annual |

| | |
|---|---|
| | urban stormwater balance, controlling surface runoff and network runoff. Simulation modelling of stormwater drainage systems: pratice (Storm Water Management Model (SWMM) by US EP) |
| 4. | Simulation modelling of stormwater drainage systems: theory and practice (Storm Water Management Model (SWMM) by US EPA), Handing out of Homework1 (HW1) |
| 5. | Good practice II: how ro handle extreme rainfall events? Examples of possible solutions. Consultation on HW1. |
| 6. | Green roofs, green walls: technical solutions and their effectiveness in controlling run-off. Consultation on HW1. |
| 7. | Consultation on HW1. |
| 8. | Simulation of urban flooding. Consultation on HW1. |
| 9. | Consultation on HW1. |
| 10. | Simulation modelling of water distribution systems: theory and practice (EPANET), handing out of Homework2 (HW2). |
| 11. | Simulation modelling of water distribution systems: basics of modelling. |
| 12. | Simulation modelling of water distribution systems: elements of the model. |
| 13. | Simulation modelling of water distribution systems: consumption model creation, Midterm test. |
| 14. | Simulation modelling of water distribution systems: evaluation of simulation results. |

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. Walski, P. et al.: Advanced Water Distribution Modeling and Management (2003, HaestadPress)
2. USAEPA: EPANET V 2.0 - Program and Documentation Download (www.epa.gov)
3. Rossman, L.A.: Storm Water Management Model, User's Manual, Version 5.1, U.S. Environmental Protection Agency, 2015.
4. Rossman, L.A, Huber, W.C.: Storm Water Management Model Reference Manual Volume 1 – Hydrology, 2016, EPA No. 600/R-15/162A.

2.6 Other information

2.7 Consultation

Consultation dates:

During courses or via e-mail:

e-mail: varga.laura@emk.bme.hu, darabos.peter@emk.bme.hu, bodi.gabor@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

## II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes set out in 2.2 is based on a midterm test, active participation in the preparation of a computational exercise (partial assessment) and the submission of the homework assignments.

3.2 Assessment methods

| Type of assessment | Short name | Evaluation |
|---|---|---|
| Midterm test | T | A.1-A.14; B.1-B.9; C.1-C.5; D.1-D.4 |
| Homework 1 | HW1 | Homework 1 (active participation, continuous performance assessment during the computational exercises and based on the documentation of the HW1) |
| Homework 2 | HW2 | Homework 2 (active participation, continuous performance assessment during the computational exercises and based on the documentation of the HW2) |

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

3.3 Evaluation system

| Abbrev. | Score |
|---|---|
| T | 40% |
| HW1 | 30% |
| HW2 | 30% |
| **Sum** | **100%** |

3.4 Requirements and validity of signature

To get signature, the student must achieve at least 50% of the points that can be obtained according to point 3.3, i.e. at least 50% in the midterm test, at least 50% in the computational exercise during the lessons and 50% in the submitted documentation.

3.5 Grading system

| Grade | Percentage (P) |
|---|---|
| excellent (5) | 80<=P |
| good (4) | 70<=P<80% |
| satisfactory (3) | 60<=P<70% |
| pass (2) | 50<=P<60% |
| fail (1) | P<50% |

3.6 Retake and repeat

1. Midterm test may be retaken once free of charge.
2. Midterm test can be retaken the second time with fee.

3.7 Estimated workload

| **Tevékenység** | **Óra/félév** |
|---|---|
| attendance at contact lessons | 14×3=42 |
| mid-semester preparation for the modelling exercises | 14×1=14 |
| preparation for the Midterm test | 12 |
| out-of-courses working time required to complete the HWs | 12 |
| homework assignment (including separate consultation) | 40 |
| **Sum** | **120** |

3.8 Effective date

1 September 2022

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Inactive courses