<div align="center">

I. Subject Specification

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1. Basic Data

1.1 Title

ADVANCED MATHEMATICS IN GEODESY AND SURVEYING

1.2 Code

BMEEOAFDT71

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. Gyula Károly Tóth
academic rank	Associate professor
email	toth.gyula@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT71
https://edu.epito.bme.hu/course/view.php?id=3448

1.10 Language of instruction

english

1.11 Curriculum requirements

Compulsory in the Land Surveying and Geoinformatics (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

Advanced Mathematics in Geodesy and Surveying - BMEEOAFDT71

2. Objectives and learning outcomes

2.1 Objectives

Goal of the subject is that the student be familiar with advanced applied mathematical methods that are widely used in geodesy and civil engineering and their fields of application. Knowledge acquired during this course should enable the student to understand and apply main mathematical methods that can be found in research papers in his field. Detailed practical examples help the application of the various methods studied.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows basics of data processing with continuous and discrete wavelets,
2. familiar with basics, main types and applications of Kalman filtering,
3. knows most important principles of digital filter design,
4. knowledgeable about most important pros and cons of various PSD estimation methods,
5. understands the merits of most frequent value procedures in comparison with traditional statistics,
6. can make distinction between traditional and bayesian statistical approaches.

B. Skills

1. can use robust and resistant data processing methodologies,
2. can routinely apply spectral estimation methods for data processing.

C. Attitudes

1. open to adopt recent mathematical methods in his field of research,
2. has a critical attitude towards the limits of widely used mathematical procedures,
3. quick to expand his knowledge

D. Autonomy and Responsibility

1. makes independent research decisions on the used mathematical procedures

2.3 Methods

lectures, interactive Jupyter notebooks

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Singular value decomposition (SVD), principal component analysis (PCA)
2.	Kalman filtering, derivation of the filter
3.	Extended Kalman filtering (EKF), unscented Kalman filtering (UKF)
4.	RANSAC estimation, ellipse, sphere, cylinder fitting
5.	Fourier transform, FFT, Fourier spectra of wheel accelerometry
6.	Continuous wavelet transform (CWT), wavelet filtering
7.	Discrete orthogonal wavelet transform (DWT)
8.	Digital filters, z-transform
9.	Parametric and nonparametric PSD estimation
10.	Basics of Bayesian statistics and its applications
11.	Most frequent value procedures (MFV) and its applications in geosciences
12.	Lattices, LLL lattice reduction, integer least squares
13.	Shifted linear interpolation / Introduction to Artificial Neural Networks
14.	Discussion of a topic proposed by students

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

- Awange, J.L., Paláncz, B., Lewis, R.H., Völgyesi, L.: Mathematical Geosciences. Hybrid Symbolic-Numeric Methods. Springer, 2018.
- Csernyák L., Hajagos B., Hursán G., Steiner F., Szűcs P., Turai E., 1997. Optimum methods in statistics. Akadémiai Kiadó, Budapest.
- Koch, K.R.: Introduction to Bayesian Statistics. 2nd Ed. Springer, 2007.
- Najim, M.: Modeling, Estimation and Optimal Filtration in Signal Processing. Wiley & Sons, 2008.
- O'Hagan, A.: The Bayesian Approach to Statistics. in: Handbook of Probability: Theory and Applications, SAGE Publications Inc., 2008.
- Olea, R.A.: Geostatistics for Engineers and Scientists. Kluwer Academic Publishers, 1999.
- Steiner F.: The Most frequent value: introduction to a modern conception of statistics. Academic Press Budapest, 1991.
- Strang, G., Borre, K.: Linear Algebra, Geodesy, and GPS. Wellesley Press, Cambridge, 1997.
- Sundararajan, D.: Discrete Wavelet Transform: A Signal Processing Approach. Wiley & Sons, 2015.
- Torrence, C., Compo, G.: A Practical Guide to Wavelet Analysis. Bulletin of the American Meteorological Society, Vol. 79, No. 1, pp. 61–78.
- Vanicek, P., Krakiwsky, E.J. : Geodesy: The Concepts. Part III. Methodology. North-Holland, 1986.

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam	E	A.1-A.6; B.1-B.2; C.1-C.3; D.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
preparation for the exam	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

ADVANCED PHYSICAL GEODESY

1.2 Code

BMEEOAFDT72

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. Völgyesi Lajos
academic rank	Professor emeritus
email	volgyesi.lajos@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT72
https://edu.epito.bme.hu/course/view.php?id=3400

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Specialization in Structural Engineering (BSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

Advanced Physical Geodesy - BMEEOAFDT72

2. Objectives and learning outcomes

2.1 Objectives

Physical and Theoretical Geodesy is the science of the figure of the Earth, which studies the large-scale figure and gravity field of the Earth, which are closely related. The figure of the Earth is approximated by an ellipsoid of revolution, after which the precise figure is described by small deviations from this ellipsoid. Vertical reference systems are discussed in this context. Extending the approach to the Earth's gravity field yields small difference quantities, such as the disturbing potential and gravity anomalies. This course covers such modern techniques that were not covered in the previous BSc and MSc geodesy and physical geodesy courses due to lack of time.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Is familiar with the terminology of physical geodesy
2. Understands the relationship and interdependence of physical geodesy and gravimetry
3. Knows the most important mathematical methods in geosciences
4. Acquires the modern views on the determination of figure of the Earth
5. Recognises the importance of gravity gradients data in physical geodesy
6. Learn about QDaedalus measurements
7. Knows the possibilities of the determination of fine structure of geoid anomalies
8. Understands the problem of geodynamic interpretation of repeated geodetic and gravity observations
9. Knows the time variations of geoid and heights

B. Skills

1. Is able to understand the relationship between physical geodesy and gravimetry
2. Is able to determine the fine structure of geoid

C. Attitudes

1. Considers importance attending lectures and continuous mid-year learning
2. Cooperates with the lecturer and fellow students in expanding the knowledge
3. In addition to the compulsory curriculum, it expands its knowledge through continuous acquisition of knowledge

D. Autonomy and Responsibility

1. Independently investigates problems raised in lectures
2. Carry out his studies with appropriate responsibility
3. Assists fellow students in preparation in necessary situations

2.3 Methods

Lectures

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Current status and challenges of the science of physical geodesy (problems and solutions)
2.	Mathematical geosciences
3.	Significance of gravimetry in physical geodesy (new possibilities)
4.	Modern views on the determination of figure of the Earth
5.	Space methods
6.	Significance of torsion balance in physical geodesy
7.	Determination of fine structure of the geoid using

	torsion balance measurements
8.	Astrogeodetic observations by the QDaedalus system
9.	Determination of fine structure of the geoid using QDaedalus measurements
10.	Time variation of height and gravity
11.	Geodynamic interpretation of repeated geodetic observations
12.	Geodynamic interpretation of repeated gravity observations
13.	Seasonal variations of geoid (4D geodesy)
14.	Summary, consultation

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

- Bernhard Hofmann-Wellenhof, Helmut Moritz: Physical Geodesy. Springer, 2006. ISBN: 3-211-33544-7
- Torge: Geodesy. Walter de Gruyter, 1991. ISBN: 3-11-017072-8
- P. Biró: Time variation of height and gravity. Akadémiai Kiadó 1983. ISBN: 963-05-3231-X
- P. Biró, J. Ádám, L. Völgyesi, Gy.Tóth: Geodesy theory and practice. 2013. (In Hungarian) ISBN 978-963-257-248-2, p. 508.

2.6 Other information

1. Attendance at the lectures is compulsory. Students who miss four or more lectures will not receive ECTS for the course.

2.7 Consultation

As indicated on the department's website or by e-mail with the lecturer; e-mail: volgyesi.lajos@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Advanced Physical Geodesy - BMEEOAFDT72

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II. Subject requirements

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Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
		A.1-A.9; B.1-B.2; C.1-C.3; D.1-D.3

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
Exam	100°%
Sum	**100%**

3.4 Requirements and validity of signature

Active attendance at lectures

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

In case of retaking an assessment the second result will be taken into account from the new and previous results.

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
mid-year learning	14×3=42
preparation for the exam	20
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

GEOSCIENTIFIC FOUNDATIONS OF GEODESY

1.2 Code

BMEEOAFDT81

1.3 Type

Module without 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. Völgyesi Lajos
academic rank	Professor emeritus
email	volgyesi.lajos@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT81
https://edu.epito.bme.hu/course/view.php?id=3578

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Specialization in Structural Engineering (BSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

Geodesy is closely related to the various earth sciences, especially the different disciplines of geophysics. We can determine the theoretical shape of the Earth from our knowledge of the Earth's gravity field. The rotation of the Earth, its precession and nutation, causes the temporal variation of the geodetical and astronomical coordinates. The tectonic movements of the Earth also cause the various coordinates to change continuously and significantly, leading to the development of 4D geodesy.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Is familiar with the terminology of earth sciences
2. Understands the relationship and interdependence of geodesy and earth sciences
3. Knows the concept and the geodetic significance of the field forces of the Earth, the inner structure and the rotation of the Earth
4. Understands the relationship between the shape and the gravity field of the Earth
5. Understands the reason of physical background of larger geoid anomalies and the time variation of geoid anomalies
6. Is aware of the physical basis of Earth's rotation, knows exactly the phenomenon of precession and nutation
7. Understands the relationship between the rotation and the equilibrium shape of the earth
8. Understands the changes in terrestrial and astronomical coordinates due to precession and nutation
9. Understands the significance of oceanography and meteorology in geodesy
10. Knows the global tectonics of the Earth
11. Understand the revolutionary importance of 4D geodesy

B. Skills

1. Is able to understand the relationship between geodesy and different earth sciences
2. Is able to understand the different geodetic subjects on the basis of his basic knowledge of earth sciences

C. Attitudes

1. Cooperates with the lecturer and fellow students in expanding the knowledge
2. Considers importance attending lectures and continuous mid-year learning
3. In addition to the compulsory curriculum, it expands its knowledge through continuous acquisition of knowledge

D. Autonomy and Responsibility

1. Carry out his studies with appropriate responsibility
2. Openly accepts well-founded critical remarks
3. Assists fellow students in preparation in necessary situations

2.3 Methods

Lectures

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	The role and significance of earth sciences in geodesy.
2.	Field forces of the Earth (gravity and geomagnetic field)
3.	Time variation of gravity and geomagnetic field
4.	The relationship between the Earth's force fields and its shape
5.	Inner structure of the Earth

6.	The physical background of larger geoid anomalies
7.	Rotation of the Earth, paleorotation, the equilibrium shape of the earth
8.	Changes in terrestrial and astronomical coordinates due to precession and nutation
9.	Role of oceanography in the geoid definition
10.	Geoid eustasy
11.	Importance of meteorology in geodesy
12.	Geodynamics
13.	Geoscientific foundation of 4D geodesy
14.	Consultation

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

- F.D. Stacey, P.M: Davis: Physics of the Earth. Cambridge, 2011.ISBN: 978-0-521-87362-8
- A.H. Cook: Physics of the Earth and planets. MacMillan, 1973. SBN: 333-10905-8
- L. Völgyesi: Geophysics. 2002. (In Hungarian) J-91226

2.6 Other information

2.7 Consultation

Consultation appointments by prior arrangement

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
		A.1-A.11; B.1-B.2; C.1-C.3; D.1-D.3

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
Exam	100%
Sum	**100%**

3.4 Requirements and validity of signature

Active attendance at lectures

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

In case of retaking an assessment the second result will be taken into account from the new and previous results.

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
mid-year learning	14×3=42
preparation for the exam	20
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

SATELLITE GEODESY

1.2 Code

BMEEOAFDT82

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	József Ádám
academic rank	Professor emeritus
email	adam.jozsef@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT82
https://edu.epito.bme.hu/course/view.php?id=3579

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

Optional in the Land Surveying and Geoinformatics (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

Satellite Geodesy - BMEEOAFDT82

2. Objectives and learning outcomes

2.1 Objectives

Goal of the subject is that the student be familiar with methods of space geodesy and their fields of application. Knowledge acquired during this course should enable the student to understand and apply main methods that can be found in research papers in his field. Practical examples help the application of the various methods studied.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1.

B. Skills

    1.

C. Attitudes

    1.

D. Autonomy and Responsibility

    1.

