Hydrography and Hydroinformatics - BMEEOVVMV64

I. Subject Specification

1. Basic Data

1.1 Title

Hydrography and Hydroinformatics

1.2 Code

BMEEOVVMV64

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2
Seminar	2

1.5 Evaluation

Midterm grade

1.6 Credits

5

1.7 Coordinator

name	Dr. József Szilágyi
academic rank	Professor
email	szilagyi.jozsef@emk.bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVMV64
https://edu.epito.bme.hu/course/view.php?id=3539

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

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

1.12 Prerequisites

Recommended prerequisites:

- Modelling of Hydrosystems (BMEEOVVMV-1)
- Civil Engineering Informatics (BMEEOFTAT42)
- Hydrology II (BMEEOVVAI41)
- Numerical Methods (BMEEOFTMK51)
- Methods of Engineering Analysis (BMEEOHSMK51)

1.13 Effective date

2 February 2022

2. Objectives and learning outcomes

2.1 Objectives

The objective of the course is that the student get familiar with system theory, linear algebra and linear systems in general for solving simple hydrological problems and also advance his/her skill of MATLAB programming. Other objectives are that the student get acquainted with the hydrological forecasting approach having been used operatively in Hungary for over 30 years now, widen his/her knowledge on time series modelling, be able to solve such practical problems, get an insight into information systems used in hydrology, into flood forecasting, into data-driven models and optimization techniques employed in the water management practice in Hungary.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Familiarity with the most frequently encountered time series concepts and models employed in hydrological research and ability to apply them for one's own research.
2. Knows the function of the Hungarian hydro-informatics system.
3. Knows the different service levels, modelling, and data requirements for flood alerting and forecasting.
4. Can give examples for data-driven approaches and optimizations in water resources management.

B. Skills

1. Advanced problem solving capacity in hydrological modelling and forecasting using linear and time series models.
2. horough knowledge of linear models of hydrology, their modifications and problem-specific applications.
3. Thorough understanding of time series models often employed in hydrology and water resources research, their correct applications and strengthened skill to further develop such models.
4. Aptitude for writing MATLAB code performing „brute-force” calibration and its application for solving problems in hydrology and civil engineering.
5. Capacity of solving complex modelling problems by MATLAB.

C. Attitudes

1. Cooperates with the instructor during the learning process.
2. Continuously and actively seeks ways of gaining knew knowledge even beyond the required curriculum and employs the internet for finding intuitive answers to research problems.
3. Open to learn new software skills.
4. Attempts to perform precise problem solutions.

D. Autonomy and Responsibility

1. Resolution to solving homework on one's own within feasible limits.

2.3 Methods

Lectures on theory. Practical guidance about the steps needed for solving computational/modelling problems and the software required. Consultation of the homework individually or in groups using one's own laptop on top of written (e-mail) and personal oral communication during consultation hours.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1	Flood warning and forecasting
2	System theory. Ordinary differential equations. Impulse response and convolution
3	The Wiener-Hopf and Yule-Walker equations
4	Using MATLAB for linear algebraic problems in hydrology I
5	Using MATLAB for linear algebraic problems in hydrology II
6	The Saint-Venant equations and their simplifications. State-space formulation of the continuous, spatially discrete linear kinematic wave. The Kalinyin-Milyukov-Nash cascade
7	The Discrete Linear Cascade Model: classical pulsed data system
8	The Discrete Linear Kascade Model: linearly interpolated data system
9	Forecasting with the DLCM.
10	The Boussinesq equation, the Diskin-Jakeman-Young rainfall-runoff model
11	Autoregressive processes, the Gauss-Markov process
12	The Kalman-filter and its application. Model calibration. Accounting for nonlinearity in linear models. GIS and remote sensing examples in hydrology
13	Optimalization methods in water resources management
14	Artificial neural networks in water resources management.

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

a) Textbooks:

1. Szilágyi J., Szöllősi-Nagy A., 2010. Recursive streamflow forecasting: a state-space approach, CRC Press, London, UK.
2. Brockwell, P., 2010. Introduction to time-series and forecasting, Springer, New York, USA.

3. Bras, R. L., Rodriguez-Iturbe, I., 1993. Random functions and hydrology, Dover, London, UK.

2.6 Other information

None

2.7 Consultation

Time of consultations: advertised on the course's webpage (occasionally by specific request), in the office of the course instructor.

This Subject Datasheet is valid for:

2024/2025 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Evaluation of the participant’s learning progress described in A 2.2. is performed by a written final test and nine homework assignments.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
1st homework (partial performance evaluation)	HW1	B.1-B.2; C.1-C.4; D.1
2nd homework (partial performance evaluation)	HW2	B.1-B.2; C.1-C.4; D.1
3rd homework (partial performance evaluation)	HW3	B.1-B.2, B.5; C.1-C.4; D.1
4th homework (partial performance evaluation)	HW4	B.1-B.2, B.5; C.1-C.4; D.1
5th homework (partial performance evaluation)	HW5	B.1-B.2, B.5; C.1-C.4; D.1
6th homework (partial performance evaluation)	HW6	A.1; B.1-B.2, B.5; C.1-C.4; D.1
7th homework (partial performance evaluation)	HW7	B.1-B.2, B.5; C.1-C.4; D.1
8th homework (partial performance evaluation)	HW8	A.2-A.3; B.1-B.4; C.1-C.4; D.1
9th homework (partial performance evaluation)	HW9	A.4; B.1-B.5; C.1-C.4; D.1
Written test (final performance evaluation)	WT	B.1-B.5

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

3.3 Evaluation system

Abbreviation	Score
HW	70%
WT	30%
Sum	**100%**

3.4 Requirements and validity of signature

Non-relevant.

3.5 Grading system

The table displays the final grade limits. The average grade of the homework assignments counts by 70% while the grade of the final test by 30%. The percentages are relative to the maximum score.

Grade	Score (P)
excellent (5)	85%<=P
good (4)	70<=P<85%
average (3)	55<=P<70%

satisfactory (2)	40<=P<55%
un satisfactory (1)	P<40%

The final test must be completed by at least 40% of the maximum score.

3.6 Retake and repeat

1. The homework is due back within two weeks always.
2. The homework can be corrected within that time limit.
3. There is a make-up test in the 15th week of the semester.

3.7 Estimated workload

Activity	**Hours/semester**
participation in contact classes	14×4=56
preparation for the final test	8
preparation of homework	9×8=72
study from notes, textbooks	14
Sum	**150**

3.8 Effective date

2 February 2022

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