Hydrological modelling and forecasting - BMEEOVVDT82

I. Subject Specification

1. Basic Data

1.1 Title

Hydrological modelling and forecasting

1.2 Code

BMEEOVVDT82

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. 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/BMEEOVVDT82
https://fiek2.mywire.org/course/view.php?id=2499

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

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

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The course will focus on time series and linear models most frequently employed in hydrology. Solution of the practical problems with the help of MATLAB will enable one to apply, modify and build such models on one's own for hydrological/civil engineering research.

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 how to generate stochastic time-series with the Monte-Carlo approach.
3. Aware of the conditions necessary for applying the Kalman filter for optimal model parameter estimation.
4. Familiar with linear hydrological models and knows how to modify them for one's own purpose.

B. Skills

1. Advanced problem solving capacity in hydrological modelling and forecasting using linear and time series models.
2. Thorough 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**
1.	Stochastic process. Basics of time series modelling: stationarity, ergodicity.
2.	Univariate ARMA and ARIMA models.
3.	The seasonal Thomas-Fiering model and its applications.
4.	Multivariate AR models.
5.	Modelling non-stationary time-series.
6.	Data generation by the Monte-Carlo method and its hydrological applications.
7.	System theory. Linear ordinary differential equations. Impulse response and convolution. The Wiener-Hopf and Yule-Walker equations.
8.	The Saint-Venant equations and its simplified versions. State-space description of the continuous, spatially discrete linear kinematic wave equation. The Kalinin-Milyukov-Nash cascade.
9.	The Discrete Linear Cascade Model: classical pulsed data framework.
10.	The Discrete Linear Cascade Model: linearly interpolated data framework.
11.	The Boussinesq equation, the Diskin-Jakeman-Young rainfall-runoff model.
12.	The Gauss-Markov process.
13.	The Kalman filter and its application for model calibration.
14.	Accounting for nonlinearity using linear models. Geographic Information Systems and remote sensing applications in hydrology.

Due to holidays and recesses this course description is only for general guidance, the accurate time-table is found on the course’s webpage, titled “Detailed semester schedule”.
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

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:

Inactive courses

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 ten 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
10th homework (partial performance evaluation)	HW10	B.5
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

Grade	**Points (P)**

excellent (5)	85%<=P
good (4)	70<=P<85%
average (3)	55<=P<70%
satisfactory (2)	40<=P<55%
unsatisfactory (1)	P<40%

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	14×2=28
preparation for the final test	8
preparation f homework	10×4=40
study from notes, textbooks	14
Sum	**90**

3.8 Effective date

1 September 2022

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Inactive courses