2.3 Methods

lectures

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Task and division of space geodesy. The structure of the universe. The Solar System. The Earth and its movements.
2.	The Earth-Moon system. The apparent motion of celestial bodies. Celestial coordinate systems. The horizon coordinate system.
3.	Star catalogues, yearbooks. Calculation of stellar coordinates. Earth reference systems. Relationship between celestial and terrestrial coordinate systems.
4.	Time systems.
5.	Time measurement needs. Clocks and frequency standards, measurement of time. Signal propagation.
6.	Basics of astrogeodetic measurements. Determination of astronomic latitude. Determination of astronomic longitude and azimuth
7.	Geodetic artificial satellites. The motion and orbit of satellites in the Earth's gravity field.
8.	Calculation of the position of an artificial satellite. Calculation of the topocentric position vector of a satellite. Observation methods and techniques. Photographic observations.
9.	Telemetry methods. Doppler measurement method.
10.	Global positioning systems (GPS, GLONASS). Calculation of the geocentric position vector of a GPS satellite from on-board orbital elements.
11.	Satellite altimetry. Satellite to satellite tracking. Satellite gravity gradiometry.
12.	Interferometric measurement of radio sources. Space

	VLBI.
13.	Geodetic applications of satellite geodesy methods. Geometric and dynamic satellite geodesy.
14.	Geodetic and geodynamic applications of VLBI.

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

- Seeber, G. : Satellite Geodesy, Berlin, New York: De Gruyter, 2008.
- Curtis, H.: Orbital Mechanics For Engineering Students 4th Edition, Butterworth-Heinemann, 2020
- Nothnagel, A.: Elements of Geodetic and Astrometric Very Long Baseline Interferometry, 2021. https://www.vlbi.at/data/publications/2021_Nothnagel_Elements_of_VLBI_20210309.pdf
- Adam, Jozsef, Estimability of Geodetic Parameters from Space VLBI Observables, NASA Goddard Space Flight Center, Greenbelt, MD, NASA Grant No. NSG 5265, OSURF Proj. No. 711055, 101 pp, July 1990. OSU Report No. 406.

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

| Assessment and evaluation of the learning outcomes |

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
exam	E	

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
preparation for the exam	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Integrated Sensor Systems in Geodesy and Surveying - BMEEOAFDT83

I. Subject Specification

1. Basic Data

1.1 Title

INTEGRATED SENSOR SYSTEMS IN GEODESY AND SURVEYING

1.2 Code

BMEEOAFDT83

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. Takács Bence
academic rank	Associate professor
email	takacs.bence@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT83
https://edu.epito.bme.hu/course/view.php?id=5454

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Integrated Sensor Systems in Geodesy and Surveying - BMEEOAFDT83

2. Objectives and learning outcomes

2.1 Objectives

In the frame of the course, students learn the mathematical, physical and algorithmic basis of applying different sensors in the field of geodesy, land surveying, geoinformatics and navigation. Students take measurements using a wide variety of sensors and develop the programs to evaluate the measurement results in teamwork.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has an overview of sensors used in geodesy, land surveying, geoinformatics and navigation
2. understands the basics of algorithms applied for sensor fusion in the previous fields
3. knows the different communication channels, protocols to communicate sensors

B. Skills

1. uses and adjusts existing matlab or python codes to evalute the measurements of sensors in geodesy, land surveying, geoinformatics and navigation.
2. is able to make cable or cordless connection to sensor and test the connection

C. Attitudes

1. is open to sharing the developed algorithms in GitHub repositories.
2. prepares enough comments in the code and commit messages for making the developments understandable for research fellows.

D. Autonomy and Responsibility

1. In some situations - as part of a team - collaborates with other students in solving tasks.

2.3 Methods

Lectures, individual projects with consultation. Presentation of an individual project.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Coordinate frames, reference systems
2.	Kalman Filter-Based Estimation
3.	Inertial Sensors
4.	Inertial Navigation
5.	Dead Reckoning, Attitude, and Height Measurement
6.	Principles of Radio Positioning
7.	Global Navigation Satellite Systems, Fundamentals
8.	GNSS: Advanced Techniques
9.	INS/GNSS Integration
10.	INS Alignment, Zero Updates, and Motion Constraints
11.	Multisensor Integrated Navigation
12.	Fault Detection, Integrity Monitoring, and Testing
13.	Applications and Future Trends
14.	Summary. Individual student project demonstrations.

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. B. Hofmann-Wellenhof, K. Legat, M. Wieser: Navigation. Springer Science & Business Media, 2003
2. P.D. Groves (2004): Principles of GNSS, Inertial and Multisensor Integrated Navigation Systems. Artech House Publishing.

Integrated Sensor Systems in Geodesy and Surveying - BMEEOAFDT83

2.6 Other information

2.7 Consultation

Appointments: As specified on the department's website, or in consultation with the course instructors via e-mail

This Subject Datasheet is valid for:

2025/2026 II. félév

Integrated Sensor Systems in Geodesy and Surveying - BMEEOAFDT83

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
exam	E	A.1-A.3
individual project	IP	B.1-B.2; C.1-C.2; D.1

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
E	60
IP	40
Sum	**100%**

3.4 Requirements and validity of signature

submission of the individual project and acceptance by the course coordinator

3.5 Grading system

The final grade is the weighted average of the evaluations according to the clause 3.3.

3.6 Retake and repeat

1. Individual project can be submitted after its deadline specified in the detailed course programme until 11:59 pm on the last day of the completion week. In this case, the student must pay the pre-determined fee.
2. Submitted and accepted home works can be corrected until the deadline given in point 1) without paying a fee.

3.7 Estimated workload

Activity	Hours/semester
Contact hours	14×2=28
Preparation of the individual project	32
Preparation for the exam	30
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 II. félév

<div align="center">

I. Subject Specification

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1. Basic Data

1.1 Title

GEOSCIENTIFIC AND NAVIGATION APPLICATIONS OF GNSS AND INSAR

1.2 Code

BMEEOAFDT84

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. Rózsa Szabolcs
academic rank	Associate professor
email	rozsa.szabolcs@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT84
https://edu.epito.bme.hu/course/view.php?id=3447

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Geoscientific and Navigation Applications of GNSS and InSAR - BMEEOAFDT84

2. Objectives and learning outcomes

2.1 Objectives

This course aims at conveying up-to-date knowledge on the research and applications of the satellite navigation technologies, especially GNSS and satellite radar imagery in Geosciences, including geophysics, tectonophysics, meteorology, atmospheric sciences and hydrology.

Moreover, the recent developments and advances in satellite navigations are also introduced in the course, including global and regional navigation satellite systems, augmentation systems, ground based radionavigation systems and the fusion of satellite navigation observations with other positioning and attitude determination sensors (e.g INS, barometer, etc.).

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has an overview of the error effects of the GNSS observations;
2. understand the various GNSS processing techniques;
3. understands the concepts of geodetic reference frames;
4. understands the principles of satellite orbit determination;
5. has an overview of the global and regional GNSS infrastructure;
6. understands the link between satellite navigation and other geosciences;
7. understands the principles of positioning, navigation and timintg (PNT) applications
8. understands the varios interferometric SAR processing techniques (DInSAR, PSInSAR, DSInSAR, etc.)

B. Skills

1. able to process GNSS observations with a scientific level GNSS processing software (Bernese, GIPSY)
2. able to retrieve various geophysical/geodetic parameters from satellite navigation observations, like atmospheric water vapour, sea (or water) level, total electron content of the ionosphere, earthquake parameters, crustal deformations;
3. able to estimate precise orbits for satellites
4. able to use the observations and products of the International GNSS Service
5. able to process interferometric SAR observations and retrieve post seismic deformations
6. able to analyse the GNSS time series

C. Attitudes

1. is keen on discovering the latest advances in satellite navigation
2. presents her/his ideas, individual works in efficient and aesthetic presentations

D. Autonomy and Responsibility

1. She/he is able to process literature on her/his own, and present the main points to other students.
2. She/he collaborates with other students in small groups to solve the project work.

2.3 Methods

Lectures including practical demonstrations, individual projects with consultation. Presentation of the results.

2.4 Course outline

Week	Topics of lectures(and/or exercise classes)
1.	Geodetic Reference Systems. Terrestrial and Celestial Reference Systems. Transformation between Reference Systems.
2.	GNSS positioning techniques (relative positioning using double differences, precise point positioning, single point positioning).
3.	Systematic error sources of GNSS positioning (orbit and clock error, inter system biases, atmospheric effects and

	modelling, antenna PCO and PCV, multipath, etc.). Linear combinations and their role in retrieving geoscientific information.
4.	Structure and operation of GNSS reference stations. The European Permanent Network, the IGS network. Products, reference frames. Realtime data transfer, tools to automatic data collection (RTKLIB, bash scripts, etc.)
5.	Introduction to the rigorous GNSS data processing. The structure and modules of the Bernese Software. Orbit integration, receiver clock synchronization, preprocessing phase observations.
6.	Parameter estimation using Bernese Software. The Bernese Processing Engine. Workflows for coordinate estimation, tropospheric delay esti ation, total electron content estimation, orbit parameter and Earth Rotation Parameter estimation.
7.	Definition of the individual project work in GNSS (**P1**).
8.	Principles and the theoretical background of interferometric SAR data processing
9.	DInSAR, PSInSAR, DSInSAR techniques.
10.	Introduction to the InSAR data repositories and the SNAP software. DInSAR workflow.
11.	Case study of estimating post-seismic surface deformations using DInSAR technique.
12.	Definition of the project work in InSAR (**P2**)
13.	Time series analysis of GNSS coordinate time series. Extracting hydrological signals from GNSS coordinate time series.
14.	Summary. Individual student project demonstrations.

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

- B. Hofmann-Wellenhof, H. Lichtenegger, E. Wasle: GNSS - Global Navigation Satellite Systems (GPS, GLONASS, Galileo and more). Springer Verlag Vienna, 2008, ISBN 978-3-211-73017-1
- P.J.G. Teunissen, O. Montenbruck: Handbook of Global Navigation Satellite Systems. Springer Nature Switzerland AG, 2017, ISBN 978-3-030-73172-4
- V.B.H. Ketelaar: Satellite Radar Interferometry, Subsidence Monitoring Techniques. Springer Science+Business Media B.V. 2009, ISBN 978-1-4020-9427-9
- ESA: inSAR Principles: Guidelines for SAR Interferometry Processing and Interpretation. Eurpean Space Agency, 2007, https://esamultimedia.esa.int/multimedia/publications/TM-19/TM-19_InSAR_web.pdf
- EO College website: https://eo-college.org/resource-spectrum/radar/

2.6 Other information

2.7 Consultation

Appointments: as specified on the department's website. Additional appointments can be made via e-mail to the lecturer(s).

Geoscientific and Navigation Applications of GNSS and InSAR - BMEEOAFDT84

This Subject Datasheet is valid for:

Inactive courses

Geoscientific and Navigation Applications of GNSS and InSAR - BMEEOAFDT84

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
GNSS Project	P1	A.1-A.4; B.1-B.4; C.2; D.1-D.2
InSAR Project	P2	B.5; D.1-D.2
Exam	E	A.1-A.8; B.6; C.1

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
P1	20%
P2	20%
E	60%
Sum	**100%**

3.4 Requirements and validity of signature

Submission of both individual projects and their acceptance by the course coordinator.

3.5 Grading system

Grade	Score (P)
excellent (5)	4.501-5.00
good (4)	3.501-4.500
satisfactory (3)	2.501-3.500
pass (2)	1.501-2.500
fail (1)	<1.501

3.6 Retake and repeat

P1 and P2 projects can be submitted after its deadline specified in the detailed course programme until 11:59 pm on the last day of the completion week. In this case, the student must pay the pre-determined fee.
2. Submitted and accepted homeworks can be corrected until the deadline given in point 1) without paying a fee.

3.7 Estimated workload

Activity	Hours/semester
Contact hours	14×2=28
Preparation of the projects (P1, P2)	42
Preparation for the exam	20
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

SPATIAL TEMPORAL DATABASES

1.2 Code

BMEEOAFDT85

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	Siki Zoltán
academic rank	Assistant professor
email	siki.zoltan@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFDT85
https://edu.epito.bme.hu/course/view.php?id=3402

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

Basic SQL and Python programming knowledge is necessary.

1.13 Effective date

1 September 2022

Spatial Temporal Databases - BMEEOAFDT85

2. Objectives and learning outcomes

2.1 Objectives

Extending database knowledge into the temporal and spatial direction. Analysis of time series data.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge
1. has an overview of database systems storing spatio-temporal data
2. understands the basic of machine learning algorithms for time series
3. knows the special SQL extensions to handle spatial and temporal data

B. Skills
1. uses public Python packages, codes to handle spatio-temporal data
2. is able to organize spatio-temporal data into database
3. is able to apply spatial-temporal queries on database

C. Attitudes
1. is open to share program codes and algorithms with teammates and other researchers
2. adds valuable comments to source codes for researcher fellows
3. accepts comments, critics and updates in teamwork

D. Autonomy and Responsibility
1. is able to cooperate teammates

2.3 Methods

Lectures, consultations, individual or team projects. Presentation of project.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Handling date-time, time-zone data in databases
2.	Spatial data storing in databases, the SFS (Simple Feature for SQL) standard
3.	Spatial and temporal functions in PostgreSQL and PostGIS
4.	Creating and maintaining spatio-temporal databases from SQL using PostgreSQL and PostGIS
5.	Using spatio-temporal database from Python
6.	Time series databases (TSDB)
7.	NoSQL databases for spatio-temporal data
8.	Preprocessing and filtering of time series of observation data
9.	Spectral analysis of time series
10.	Machine learning and time series data
11.	Introduction to team/individual project
12.	Project consultation
13.	Project consultation
14.	Project presentation and evaluation

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

- Ben Auffarth: Machine Learning for Time-Series with Python, Packtpub 2021 October

Spatial Temporal Databases - BMEEOAFDT85

- Andrew P. McMahon: Machine Learning Engineering with Python, Packtpub 2021 November
- Dominik Mikiewicz , Michal Mackiewicz , Tomasz Nycz: Mastering PostGIS, Packtpub 2017 May

2.6 Other information

2.7 Consultation

Appointments: As specified on the department's website, or in consultation with the course instructors via e-mail or Teams

This Subject Datasheet is valid for:

2025/2026 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
exam	E	A.1, A.2, A.3
project	P	B.1, B.2, B.3; C.1, C.2, C.3; D.1

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
E	50%
P	**50%**
Sum	**100%**

3.4 Requirements and validity of signature

submission of the individual project and acceptance by the course coordinator

3.5 Grading system

The final grade is the weighted average of the evaluations according to the clause 3.3.

3.6 Retake and repeat

1. Individual project can be submitted after ithe deadline specified in the detailed course programme until 11:59 pm on the last day of the completion week. In this case, the student must pay the pre-determined fee.
2. Submitted and accepted home works can be corrected until the deadline given in point 1) without paying a fee.

3.7 Estimated workload

Activity	Hours/semester
Contact hours	14×2=28
Preparation of the project	36
Preparation for the exam	26
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Image processing - BMEEOFTDT71

I. Subject Specification

1. Basic Data

1.1 Title

IMAGE PROCESSING

1.2 Code

BMEEOFTDT71

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. Arpad Barsi
academic rank	Professor
email	barsi.arpad@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT71
https://edu.epito.bme.hu/course/view.php?id=2489

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Image processing - BMEEOFTDT71

2. Objectives and learning outcomes

2.1 Objectives

By completing the image processing course, students will gain a comprehensive understanding of the creation, storage and use of digital images. They will become familiar with basic image manipulation operators and techniques, computer vision solutions and their links to other disciplines. In addition to theoretical methods, the course will also cover practical applications and development environments. Throughout the semester, individual problems are solved through independent problems, allowing PhD students to integrate image analysis technologies into their own research.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Has an overview of the latest development in the field of image processing and computer vision.
2. Knows the advantages and shortcomings of the particular image acquisition and storage methods.
3. Has an overview of the cutting-edge image processing techniques and solutions.
4. Knows the main engineering application fields images can support.

B. Skills

1. Evaluates the performance of the particular image processing technology.
2. Selects appropriate data acquisition technology considering the application requirements.
3. Selects the effective data processing method for particular tasks.
4. Is able to assess the potential of data processing techniques.

C. Attitudes

1. Cooperates with the teacher and fellow students in expanding the knowledge,
2. Expands his knowledge with the continuous acquisition of knowledge,
3. Open to the use of information technology tools,

D. Autonomy and Responsibility

1. Is able to perform own literature survey.
2. Makes responsible decisions based on consultation.

2.3 Methods

Some introductory lectures on state-of-the-art of image processing, own research in a selected area, continuous consultation, and home assignment.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Basic terms of images and image processing
2.	Image capture and storage
3.	Image features and statistics
4.	Histogram and LUT manipulations
5.	Image filtering
6.	Image segmentation and classification
7.	Basics of computer vision
8.	Consultation
9.	Consultation
10.	Consultation
11.	Consultation
12.	Consultation
13.	Consultation
14.	Students' presentation

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to

Image processing - BMEEOFTDT71

the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

Gonzalez - Woods: Digital Image Processing

2.6 Other information

2.7 Consultation

Weekly opportunities discussed by supervisor.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Learning outcomes formulated in point 2.2 are assessed on homework assignment and exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Home assignment	HW	A.1-A.4; B.1-B.4; C.1-C.3; D.1-D.2
Exam	E	A.1-A.4; B.1-B.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

Abbreviation	Score
HW	50%
E	50%
Sum	**100%**

3.4 Requirements and validity of signature

Successfully submitted and presented home assignment.

3.5 Grading system

The final grade is calculated by the average of the HW and E.

3.6 Retake and repeat

Late submission of the home assigment is allowed on the make-up week.

3.7 Estimated workload

Activity	Hours/semester
classes	28
preparing HW	40
preparing for the E	22
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

GEOINFORMATICAL SYSTEMS

1.2 Code

BMEEOFTDT72

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Seminar	2

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. György Szabó
academic rank	Associate professor
email	szabo.gyorgy@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT72
https://edu.epito.bme.hu/course/view.php?id=2490

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

Basic knowledge of database managemet, elemetary geospatial software application experience required, pyton language experience can be useful.

1.13 Effective date

1 September 2022

Geoinformatical systems - BMEEOFTDT72

2. Objectives and learning outcomes

2.1 Objectives

Within the framework of the course, students solve independent research tasks related to their PhD theme.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. understand the main principles of location-based environmental analysis,

    2. know the processes of location based environmental phenomena and how they are described,

    3. know the steps of digital representation of the built and natural environment,

    4. familiar with spatial data capture, spatial analysis and visualization techniques

B. Skills

    1. to create a structural spatial model of our urban and rural environment,

    2. create indices for the analysis of the complex interaction between nature, infrastructure, society and culture, spatial indicators

C. Attitudes

    1. open to the use of geospatial tools, to produce new scientific results

    2. make efforts to carry out relevant decision support analyses

D. Autonomy and Responsibility

    1. independently able to model spatial phenomena and realize their relationships,

    2. independently capable of basic spatial analysis,

    3. independently capable of using heterogeneous spatial databases,

    4. systematic thinking when examining spatial environmental phenomena and susainability

2.3 Methods

Lectures, workshops , course discussion, professional project report and scientific paper composition

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Entry test of participants Requirements, methods, resources
2.	Location based data driven decision support in the XXI. century
3.	Reserach paper requirements, sample papers
4.	GS based project planing framework
5.	Consultation
6.	Consultation
7.	Consultation
8.	Consultation
9.	Consultation
10.	Mid-semester report
11.	Consultation
12.	Consultation
13.	Consultation
14.	Final delivery of the report and paper

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

Study materials, tutorials on the webpage of the course

Geoinformatical systems - BMEEOFTDT72

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

Geoinformatical systems - BMEEOFTDT72

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The evaluation of the semester's work is carried out in the form of an exam with the oral defense of the following written works prepared during the semester:

1.**Scientific paper:** Writing a GIS based, location specific scientific publication related to PhD research in accordance with the published content and form requirements

2.**Project specification**: Develop a technological project framework related to PhD research, business application based on geospatial system, with special regard to the specification of the information products to be created, the description of the range of basic data required and the cost/benefit analysis of the system to be built

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
semester activity	SA	A.1-A.4; B.1-B.2; C.1-C.2; D.1-D.4

Oral exam, OE, Scientefic paper, Project technical report

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
SA	20
OE	**80%**

Sum 100%

3.4 Requirements and validity of signature

Active semeter work are required

Delivery of the mid-semeter evaluation report

3.5 Grading system

Grade	Points (P)
excellent (5)	>80
good (4)	70-79
satisfactory (3)	60-69
passed (2)	>=50
failed (1)	<50

3.6 Retake and repeat

Requlated by BME Code of Studies

3.7 Estimated workload

Activity	Hours/semester
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

LASER SCANNING

1.2 Code

BMEEOFTDT81

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Consultation	2

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Lovas Tamás
academic rank	Associate professor
email	lovas.tamas@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT81
https://edu.epito.bme.hu/course/view.php?id=2491

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Laser scanning - BMEEOFTDT81

2. Objectives and learning outcomes

2.1 Objectives

Students accomplishing the course will have an overview of the R&D activities and trends in the field of laser scanning. They learn the latest technological developments in airborne, mobile, and terrestrial laser scanning. Besides data acquisition techniques and solutions, students study point cloud processing techniques. They have the opportunity to deepen their knowledge in a selected area of laser scanning, survey the relevant literature, and try the methods. This way the course supports PhD students to review state-of-the-art technologies and solutions and select results that can be used in their own research work.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Has an overview of the latest development in the field of airborne, mobile, and terrestrial laser scanning.
2. Knows the advantages and shortcomings of the particular laser scanning data acquisition methods.
3. Has an overview of the cutting edge point cloud processing techniques and solutions.
4. Knows the main engineering application fields laser scanning can support.

B. Skills

1. Evaluates the performance of the particular laser scanning technology.
2. Selects appropriate data acquisition technology considering the application requirements.
3. Selects the effective data processing method for particular tasks.
4. Is able to assess the potential of data processing techniques.

C. Attitudes

1. Cooperates with the teacher and fellow students in expanding the knowledge,
2. Expands his knowledge with the continuous acquisition of knowledge,
3. Open to the use of information technology tools,

D. Autonomy and Responsibility

1. Is able to perform own literature survey.
2. Makes responsible decisions based on consultation.

2.3 Methods

Some introductory lectures on the state-of-the-art of laser scanning, own research in a selected area, continuous consultation, home assignment.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Laser scanning state-of-the-art
2.	Airborne laser scanning
3.	Mobile laser scanning
4.	Terrestrial laser scanning
5.	Point cloud processing - registration
6.	Point cloud processing - modeling
7.	Point cloud processing - segmentation
8.	Point cloud processing - classification
9.	consultation
10.	consultation
11.	consultation
12.	consultation
13.	consultation
14.	Students' presentation

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

Vosselman-Haas: Airborne and Terrestrial Laser Scanning
Shan-Toth: Topographic Laser Ranging

2.6 Other information

2.7 Consultation

Weekly opportunities discussed by supervisor.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Learning outcomes formulated in point 2.2 are assessed on homework assignment and exam.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Home assignment	HW	A.1-A.4; B.1-B.4; C.1-C.3; D.1-D.2
Exam	E	A.1-A.4; B.1-B.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
HW	50%
E	50%
Összesen	**100%**

3.4 Requirements and validity of signature

Successfully submitted and presented home assignment.

3.5 Grading system

The final grade is calculated by the average of the HW an E.

3.6 Retake and repeat

Late submission of the home assigment is allowed on the make-up week.

3.7 Estimated workload

Tevékenység	Óra/félév
classes	28
preparing HW	40
preparing for the E	22
Összesen	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Műholdas távérzékelés - BMEEOFTDT82

I. Subject Specification

1. Basic Data

1.1 Title

MŰHOLDAS TÁVÉRZÉKELÉS

1.2 Code

BMEEOFTDT82

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. Kugler Zsófia
academic rank	Associate professor
email	kugler.zsofia@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT82
https://edu.epito.bme.hu/course/view.php?id=2482

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2023

Műholdas távérzékelés - BMEEOFTDT82

2. Objectives and learning outcomes

2.1 Objectives

A tárgy célja áttekintést adni a képalkotó műholdas távérzékelési technológiákról, legújabb trendekről és alkalmazásairól. Az előadásokon a hallgatók megismerik a széles körben alkalmazott műholdas távérzékelési szenzorok felépítését, technológiai jellemzőit, a végtermékeket és a jellemző alkalmazási területeket. Gyakorlaton elsajátított tudásuk alapján, feladatmegoldó képességek fejlesztésére, rövid, de egyénileg végrehajtandó távérzékelési feladatot kapnak, ahol önálló feldolgozással kell eljutni az adatbeszerzéstől a térképezési végtermék előállításáig.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Áttekintéssel rendelkezik a műholdas távérzékelésiszenzorok felépítéséről, technológiai jellemzőiről.
2. Áttekintéssel rendelkezik műholdas távérzékelés fizikai hátterével, adatok beszerzésével és alapvető feldolgozási eljárásaival.
3. Áttekintéssel rendelkezik a műholdas távérzékelésfőbb alkalmazási területeiről
4. Ismeri az képkiértékelési és képfeldolgozási módszereket.
5. Tisztában van a tanult adatfeldolgozási módszerek erőforrás igényeivel.

B. Skills

1. Képes térképezési céllal műholdas adatbázisból, képfeldolgozási műveletek elvégzésével Földmegfigyelés témában geoadat létrehozására.
2. Lényegre törően, szakszavak helyes használatával ismerteti szóban és írásban a tantárgy főbbtémaköreit.

C. Attitudes

1. Törekszik pontos távérzékelési végtermékek készítésére.
2. A házi feladatok elkészítése során önállóságra törekszik és oktatói segítséget csak a szükséges mértékben kér

D. Autonomy and Responsibility

1. Önállóan végzi el az órai munkaként kijelölt feladatokat.
2. Munkáját érő oktatói kritikák esetén a megalapozott kritikai észrevételeket elfogadja, beépíti további feladatvégzésébe.

2.3 Methods

Előadások és számítógépes laboratóriumi gyakorlatok. Teljesítményértékelés számítógépen megoldandó feladatokon keresztül.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	
2.	
3.	
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12.	
13.	

14.	

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

Jegyzetek:
1. Lovas –Berényi -Barsi: Lézerszkennelés, TercKiadó, 2012.
2. Winkler Gusztáv: Információgyűjtő módszerek a távérzékelésben, 2002 Műegyetem kiadó, Budapest
3. Lillasand T. M., Kiefer R. W., Chipman W. J. : Remote Sensing and Interpretation , John Wiley and Sons, Inc., 2007

2.6 Other information

2.7 Consultation

Konzultációs időpontok: A tanszék honlapján megadottak szerint, vagy előzetesen, e-mail-ben a gyakorlatvezetőkkel egyeztetve.

This Subject Datasheet is valid for:

Nem induló tárgyak

Műholdas távérzékelés - BMEEOFTDT82

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

A 2.2. pontban megfogalmazott tanulási eredmények értékelése vizsga és házi feladatalapján történik.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
zárthelyi dolgozat	V	A.1-A.5; B.1-B.2; C.1-C.2; D.1-D.2

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
V	100%
Összesen	**100%**

3.4 Requirements and validity of signature

A tárgyból nem szerezhető aláírás.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	80<=P
jó (4)	70<=P<80%
közepes (3)	60<=P<70%
elégséges (2)	50<=P<60%
elégtelen (1)	P<50%

3.6 Retake and repeat

Pótlás a vizsgaszabályzat szerint.

3.7 Estimated workload

Tevékenység	Óra/félév
részvétel és felkészülés a kontakt tanórákon	14×5=70
Összesen	**70**

3.8 Effective date

1 September 2023

This Subject Datasheet is valid for:

Nem induló tárgyak

I. Subject Specification

1. Basic Data

1.1 Title

DIGITAL SURFACE MODELING

1.2 Code

BMEEOFTDT83

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. Attila Juhász
academic rank	Associate professor
email	juhasz.attila@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT83
https://edu.epito.bme.hu/course/view.php?id=5449

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 May 2021

Digital surface modeling - BMEEOFTDT83

2. Objectives and learning outcomes

2.1 Objectives

The course consists the theorethical knowledge of digital terrain / surface modeling and analysis in depth. After completing this course, the students will understand the details of data acquisition procedures and sources used in digital elevation modeling (DEM), the structure of the databases, interpolation and analysis methods. The mathematical background of these methods will also be presented. In practice, the students will be able to collect relevant elevation data, perform spatial analysis functions, create and visualize appropriate digital elevation model in connection with environmental phenomenas of natural and built-in areas. The course reviews the entire process of elevation data acqusition, the DEM's structures, interpolation, analysis and visualization.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. The elevation data acquisition methods (operational principles, groups, characteristics)
2. Elevation data preprocession, filtering
3. Knowledge of DEM structures
4. Interpolation methods
5. Technological background of DEM analysis and visualization

B. Skills

1. Ability of creating a strucured DEM
2. Preprocessing and filtering the raw data
3. Selection of relevant interpolation method
4. Creation of static and dynamic data visulization

C. Attitudes

1. Openmind to the usage of GIS tools and solutions
2. Systematic thinking

D. Autonomy and Responsibility

1. Independent work
2. Ability in organizing and managing

2.3 Methods

Lectures, oral and written communication, usage of IT tools and technologies, Discussions, analysis and calculations during the courses.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Basics of the digital elevation modeling.
2.	DEM structures
3.	Elevation data acqusition sources I.
4.	Elevation data acqusition sources II.
5.	Interpolation methods I.
6.	Interpolation methods II.
7.	Interpolation methods III.
8.	Data quality
9.	Mathematical background of 3D analysis
10.	Static and dynamic visualization
11.	DEM exercise (consultation)
12.	DEM exercise (consultation)
13.	DEM exercise (consultation)
14.	DEM exercise (consultation)

Digital surface modeling - BMEEOFTDT83

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

- Documents on the homepage of the subject.
- Web documents.

2.6 Other information

2.7 Consultation

The consultation times are listed on the department's homepage.

In e-mail: juhasz.attila@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

Digital surface modeling - BMEEOFTDT83

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The evaluation of the students knowledge (listed in 2.2) is based on a complex practical task and an oral exam.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Complex task	T	A.1-A.5; B.1-B.4; C.1-C.2; D.1-D.2
Oral exam	E	A.1-A.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

Jele	Részarány
T	50%
E	50%
Összesen	**100%**

3.4 Requirements and validity of signature

The criteria of getting signature is to acquire the 50% of the potential points during the semester.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	80<=P
jó (4)	70<=P<80%
közepes (3)	60<=P<70%
elégséges (2)	50<=P<60%
elégtelen (1)	P<50%

3.6 Retake and repeat

The complex task can be replaced till the last day of the repeat week. In written form unti 16:00 or in e-form until 23:59.

3.7 Estimated workload

Tevékenység	Óra/félév
Attendance on the contact lectures	28×1=28
Praparation to the task	10
Creating the task	30
Preparation to the exam	10
Sum	**78**

3.8 Effective date

1 May 2021

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

CLOSE-RANGE PHOTOGRAMMETRY

1.2 Code

BMEEOFTDT84

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. Bence MOLNÁR
academic rank	Associate professor
email	molnar.bence@emk.bme.hu

1.8 Department

Department of Photogrammetry and Geoinformatics

1.9 Website

https://epito.bme.hu/BMEEOFTDT84
https://edu.epito.bme.hu/course/view.php?id=2494

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Close-range photogrammetry - BMEEOFTDT84

2. Objectives and learning outcomes

2.1 Objectives

Capable to analyse close-range photogrammetry projects and improve accuracy based on a good understanding of theory. Students will process and understand state-of-the-art papers and present them to other participants. Finally, there will be practical work as well where students can apply recently learned knowledge.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. State-of-the-art photogrammetry algorithms and solutions

B. Skills

    1. Solving difficult situations during post processing

C. Attitudes

    1. Search for related papers and recent technologies/algorithms

D. Autonomy and Responsibility

    1. Understand and apply recent algorithms and solutions.

2.3 Methods

Literature processing

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

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

Consultaion

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Presentation	P	A.1; B.1; C.1; D.1

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
P	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Prepare	90
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

ARTIFICIAL INTELLIGENCE

1.2 Code

BMEEOFTDT85

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	Béla Paláncz
academic rank	Professor emeritus
email	palancz.bela@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOFTDT85
https://edu.epito.bme.hu/course/view.php?id=2495

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

Required previous subjects (need to be completed to register): Corresponding MSc subjects

1.13 Effective date

1 September 2022

Artificial intelligence - BMEEOFTDT85

2. Objectives and learning outcomes

2.1 Objectives

Practical and theoretical introduction to models and methods of machine and deep learning.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. General, solid knowledge of the ML and DL techniques and their applications.

B. Skills

    1. Finding the proper methods for the actual problem
    2. Recognition the advantages and handicaps of the applied methods
    3. Providing alternative solutions
    4. Ability to evaluate real project
    5. Select and using appropriate software

C. Attitudes

    1.

D. Autonomy and Responsibility

    1.

2.3 Methods

Lectures, electronic hand-outs, computer solution of practical problems

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Introduction. Artificial intelligence - Machine learning - Deep Learning. Tasks - Models - Learning Methods
2.	Methods of feature reduction 1: PCA -SVD - KL Decomposition - TLS - IC Analysis
3.	Methods of feature reduction 2: DFT - DWT - RBF Approximation - Autoencodig - Fractal Compression
4.	Classification: KNN - Logistic regression - Tree Based Models - SVM - Naive Bayes Classifier
5.	Clustering: KMeans - Hierarchical - Density Based Spacial - Sprectal
6.	Regression: KNN - Linear - Non-Linear - Robust - Symbolic - SVM
7.	Neural Networks Basic: Single and Multilayer Perceptron
8.	Hopfield Net and its applications
9.	Unsupervised Net and its applications
10.	Recurrent Network
11.	Features of Deep Learning - applications
12.	Convolutional Neural Network with applications
13.	Project work - consultation
14.	Project work - consultation

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

Textbooks:

Artificial intelligence - BMEEOFTDT85

1. Awange - Paláncz - Lewis - Völgyesi: Mathematical Geosciences 2nd edition, Springer 2022
2. Awange - Paláncz - Völgyesi: Hybrid Imaging and Visualization Springer 2020

Online materials:

1. Electronic Lecture Notes

2.6 Other information

Website:

- www.wolframcloud.com/obj/palancz/Published/Artificial_Intelligence.nb

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: oktato@mail.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Artificial intelligence - BMEEOFTDT85

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
		A.1; B.1-B.5; C.1; D.1

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Útpályaszerkezet diagnosztika és méretezés - BMEEOUVDT81

I. Subject Specification

1. Basic Data

1.1 Title

ÚTPÁLYASZERKEZET DIAGNOSZTIKA ÉS MÉRETEZÉS

1.2 Code

BMEEOUVDT81

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	Tóth Csaba
academic rank	Associate professor
email	toth.csaba@emk.bme.hu

1.8 Department

Department of Highway and Railway Engineering

1.9 Website

https://epito.bme.hu/BMEEOUVDT81
https://edu.epito.bme.hu/course/view.php?id=2564

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The objective of the course is to get acquainted with unique design principles of road pavement structures. Learning outcomes include the choice of a pavement structure type from the catalogue as well as to create pavement structure models with customised material parameters, in order to provide a better possibility for engineers to design more economical pavement structures.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Gets acquainted with the theoretical principles and practice of current design procedures.
2. Gets acquainted with requirements for road pavements.
3. Gets acquainted with material models used for road pavement structures.
4. Gets acquainted with possibilities of calculation of the design traffic.
5. Gets acquainted with principles and steps of the analytic design of new asphalt pavements.
6. Gets acquainted with design principles of concrete pavements and airport pavements.
7. Gets acquainted with technological details of pavement structures for low volume roads and small element pavements.
8. Gets acquainted with the main steps of leading international design procedures.
9. Gets acquainted with calculation and operation principles of leading international pavement structure design software.
10. Gets acquainted with the main distress types of road pavements as well as their causes.
11. Gets acquainted with alternative methods for strengthening of asphalt pavement structures.

B. Skills

1. Is able to create a design model of a road pavement structure, as well as to determine material parameters required for calculations.
2. Is able to determine stresses and strains in the road pavement structure.
3. Is able to determine the damaging effect of a special vehicle.
4. Is able to determine the technical equivalence of different road pavement structures.
5. Is able to design a unique road pavement structure differing from the catalogue types.
6. Is able to design a concrete pavement according to specifications and conditions.
7. Is able to find a connection between distresses on road pavement or in the pavement structure layer and their causes.
8. Is able to apply the acquired software for creating a pavement structure model as well as for determining stresses and strains under loads.
9. Is able to present their own ideas in an ordered oral or written form.

C. Attitudes

1. Co-operates with the instructor in the preparation of the partial performance assessment.
2. Strives to solve tasks accurately and without errors.
3. Strives to accurate professional phrasing in oral and written presentations.
4. Strives to provide an ordered documentation of the expected engineering level in its form and quality at written performance evaluations.

D. Autonomy and Responsibility

1. Responsibly prepares for a successful final performance assessment.
2. Individually fulfils tasks within the partial performance assessment according to their best own knowledge.
3. Receives openly any reasonable critical remark.
4. Applies a systematic approach in their own thinking.

2.3 Methods

Presentations (written and oral), individually prepared homework assignments (design tasks), oral and written communication at performance assessments and examinations.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Historical pavement structures. Pavement structure types
2.	Climatic and traffic loads, deterioration. History of pavement structure design
3.	Pavement design theory and practice 1. Calculation of traffic loads
4.	Pavement design theory and practice 2. Structural design of flexible pavements
5.	Asphalt pavement structure catalogue. Design of pavement strengthening
6.	Pavement design theory and practice 3. Modelling of pavement structures
7.	Pavement design theory and practice 4. Structural design of rigid pavements
8.	Airport pavements. Stone pavements
9.	Asphalt technology. Design of asphalt mixes
10.	Concrete technology. Design of concrete mixes
11.	Earthworks, geotechology, drainage
12.	Pavement condition, surface distresses
13.	Pavement maintenance, preventive. maintenance, pavement management
14.	Innovative pavement structures. Sustainability, recycling and re-use

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. Yang H. Huang: Pavement Analysis and Design. Kiadó: Pearson; 2 edition (2003). ISBN-10: 0131424734
2. Per Ullidtz: Modelling Flexible Pavement Response and Performance. Kiadó: Tech Univ. of Denmark Polytekn. 1998. ISBN-10: 8750208055

2.6 Other information

1. Attendance to lectures / seminars / exercise classes / laboratory practices is compulsory. The signature and credits from the subject will be refused to students attending less than 70% of classes.
2. Students are evaluated based on their actual individual performance. Students are required to show evidence of their own knowledge and skills. Submitting a work of others, obtaining or giving unauthorized help (e.g., during an exam or test) cheating and plagiarism in any form is unacceptable. Whoever violate the respective Regulations of the University will be given a failing grade (1), without the possibility of retake and repeat, and will be reported to the Dean's Office.

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail.

This Subject Datasheet is valid for:

Útpályaszerkezet diagnosztika és méretezés - BMEEOUVDT81

Nem induló tárgyak

Útpályaszerkezet diagnosztika és méretezés - BMEEOUVDT81

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes specified in clause 2.2. above and the evaluation of student performance occurs via tests, homework assignments and class work.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
homework	H	A.1-A.10; B.1-B.8; C.1-C.3; D.1-D.2
written/oral examination	E	A.1-A.11; B.1-B.9; C.1-C.4; D.1-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
H	25%
E	75%
Összesen	**100%**

3.4 Requirements and validity of signature

The condition for the signature is to get at least 50% of the points available in the semester according to clause 3.3. above, in each performance assessment as well as in summarised points. Moreover, the attendance to lectures is compulsory at least on 70% of lectures.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	80<=P
jó (4)	70<=P<80%
közepes (3)	60<=P<70%
elégséges (2)	50<=P<60%
elégtelen (1)	P<50%

3.6 Retake and repeat

1. Active attendance – based on its nature – is not repeatable, not correctable, not replaceable or taken out any other way.
2. The midterm performance assessments can be retaken or repeated in a summarised form in the retake period, free of charge at the first occasion. In case of a repeat, the result taken is based on the former and the new results, providing the more favourable for the student.
3. In case of a failed retake, there is a second occasion – by paying the appropriate fee determined in the Regulations – for repeating the unsuccessful first retake in a summarised form.

3.7 Estimated workload

Tevékenység	Óra/félév
contact hours	28
homework	32
preparation for the examination	30
Összesen	**3×30=90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Nem induló tárgyak

<div style="text-align:center">

I. Subject Specification

</div>

1. Basic Data

1.1 Title

RAILWAY TRACK GEOMETRY

1.2 Code

BMEEOUVDT82

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. Liegner Nándor
academic rank	Associate professor
email	liegner.nandor@emk.bme.hu

1.8 Department

Department of Highway and Railway Engineering

1.9 Website

https://epito.bme.hu/BMEEOUVDT82
https://edu.epito.bme.hu/course/view.php?id=2568

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is for the student to model the theoretical and practical requirements of railway track geometry. Get to know the theory of differential geometry, the natural triedron, their derivatives, movement characteristics, speed, acceleration, changing of acceleration and their derivation in respect of length of arc and time. Be able to determine the details of the transition geometry, apply the transition geometry of cant. Types of transition curves, vertical transition curves. Cant deficiency, cant excess, effect of body tilt coaches on cant deficiency. Familiar with the relevant standards of design of railway track geometry with continuous change and that with abrupt change of curvature. Analise the need to build a transition curve and cant. Familiarize with the theory required to geometrical calculation of the switches and crossings.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has relevant knowledge of differential geometry,
2. knows the mathematical basics of movement characteristic,
3. knows the application of movement characteristic,
4. knows the theory of transition geometry of curvature,
5. knows the theory of transition of cant,
6. can apply and supervise the rules of relevant standards,
7. knows how to analyze continuous change and abrupt change of curvature,
8. knows the theory of calculation of switches, crossings and individual track connections.

B. Skills

1. able to derive and calculate movement characteristics,
2. suitable for the geometrical calculation of the details of any geometry of curvature transition,
3. suitable for the geometrical calculation of the details of any transition of cant,
4. able to model the geometry of curvature transition,
5. able to model transition of cant, cant deficiency, cant excess, effect of body tilt coaches on cant deficiency,
6. be able to determine the need to apply a curvature transit and transition of cant,
7. able to analyze the geometrical properties of turnouts, crossings and any types of track connections on the basis of movement characteristics.

C. Attitudes

1. cooperates with the teacher and fellow students in expanding the knowledge,
2. expands his knowledge with continuous acquisition of knowledge,
3. open to the use of information technology tools,
4. strives to know and routinely use the tools needed to solve problems,
5. strives for an accurate and error-free solution.

D. Autonomy and Responsibility

1. independently considers the planning tasks and problems of the railway line and solves them on the basis of research capabilities,
2. openly welcomes substantiated critical remarks,
3. cooperates with research fellows in solving tasks,
4. takes a systematic approach to its thinking.

2.3 Methods

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

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Mathematical basis of differential geometry, natural triedron, derivation of movement characteristics, speed, acceleration, changing of acceleration
2.	Determination of practical formulae of movement characterisitcs
3.	Geometry of curvature transition in case of linear, cosine, sine, fourth power parabolic and Wiener Bogen transition curves, part I.
4.	Geometry of curvature transition in case of linear, cosine, sine, fourth power parabolic and Wiener Bogen transition curves, part II.
5.	Geometry of curvature transition in case of linear, cosine, sine, fourth power parabolic and Wiener Bogen transition curves, part III.
6.	Effect of cant, cant deficiency, cant excess, types of cant transition, part I.
7.	Cant transitions, part II.
8.	Determination of the length of the transition curves.
9.	Review of existing standards of design of geometrical alignment of railway tracks and that of cant.
10.	Assessment of the need of transition curves and / or transition of cant.
11.	Effect of body tilt coaches on cant deficiency and track alignment.
12.	Evaluation of swithces, crossings and track connections on basis of movement characteristics, part I.
13.	Evaluation of swithces, crossings and track connections on basis of movement characteristics, part II.
14.	Consultation

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

Dr. Jenő Megyeri: Railway Motion Geometry, Technical Publishing House, Budapest, 1986

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes set out in point 1 is based on a written exam at the end of the semester.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Written exam (summary performance evaluation)	E	A.1-A.8; B.1-B.7

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
E	100
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Score (P)
excellent (5)	87.5 <= P
good (4)	75 <= P <87.5%
satisfactory (3)	62.5 <= P <75%
pass (2)	50 <= P <62.5%
fail (1)	P <50%

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	14×3=42
preparation for the classes	14
exam preparation	34
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

I. Subject Specification

1. Basic Data

1.1 Title

MODELLING OF RAILWAY TRACKS

1.2 Code

BMEEOUVDT83

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. Liegner Nándor
academic rank	Associate professor
email	liegner.nandor@emk.bme.hu

1.8 Department

Department of Highway and Railway Engineering

1.9 Website

https://epito.bme.hu/BMEEOUVDT83
https://edu.epito.bme.hu/course/view.php?id=2567

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Modelling of railway tracks - BMEEOUVDT83

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to model the superstructure of the railway track with FEM softwares with regards of load bearing capacity and stability of the track. Laboratory tests are to carry out so the results serve as basis of the FEM models. The students will get acquainted with the methods of the use and stability testing of the railway superstructure in addition to the latest developed track structures. After completing the course, they are able to determine the behavior of the various superstructures, the relationship between the bridges and the superstructure. Participants can also listen to case studies related to state-of-the-art superstructures.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the most important superstructure dimensioning procedures,
2. knows the latest developed superstructure elements, their background,
3. knows the internal forces of a CWR track,
4. knows how to model the loads transferred to the track during deceleration and acceleration of trains
5. is familiar with the superstructure solutions of bridges, in connection with this, the types of rail expansion devices and their location on bridges,
6. knows the theoretical background and technical solutions of the transitional sections formed at the connection of the bridges and the earthwork.
7. is familiar with the theoretical background and modelling methods of the lateral stability test of the track.

B. Skills

1. be able to form an opinion on superstructure dimensioning procedures,
2. is able to determine the relevant loads using FEM models even in more complex cases,
3. be able to determine the forces and displacements in a CWR superstructure in both crushed stone and flexible bearing tracks as well as in the case of a rail with expansion device,
4. able to compile gap tables,
5. able to model track stability testing,
6. able to model load bearing capacity of railway track structural elements such as rail-joints, rail fastenings, sleepers and ballast bed, embedded rail superstructure, etc.

C. Attitudes

1. cooperates with the instructor in the preparation of partial performance evaluations,
2. strives for an accurate and error-free solution,
3. strives for precise, professional wording in its oral and written statements,
4. In the course of its written performance evaluations, it strives to produce orderly documentation of the quality and appearance expected at the researcher level.

D. Autonomy and Responsibility

1. prepare responsibly for the successful completion of performance appraisals,
2. perform the tasks issued during the independent partial performance assessments independently and to the best of his / her knowledge,
3. openly welcomes substantiated critical remarks.

2.3 Methods

Lectures and laboratory tests with presentations, self-made home planning assignment, written and oral communication: performance evaluation, exam, and active participation in contact classes.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Development and evaluation of railway superstructure dimensioning procedures. Use of the Zimmermann-

	Eisen mann superstructure sizing method.
2.	Presentation of the latest rail fastening systems and track structures, developments (case study).
3.	Building up FEM models to model the load bearing capapcity of the railway tracks. Computation of internal forces in the track.
4.	Laboratory test to measure the static and dynamic stiffness of rail fastening systems and investigate the effect of stiffness on the internal forces of the track by FEM models.
5.	Longitudinal forces in the CWR superstructures. Determination of rail end motion in case of a superstructure with crushed stone and in case of slab tracks. Modeliing oneway change of temperature and return change of temperatue.
6.	Laboratory test on determining the longitudinal rail restraint of different types of rail fastenings. Effects of rail clips with reduced and increased longitudinal rail restraint.
7.	Modelling the effect of reduced and increased longitudinal rail restraint on expansion of the rail with FEM models in case of ballasted tracks and concrete slab tracks.
8.	Types of rail expansion devices. Calculation of gap tables, factors influencing its design. Structures of bridges, static layouts. Longitudinal forces arising from the movement of bridges in the rail and on the supports. Effect of loaded and unloaded superstructure. Case study.
9.	Modelling the effects of breaking and acceleration forces of trains, superimposed on effects of change of temperature.
10.	Expansion behavior of rail fiber embedded in elastic material. More accurate determination of inhibited dilatation based on experimental resistance curves. Effect of train start - up and braking.
11.	FEM modelling of flexible transition sections between bridges and CWR tracks. Case study on the behavior of bridge structures.
12.	Stability of CWR tracks against buckling, factors influencing stability. The equation of equilibrium. Options for increasing resistance of ballast bed.
13.	Modelling stability of CWR tracks.
14.	Consultation

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

Coenraad Esveld: Modern Railway Tracks, Digital Edition 2014, version 3.1, ISBN 978-1-326-05172-3

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Modelling of railway tracks - BMEEOUVDT83

Inactive courses

Modelling of railway tracks - BMEEOUVDT83

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes formulated in point A is based on two homework assignments (continuous independent partial performance assessment).

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework (small homework, one-time partial performance evaluation	HW	A.2-A.3
Written exam (summary performance evaluation)	E	A.1-A.7; B.1-B.6

The actual place and date of the assessments carried out in the active period, the dates of handing out and handing in the homeworks are contained in the "Detailed schedule of the semester", that is available on the website of the subject.

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	20
Exam	80
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points
excellent (5)	87.5
good (4)	75
satisfactory (3)	62.5
passed (2)	50
failed (1)	0

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	28
homework preparation	30
preparing for the exam	32
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

TANTÁRGYI ADATLAP

I.   TANTÁRGYLEÍRÁS

1   ALAPADATOK

1.1   Tantárgy neve

Közlekedési modellek

1.2   Azonosító (tantárgykód)

…

1.3   A tantárgy jellege

kontaktórás tanegység

1.4   Óraszámok

típus	óraszám/félév
előadás (elmélet)	1
gyakorlat	1

1.5   Tanulmányi teljesítményértékelés (minőségi értékelés) típusa

vizsgajegy

1.6   Kreditszám

3

1.7   Tantárgyfelelős

neve:	dr. Juhász János
beosztása:	egyetemi docens
elérhetősége:	juhasz.janos@emk.bme.hu

1.8   Tantárgyat gondozó oktatási szervezeti egység

Út és Vasútépítési Tanszék (http://www.uvt.bme.hu)

1.9   A tantárgy weblapja

…

1.10   A tantárgy oktatásának nyelve

magyar, angol

1.11   A tantárgy tantervi szerepe

választható PhD tantárgy

1.12   Közvetlen előkövetelmények

-

1.13   A tantárgyleírás érvényessége

2022. szeptember 1-től.

2 CÉLKITŰZÉSEK ÉS TANULÁSI EREDMÉNYEK

2.1 Célkitűzések

A tantárgy célja a közúti forgalom makroszkopikus és mikroszkopikus jellemzői, a közlekedésbiztonságot meghatározó tényezők vizsgálata szimulációs módszerek alkalmazásával. Ennek során a hallgatók feladatai

- A szimulációs modellezés módszereinek megismertetése, elsajátítása.
- A mikroszkopikus forgalomáramlási és a magatartási modellek különbségeinek áttekintése.
- Az automatizált járművek közlekedésének és az intelligens infrastruktúra megvalósításának hatása a közúti forgalomáramlásra, valamint a közlekedésbiztonságra.
- A modellezéshez szükséges adatok meghatározása, összegyűjtése.
- A makroszkopikus és a mikroszkopikus eljárások alkalmazásának előnyei és korlátai, a számítási adatok értékelése.
- A gyalogos és a kerékpáros forgalom szimulációs vizsgálata. Különös tekintettel a növekvő kerékpáros forgalom és a gépjármű közlekedés integrációjára.
- Multimodális csomópont forgalmának tanulmányozása szimulációs módszerekkel.

2.2 Tanulási eredmények

A tantárgy sikeres teljesítése után a hallgató:

A. Tudás
1. Ismeri a közúti forgalom makroszkopikus és mikroszkopikus jellemzőit.
2. Ismeri a szimulációs modellezés módszereit.
3. Ismeri a modellezéshez szükséges adatok meghatározásának, összegyűjtésének módszereit.
4. Ismeri a közlekedési folyamat (forgalomáramlás), valamint a közlekedési szereplők viselkedésének vizsgálatára szolgáló modelleket.
5. Ismeri a gyalogos forgalomáramlás mikroszkopikus modellezésének módszereit.

B. Képesség
1. Képes a közúti forgalom vizsgálatára makroszkopikus és mikroszkopikus szimulációs modell segítségével.
2. Képes a VISUM program alkalmazására a közlekedés makroszkopikus modellezésénél.
3. Képes a VISSIM program gyakorlati alkalmazására a jármű és a gyalogosforgalom áramlásának vizsgálatára, a különböző forgalomirányítási módszerek összehasonlítására.
4. Képes multimodális csomópont kialakítás tervváltozatainak mikroszkopikus szimulációval történő összehasonlító elemzésére.

C. Attitűd
1. Részt vesz az előadásokon és a gyakorlatokon, az önálló tanulmányt határidőre elkészíti.
2. Az előadások során aktívan bekapcsolódik az aktuális téma feldolgozásába.
3. Az önálló tanulmány készítése során törekszik új műszaki megoldások kidolgozására.
4. Részt vesz a hallgatótársak előadásait követő szakmai vitában.
5. Nyitott az új ismeretek megismerésére, elsajátítására.

D. Önállóság és felelősség
1. Felelősséggel alkalmazza a tantárgy keretében megszerzett ismereteket.
2. Önállóan képes új műszaki megoldások kidolgozására.
3. Elfogadja az együttműködés kereteit, a feladattól függően önállóan vagy csapat részeként is képes munkáját elvégezni.

2.3 Oktatási módszertan

Előadások prezentációval, mintapéldákkal, esettanulmányokkal, valamint önállóan készített otthoni modellezési feladat, kommunikáció írásban és szóban (teljesítményértékelés és vizsga során).

2.4 Részletes tárgyprogram

óra	
2	A közúti forgalom mikroszkopikus és makroszkopikus jellemzői. A szimulációs modellezés módszereinek áttekintése.
2	Hálózati modell felépítése. Utazási igények. Módválasztás.
2 gy	Bevezetés a VISUM program alkalmazásába
2	Ráterhelési eljárások.
2	Forgalmi modell kalibrálása, validálása és kiértékelése
2 gy	VISUM modellező szoftver gyakorlati alkalmazása
2 gy	VISUM modellező szoftver alkalmazás esettanulmányok
2	Mikroszkopikus forgalmi modellezés alapfogalmai.
2 gy	Bevezetés a VISSIM program alkalmazásába
2	Forgalomáramlás vizsgálata, változatok összevetése, értékelése.
2 gy	VISSIM modellező szoftver gyakorlati alkalmazása, esettanulmányok
2 gy	Önálló feladat kiadása
2	PC-Crash modellező szoftver bemutatása
2 gy	Önálló feladat bemutatása

Az aktuális időpontokat a tárgy honlapján elérhető "Részletes féléves ütemterv" tartalmazza.

2.5 Tanulástámogató anyagok

Tankönyvek

1. Juan de Dios Ortúzar, Luis G. Willumsen: Modelling Transport
2. Dr. Fi István: Közúti csomópontok tervezési elvei és forgalmi méretezésük, Műegyetemi Kiadó, 2005, ISBN 963 420 826 6

Segédletek, számítási segédletek:

1. Háznagy Andor: Közlekedési modellezés
2. PTV VISUM User Guide
3. PTV VISSIM User Guide
4. Tantárgyi oldalról letölthető mintapéldák

2.6 Egyéb tudnivalók

A kontaktórákon való részvétel 70%-ban kötelező. Az a hallgató, aki ennél több alkalommal hiányzik, nem szerezheti meg a tantárgy kreditjét.

2.7 Konzultációs lehetőségek

Konzultációs időpontok:

A tantárgy adatlapján megadottak szerint, vagy előzetesen, e-mail-ben az előadókkal egyeztetve.

II.   TANTÁRGYKÖVETELMÉNYEK

3   A TANULMÁNYI TELJESÍTMÉNY ELLENŐRZÉSE ÉS ÉRTÉKELÉSE

3.1   Általános szabályok

A 2.2. pontban megfogalmazott tanulási eredmények értékelése két évközi önálló részteljesítmény-értékelés (otthoni feladat), az előadásokon tanúsított részvétel, valamint írásbeli és szóbeli vizsga alapján történik.

3.2   Teljesítményértékelési módszerek

Teljesítményértékelés neve (típus)	jele	értékelt tanulási eredmények (2.2 pont alapján)
Házi feladat (részteljesítmény értékelés)	HF	A.1-A.5; B.1-B.4; C.1-C.5.; D.1-D.3.
Vizsga (összegző teljesítményértékelés)	V	A.1-A.5; D.1-D.2.

A házi feladat ki- és beadási határidejét a „Részletes féléves ütemterv" tartalmazza, amely elérhető a tárgy honlapján.

3.3   Teljesítményértékelések részaránya a minősítésben

jele	részarány
HF	50%
szorgalmi időszakban összesen	**50%**
V	50%
Összesen	**100%**

HF eredménytelen, ha nem éri el az elérhető pontszám 50%-át, vagy a megadott határidőig nem adja be. Az elérhető pontszám 50%-ánál gyengébb vizsgaeredmény Elégtelen vizsgajegyet eredményez.

3.4   Az aláírás megszerzésének feltétele, az aláírás érvényessége

Az aláírás megszerzésének feltétele, hogy a 3.3. pont szerint a szorgalmi időszakban megszerezhető pontszám legalább 50%-át elérje a hallgató, mind az egyes egyedi teljesítményértékelésekre, mind az összegzett pontszámra vonatkozólag. Emellett az előadások és gyakorlatok 70%-án való részvétel kötelező.

3.5   Érdemjegy megállapítása

A jelenléti feltételeket teljesítők érdemjegyét az alábbi szempontok szerint határozzuk meg:

HF sikeressége az összpontszám 50%-ának megfelelő eredménye elérése. A végső érdemjegyet a félévközi teljesítményértékelések és az írásbeli vizsga 3.3. pont szerinti súlyozott átlaga alapján számítjuk: A végső osztályzat az egyes értékelésekre kapott osztályzatok 3.3. pont szerinti súlyozása szerint, és a kerekítés általános szabályait betartva alakul.

$70<=P<=P<=P$

érdemjegy	Pontszám (P)
jeles (5)	80<=P
jó (4)	70<=P<80%
közepes (3)	60<=P<70%
elégséges (2)	50<=P<60%
elégtelen (1)	P<50%

3.6 Javítás és pótlás

1) Az otthoni feladat – szabályzatban meghatározott díj megfizetése mellett – késedelmesen a „Részletes féléves ütemterv"-ben ismertetett időpontokban adhatók be.

2) A szintfelmérő teljesítményértékelés első alkalommal a „Részletes féléves ütemterv"-ben ismertetett időpontban díjmentesen pótolható vagy javítható. Javítás esetén az új eredmény a korábbi eredményt minden esetben felülírja.

3) Amennyiben a 2) pont szerinti pótlással sem tud a hallgató elégtelentől különböző érdemjegyet szerezni, úgy – szabályzatban meghatározott díj megfizetése mellett – második alkalommal, ismételt kísérletet tehet a sikertelen szintfelmérő teljesítményértékelés első pótlásának javítására a pótlási időszakban.

3.7 A tantárgy elvégzéséhez szükséges tanulmányi munka

Tevékenység	óra/félév
részvétel a kontakt tanórákon	28
házi feladat elkészítése	12
részvétel konzultációkon	12
kijelölt írásos tananyag önálló elsajátítása	18
felkészülés teljesítményértékelésre	20
összesen	**90**

3.8 A tantárgykövetelmények érvényessége

2022. szeptember 1-től

I. Subject Specification

1. Basic Data

1.1 Title

ECOLOGY

1.2 Code

BMEEOVKDT71

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	1
Consultation	1

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Zsolt Kozma
academic rank	Associate professor
email	kozma.zsolt@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT71
https://edu.epito.bme.hu/course/view.php?id=2583

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Ecology - BMEEOVKDT71

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to give (i) relevant insight into ecology with attention to the research topics of the participants and (ii) to improve the literature review skills of the participants.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. Participants will get to know the ecological aspects, methods and data sources relevant for their field for research.

B. Skills

    1. Participants will improve their literature review skills

C. Attitudes

    1. Participants will acquire proper engineering attitude towards the ecosystem (principles of prevention and precaution, etc.)

D. Autonomy and Responsibility

    1. Participants will be able to autonomously assess the ecological consequences of engineering activity in their field

2.3 Methods

Consultation, classroom exercises, self paced homework assignment

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Lecture: Principles in ecology
2.	Lecture: Principles in ecology
3.	Lecture: topic is tailored for the interest of the participants
4.	Introduction into homework assignment
5.	Consultation
6.	Consultation
7.	Lecture: nature based solutions
8.	Lecture: ecosystem services
9.	Consultation
10.	Consultation
11.	Consultation
12.	Consultation
13.	Consultation
14.	Presentation of homework assignments

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) Lecture slides:

- William J. Mitsch, James G. Gosselink Wetlands 5th Edition Wiley, 2015 ISBN-13: 978-1118676820
- William J. Mitsch, James G. Gosselink, Li Zhang, Christopher J. Anderson Wetland Ecosystems 1st Edition Wiley, 2009 ISBN-13: 978-0470286302

2.6 Other information

2.7 Consultation

Zsolt Kozma:

kozma.zsolt@emk.bme.hu

+36 1 463 2957

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The grade will measure the learning outcomes listed under 2.2 and will be decided based on the homework assignment (written material and presentation)

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework assignment	HW	A.1; B.1; C.1; D.1
Exam	E	A.1; B.1; C.1; D.1

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	50%
E	50%
Sum	**100%**

3.4 Requirements and validity of signature

Participants, who hand in their homework in the Semester or in the Retak week as the latest will receive signature

3.5 Grading system

Grade	Points (P)
excellent (5)	5
good (4)	4
satisfactory (3)	3
passed (2)	2
failed (1)	1

3.6 Retake and repeat

Homework assignment handing in: Possible in the retake week.
Homework assignment presentation: Possible in the Exam period

3.7 Estimated workload

Activity	Hours/semester
Lectures and consultations	28
Homework	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

<div align="center">

I. Subject Specification

</div>

1. Basic Data

1.1 Title

AQUATIC CHEMISTRY

1.2 Code

BMEEOVKDT72

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	28

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	István Licskó
academic rank	Honorary professor
email	licsko.istvan@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT72
https://edu.epito.bme.hu/course/view.php?id=2582

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Aquatic chemistry - BMEEOVKDT72

2. Objectives and learning outcomes

2.1 Objectives

Extend knowledge in aquatic chemistry of PhD students connecting their specific study area

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. PhD students will be able to apply the most important basic knowladge of aquatic chemistry, connecting to their specific field

B. Skills

    1. Development the skills necessary for successful treatment of aquatic chemistry's problems appearing on the specific area of PhD students

C. Attitudes

    1. Arouse the interest of PhD students, furthermore, and develop their willingness for cooperation

D. Autonomy and Responsibility

    1. Development the skills that provide for PhD students to solve problems independently

2.3 Methods

On-site lectures and consultations

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Bases of atomic systems - The nucleus
2.	Characteristics of electrons - Electronegativity
3.	Types of chemical bonds
4.	Extraordinarily characters of water
5.	Water as a solvent - Aquatic solutions
6.	Basic processes in chemistry and aquatic chemistry
7.	Oxidation and reduction
8.	Acids, bases and salt formation processes
9.	Equilibrium processes in chemistry and aquatic chemistry
10.	Idea of pH, importance of pH, buffering systems
11.	Equilibrium systems of carbon-dioxide - the acidity of precipitation
12.	Factors, are affected reaction rate of chemical, aquatic chemical processes
13.	Energy relations of chemical, aquatic chemical processes - catalysis, catalysts
14.	Aerob and anaerob processes in chemistry and aquatic chemistry

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

2.6 Other information

2.7 Consultation

Aquatic chemistry - BMEEOVKDT72

This Subject Datasheet is valid for:

Inactive courses

Aquatic chemistry - BMEEOVKDT72

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Examination	E	A.1; B.1; C.1; D.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

70% attendency

3.5 Grading system

Grade	Points (P)
excellent (5)	90%
good (4)	80%
satisfactory (3)	70%
passed (2)	60%
failed (1)	<60%

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Active participation on lectures	28
Sum	**28**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

WATER QUALITY IN DRINKING WATER NETWORKS

1.2 Code

BMEEOVKDT81

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	28

1.5 Evaluation

Exam

1.6 Credits

3

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/BMEEOVKDT81
https://edu.epito.bme.hu/course/view.php?id=2581

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Water quality in drinking water networks - BMEEOVKDT81

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to introduce the students to the possibilities of preserving and improving the water quality in drinking water networks. Topics to be discussed: overview of the causes of water quality deterioration in water distribution systems; condition assessment methodology; basic data of system analyses; preparation of load forecasts; monitoring water quality changes in the water network; application of special water quality control measures and treatment technologies affecting water quality.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. understands the theoretical background of hydraulic modeling of water supply networks,
2. knows the typical pollutants of drinking water distribution systems,
3. knows the removal options for contaminants,
4. is aware of the technical and legal background of water supply systems,
5. understands the effects of long-term planning on water quality,
6. is familiar with modern reconstruction and water treatment technologies,
7. is familiar with water quality problems during operation,

B. Skills

1. is able to identify the drinking water quality characteristics,
2. is able to identify water quality problems during planning and operation of drinking water distribution systems,
3. complex management of various technical problems related to water supply,
4. selects the optimal intervention in the water supply system,
5. is able to present the optimal intervention to decision makers,
6. identifies design problems related to drinking network water quality during construction and afterwards,
7. is able to express his thoughts in an orderly form orally and in writing.

C. Attitudes

1. cooperates with the teacher and fellow students when expanding the knowledge,
2. open to the use of information technology tools,
3. strives to know and routinely use the system of tools needed to solve drainage problems,
4. strives for an accurate and error-free solution,
5. strives for economic efficiency

D. Autonomy and Responsibility

1. independently considers and solves the tasks and problems related to water supply on the basis of specific resources,
2. openly welcomes substantiated critical remarks,
3. in some situations - as part of a team - cooperates with his / her fellow students in solving the tasks,
4. takes a systematic approach to its thinking.

2.3 Methods

Lectures with theoretical knowledge; written and oral communication. Use of IT tools and techniques. Solving case study tasks together, literature research, processing

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Water quality problems in drinking water network systems
2.	Water quality deterioration in drinking water network systems

3.	Relation between the drinking water treatment and the drinking water quality in the distribution system
4.	Risk reduction methods I.
5.	Risk reduction methods II.
6.	Case studies
7.	Simulation modelling of water distribution systems: basics of hydraulic and water quality modelling, theory and practice (EPANET)
8.	Topics identified during individual consultations
9.	Simulation modelling of water distribution systems: elements of the model
10.	Simulation modelling of water distribution systems: consumption model creation
11.	Simulation modelling of water distribution systems: evaluation of hydraulic simulation results.
12.	Simulation modelling of water distribution systems: evaluation of water quality simulation results.
13.	Case studies I.
14.	Case studies II.

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

- EPANET user manual
- slides of the lectures

2.6 Other information

Attendance at the lectures is mandatory. Missing out more than 30% of the lectures means failing the subject.

2.7 Consultation

Consultations: at the beginning of the semester at the consultation time announced on the department's website or contact the lecturers via e-mail: (Roland Fülöp: fulop.roland@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 learning outcomes defined in point 2.2 are assessed based on the exam during exam period.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Written and oral exam (summary performance measurement)	Exam (E)	A.1-A.7; B.1-B.7; C.1-C.5; D.1-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

Abbreviation	Score
Exam (E)	100%
Sum	**100%**

3.4 Requirements and validity of signature

The criterion for completion of the subject is to get at least Passed (2) grade at the exam.

3.5 Grading system

Grade	Points (P)
Excellent (5)	80<=P
Good (4)	70<=P<80%
Satisfactory (3)	60<=P<70%
Passed (2)	50<=P<60%
Fail (1)	P<50%

3.6 Retake and repeat

it is possible to repeat the exam if the first attempt is not succesfull / in order to achieve better grade.

3.7 Estimated workload

Activity	Hours/semester
contact hours	2×14=28
preparation for the courses	32
preparation for the exam	30
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

WATER QUALITY CLASSIFICATION

1.2 Code

BMEEOVKDT82

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	28

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	István Licskó
academic rank	Honorary professor
email	licsko.istvan@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT82
https://edu.epito.bme.hu/course/view.php?id=2580

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Water quality classification - BMEEOVKDT82

2. Objectives and learning outcomes

2.1 Objectives

Development appropriate knowledge in water quality classification of PhD students connecting their specific study area

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. PhD students will be able to apply the most important basic knowladge of water quality classification, connecting to their specific field

B. Skills

1. Development the skills necessary for successful treatment of water quality's problems appearing on the specific area of PhD students

C. Attitudes

1. Arouse the interest of PhD students, furthermore, develop their willingness for cooperation

D. Autonomy and Responsibility

1. Development the skills that provide for PhD students to solve problems independently

2.3 Methods

On-site lectures and consultations

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Groups in water quality classification (physical, chemical, biological, microbiological, radiological, WFD)
2.	Water quality classification concerning the water uses and to achieve good water quality situation (WFD)
3.	Water sampling, site investigation and laboratory measurement
4.	Most important components concerning the physical investigation
5.	Components of chemical investigation
6.	Micropollutants
7.	Water quality classification concerning the drinking water supply
8.	Water quality classification concerning the respects of wastewater treatment and recipients
9.	Water quality classification concerning the different water use
10.	Biological investigation concerning the water quality classification
11.	Microbiological investigation in the water quality classification
12.	Complex water quality classification concerning the eutrophication of ponds and lakes
13.	A new complex water quality classification methodology - an important part of WFD
14.	WFD

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to

Water quality classification - BMEEOVKDT82

the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Examination	E	A.1; B.1; C.1; D.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

70% attendancy on the contact hours

3.5 Grading system

Grade	Points (P)
excellent (5)	90%
good (4)	80%
satisfactory (3)	70%
passed (2)	60%
failed (1)	<60%

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Active participation on lectures	28
Sum	**28**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

NATURAL WASTEWATER TREATMENT

1.2 Code

BMEEOVKDT83

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	28
Consultation	12
Field course	(1)

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Ferenc Szilágyi
academic rank	Honorary professor
email	szilagyi.ferenc@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT83
https://edu.epito.bme.hu/course/view.php?id=2579

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Natural wastewater treatment - BMEEOVKDT83

2. Objectives and learning outcomes

2.1 Objectives

Understanding the effectiveness and limitations of the different natural treatment methods. Comparison the natural treatment systems with activated sludge treatment from many aspects. Planning capabilities of such systems.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Ability to understand the operation and contaminant removal processes in these systems.
2. Basic knowledge about the advantages and disadvantages of natural treatment in comparison with common activated sludge treatment.
3. Basic knowledge about the design criteria of the different natural treatment systems.

B. Skills

1. Knows the operation of the different natural treatment systems.
2. Knows the legal background of application.
3. Understand the processes leading to decrease contaminant concentrations during the treatment process.
4. Ability to make corrections if disorder operation occurs.

C. Attitudes

1. Cooperates with the teacher and fellow students in expanding the knowledge.
2. Open to use the IT possibilities.
3. Strives for economic efficiencies.
4. Self-made expand the knowledge in the given topic.

D. Autonomy and Responsibility

1. Independently solve and consider the task and problems.
2. Open for criticism.
3. Take a systematic approach for thinking.

2.3 Methods

Lectures with theoretical knowledge. Written and oral communication. Use IT tools. Solving case study in group, literature search, field trip.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction between natural treatment system and activated sludge sewage treatment.
2.	Types and characteristics of the natural treatment systems. Inter comparison among the systems based on capacity range, effectiveness and cost. Detailed experiences of sewage pond systems based on literature data.
3.	Detailed experiences of root zone treatment systems on literature data.
4.	Detailed experiences of marshland treatment systems based on literature data.
5.	Detailed experiences of sand and soil filtration systems based on literature data.
6.	Evaluation of the environmental characteristics in order to select the appropriate natural system to fit the local circumstances.

7.	Field trip to an existing natural treatment plant.
8.	Design criteria of the root-zone treatment systems.
9.	Design criteria of the pond treatment systems.
10.	Design criteria of the root-zone treatment systems. Design criteria of the pond treatment systems.
11.	Design criteria of the marshland treatment systems.
12.	Design criteria of the irrigation sewage treatment systems.
13.	Summary of the experiences of the existing natural treatment plants and comparison of their main characteristics with the activated sludge plant in the same capacity range.
14.	Oral exam.

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

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam	E	A.1-A.3; B.1-B.4; C.1-C.4; D.1-D.3

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
E	100
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

The grade is calculated based on performance in the exam.

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Lectures	14×2=28
Literature review	1×30=30
Preparation for the exam	1×32=23
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

DRINKING WATER TREATMENT TECHNOLOGIES AND HEALTH ASPECTS OF WATER SUPPLY

1.2 Code

BMEEOVKDT84

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. Laky Dóra
academic rank	Associate professor
email	laky.dora@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT84
https://edu.epito.bme.hu/course/view.php?id=2578

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

2 February 2022

Drinking water treatment technologies and health aspects of water supply - BMEEOVKDT84

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to introduce the complex processes taking place during drinking water treatment technologies with special focus on the treatment of deep well waters: removal of dissolved gases, iron, manganese, arsenic, ammonium ion and the by-product formation during treatment. The course deals with the adverse health effects of certain water quality compounds and the possibilities to minimize their concentration in the water. The course also gives an overview about the water quality changes in the distribution system.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows the most typical pollutants in different water bases and knows the adverse effects of them
2. Understands the main aspects of drinking water treatment processes with special focus on the treatment of deep well waters
3. Knows the adverse health effects of certain water quality compounds and the possibilities to minimize their concentration in the water
4. Knows the secondary water quality deterioration processes in the drinking water supply network and their effects

B. Skills

1. Is able to prepare treatment technological scheme(s) for raw water, which contains dissolved gases, iron, manganese, ammonium ion and arsenic
2. Is able to solve drinking water quality problems in a case study area, where the water originates from deep well waters
3. Is able to make preliminary estimation about the needed chemical dosages and size of the filters for a given raw water quality and flow rate

C. Attitudes

1. Collaborates with the instructor and groupmates
2. He/she constantly expands his/her knowledge, and in addition to the compulsory curriculum, he/she searches answers from web resources as well
3. Strives for comprehensible, precise wording in oral communication

D. Autonomy and Responsibility

1. Use of systematic approach in problem solving
2. Cooperation with fellow students in teamwork

2.3 Methods

Lectures with theoretical knowledge; written and oral communication. Use of IT tools and techniques. Solving drinking water quality problems in a case study area together or in group work.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction I. – drinking water sources and possible pollutants
2.	Introduction II. – drinking water sources and possible pollutants
3.	Removal of iron and manganese from drinking water
4.	Removal of dissolved gases from drinking water
5.	Removal of arsenic from drinking water
6.	Removal of ammonium ion from drinking water
7.	Complex technological schemes for drinking water treatment

8.	Calculations – examples for the estimation of chemical dosages and size of the rapid filter in a drinking water treatment process
9.	Drinking water quality changes in the water supply network
10.	Health effects of certain water quality parameters, the approach of water safety planning
11.	Case study area - evaluation of drinking water quality problems, possible solutions (case study No.1)
12.	Case study area - evaluation of drinking water quality problems, possible solutions (case study No.2)
13.	Case study area - evaluation of drinking water quality problems, possible solutions (case study No.3)
14.	Case study area - evaluation of drinking water quality problems, possible solutions (case study No.4)

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. Water Treatment Plant Design (American Water Works Association)
2. Slides of the lectures

2.6 Other information

Attendance at lectures is mandatory. Minimal required attendance rate is 70%.

2.7 Consultation

The instructor is available for consultation during her office hours, as advertised on the department website. Special appointments can be requested via e-mail from the lecturer: (laky.dora@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 learning outcomes defined in point 2.2 are assessed based on the oral exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam (oral exam)	E	A.1-A.4; B.1-B.3; C.1-C.3; D.1-D.2

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

The students have to attend at least 70% of the lectures in order to get the possibility to take the exam. The students have to get at least Passed (2) grade at the exam.

3.5 Grading system

Based on the performance at the oral exam.

3.6 Retake and repeat

If the exam is not successfull, it can be repeated.

3.7 Estimated workload

Activity	Hours/semester
Contact hours	14×2=28
Preparation for the exam	62
Sum	**90**

3.8 Effective date

2 February 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

STATE OF THE ART WASTEWATER TREATMENT

1.2 Code

BMEEOVKDT85

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)	

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Miklós Patziger
academic rank	Associate professor
email	patziger.miklos@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKDT85
https://edu.epito.bme.hu/course/view.php?id=2577

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

State of the art wastewater treatment - BMEEOVKDT85

2. Objectives and learning outcomes

2.1 Objectives

Providing skills in state of the art wastewater treatment and water resources recovery

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. Wastewter treatment: design, operation, economics, reuse, energy questions

B. Skills

    1. Wastewter treatment: design, operation, economics, reuse, energy questions

C. Attitudes

    1. Tutorial

D. Autonomy and Responsibility

    1. Elaborating individual topics

2.3 Methods

Lessons, individual projects, presentation

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Tutorials
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	Presentation

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

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

State of the art wastewater treatment - BMEEOVKDT85

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes

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
Sum	100%

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Sum	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

THEORETICAL HYDRODYNAMICS

1.2 Code

BMEEOVVDT71

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. János Józsa
academic rank	Professor
email	jozsa.janos@bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT71
https://edu.epito.bme.hu/course/view.php?id=5263

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

Recommended courses: Any courses on hydrodynamics and partial differential equations and vector fields.

1.13 Effective date

1 September 2022

Theoretical hydrodynamics - BMEEOVVDT71

2. Objectives and learning outcomes

2.1 Objectives

The aim of the subject is to familiarize the student with the mathematical foundations and basic equations of fluid dynamics.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knowledge of the basic concepts of partial differential equations and vector fields.
2. Knowledge of the basic kinematic and dynamic concepts necessary to describe the liquid as a continuum.
3. Knowledge of the basic equation of fluid dynamics and its most important features.
4. Knowledge of the vorticity transport equation derived from the basic equation of fluid dynamics. Knowledge of the general geometric formulation of two- and three-dimensional hydrodynamics.

B. Skills

1. Advanced problem-solving capacity in mathematics and physics, especially on algebraic manipulations.
2. Ability to formulate a hydrodynamic model, such as the complex of physical environment, mathematical equations and boundary conditions.

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.

D. Autonomy and Responsibility

1. Participates in lectures and prepares for the exam.

2.3 Methods

Lectures on theory.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction: partial differential equations and vector fields.
2.	Introduction: partial differential equations and vector fields.
3.	Introduction: partial differential equations and vector fields.
4.	The continuum model of the fluid. Velocity, acceleration. The acceleration as a Lie-derivative.
5.	Description of streamlines. The velocity field as a transformation on streamlines. Continuous transformation groups.
6.	Conservation of the matter. Divergence of the velocity field.
7.	Rotation of a fluid element. Vorticity of the velocity field.
8.	Incompressible and irrotational plane flows. Laplace equation.
9.	The vorticity of the acceleration. Lie-bracket of vector fields. Commuting flows.
10.	Circulation. Vortex theorems.
11.	The Cauchy stress tensor. Navier-Stokes equations.

12.	Navier-Stokes, Euler, and Bernoulli equations.
13.	The vorticity transport equations. Geometric picture of fluid flows.
14.	Dimensionless numbers. The dimensionless form of Navier-Stokes equations. The appearance of viscosity, as a symmetry breaking.

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. Andreev, V.K., et al., 1998. Application of Group-Theoretical Methods in Hydrodynamics, Kluwer.
2. Arnold, V.I., 1974. Mathemtical Methods of Classical Mechanics, Springer.
3. Batchelor, G.K., 1967. An Introduction to Fluid Dynamics, Cambridge University Press.
4. Olver, P. J., 1986. Application of Lie Groups to Differential Equations, Springer.

2.6 Other information

None

2.7 Consultation

Time of consultations: previously agreed times.

This Subject Datasheet is valid for:

2025/2026 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 2.2. is performed by an oral exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Oral exam	V	A.1-A.4; B.1-B.2; C.1-C.2; D.1

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
V	100%
Sum	**100%**

3.4 Requirements and validity of signature

At least 70% of the attendance of the classes is expected.

3.5 Grading system

If the grade for the exam is at least satisfactory, the final grade is the grade for the exam.

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	14×2=28
study from notes, textbooks, preparation for the exam	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Computational hydraulics - BMEEOVVDT72

I. Subject Specification

1. Basic Data

1.1 Title

COMPUTATIONAL HYDRAULICS

1.2 Code

BMEEOVVDT72

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. Krámer Tamás
academic rank	Professor
email	kramer.tamas@emk.bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT72
https://edu.epito.bme.hu/course/view.php?id=5313

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Computational hydraulics - BMEEOVVDT72

2. Objectives and learning outcomes

2.1 Objectives

You will understand the basics of classical numerical methods for modelling the motion of water in hydraulic and environmental engineering problems. General topics: governing equations, discretisation, and criteria for judging the quality of various solvers (accuracy, stability). In the context of free-surface flows, we look at the finite difference, finite volume and finite element methods. The topics will be theoretical, considering practical applications but independent of software implementations. The course aims to be valuable to programmers and model users.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. You will understand the governing equations and numerical methods for solving flow and transport phenomena.
2. You will be aware of the limitations and common difficulties in using different numerical methods in solving flow and transport problems

B. Skills

1. You will be able to develop a simple algorithm for the solution of the advection equation
2. You will be be confident in using computational hydraulics software to solve engineering problems

C. Attitudes

1. You will learn how to

D. Autonomy and Responsibility

1.

2.3 Methods

Weekly lectures, focusing on the theory. Questions will be given to be answered by email until the next class. Solution to these will be discussed on request at the beginning of the lecture.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Introduction
2.	Governing equations.
3.	Discretisation in space and time. Mesh types.
4.	Basic properties of numerical solvers: convergence, stability, monotonicity, conservation
5.	Principles of the finite difference method
6.	Principles of the finite difference method -- continued
7.	The finite difference method applied to the St Venant equations (1D)
8.	The finite difference method applied to the St Venant equations (1D) -- continued
9.	The finite difference method applied to the shallow water equations (2D)
10.	The finite difference method applied to the Navier Stokes equations (3D)
11.	Wave propagation and characteristics – the Riemann problem and its solution
12.	Principles of the finite volume method for the shallow water equations
13.	Principles of the finite element method for flow

Computational hydraulics - BMEEOVVDT72

	problems
14.	Summary

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. Ferziger and Peric - Computational Fluid Dynamics
2. J. Cunge-F. Holly-R. Verwey: Practical aspects of computational river hydraulics
3. P. Novak, V. Guinot, A. Jeffrey, D.E. Reeve: Hydraulic modelling - an Introduction
4. PPT slides

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

2025/2026 semester II

Computational hydraulics - BMEEOVVDT72

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Seepage and groundwater hydraulics - BMEEOVVDT81

I. Subject Specification

1. Basic Data

1.1 Title

SEEPAGE AND GROUNDWATER HYDRAULICS

1.2 Code

BMEEOVVDT81

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. Csoma Rózsa
academic rank	Associate professor
email	csoma.rozsa@emk.bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT81
https://edu.epito.bme.hu/course/view.php?id=2498

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

2 February 2022

Seepage and groundwater hydraulics - BMEEOVVDT81

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to make students recognize basic and special phenomenon in the field of seepage and groundwater flow, to learn how to find and evaluate the literature to describe it and how to make a synthesis.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. to be aware of the general terminology of hydrogeology
2. to be aware of the general equations describing seepage and groundwater flow, and also special phenomenon
3. to be aware of the phenomenon and methods to be applied in case of compound hydrogeological systems

B. Skills

1. to be able to describe groundwater flow systems with the proper hydraulic models,
2. based on the knowledge in the technical literature to be able to give a detailed introduction of a smaller, special topic
3. to be able to present his/her results in proper oral and written form,
4. to be able to participate in discussions in the fireld if seepage and groindwater flow

C. Attitudes

1. to collaborate with the teachers and his/her mates in gaining knowledge,
2. to follow the lectures, to make effort to understand the study material,
3. to strive for the proper identification of problems in connection with seepage and groundwater flow and their proper solution,
4. to strive for accuracy in his/her calculations/solutions,
5. to realize the importance of the effects of human activities on the environment.

D. Autonomy and Responsibility

1. to be independent in exploring the resources to introduce seepage and groundwater flow procedures,
2. to be open to careful and deep going critique,
3. to collaborate with the mates to discover certain field and to discuss it,
4. to understand the complexity, comprehensiveness of the problems and recognizing the synergies.

2.3 Methods

The first part of the course consists of lecutes on special questions of seepage and groundwater flow. After it, the students prepare presentations of cca 30 min. on topics agreed with the lecturer and the class mates. The topic should be connected to the research field of the student, if possible. Each presentation is followed by a discussion.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Basic elements, basic equations: a recall and standardisation: I. seepage flow
2.	Basic elements, basic equations: a recall and standardisation: II. groundwater flow
3.	Groundwater modelling, theorems and methodology
4.	Models based on superposition
5.	Tóth's theorem of groundwater basins
6.	Special questions of ubderground transpor processes : I. advection
7.	Special questions of ubderground transpor processes : II. other transport mechanisms

8.	Beyond Darcy flow: microseepage
9.	Beyond Darcy flow: turbulent seepage
10.-14.	students' presentations

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) Tankönyvek:
1. Bear, J.: Hydraulics of Groundwater. McGraw-Hill Inc. New-York, 1979.
2. Bear, J.: Dynamics of Fluids in Porous Media. American Elsevier Publishing Company Inc. New York London Amsterdam, 1988.
3. Bear, J. - Verruijt, A.: Modelling Groundwater Flow and Pollution. D. Reidel Publishing Company, Dordrecht, 1987.
4. Friend, J.J.: Groundwater Pollution. Developments in Water Sciences No. 4. Elsevier Scientific Publishing Company Amsterdam - Oxford - New York. 1975
5. Haitjema, H. M.:. Analytic Element Modelling of Groundwater Flow. Academic Press. San Diego, 1995.
6. Kinzelbach, W.: Groundwater Modelling. Developments in Water Sciences No. 24. Elsevier Scientific Publishing Company, Amsterdam - Oxford - New York, 1986.
7. Marino, M. A: - Luthin, J. N.: Seepage and Groundwater. Developments in Water Sciences No. 13. Elsevier Scientific Publishing Company, Amsterdam - Oxford - New York, 1982.
8. Strack, O. D. L.: Groundwater Mechanics. Prentice-Hall, Englewood Cliffs, New Jersey, 1989.
9. Verruijt, A.: Theory of Groundwater Flow. Macmillan Civil Engineering Hydraulics Series. Macmillan and Co. Ltd. London, 1970.
10. Wang, H. F. - Anderson, M. P.: Introduction to Groundwater Flow Modelling. Finite Difference and Finite Element Methods. W.H.Freeman and Company, San Francisco, 1982.
11. József Tóth: Gravitational Systems of Groundwater Flow. Theory, Evaluation, Utilization. Cambridge Univerity Press, 2009.

b) Online materials: materials uploaded to the web site of the subject, e.g.:
1. Lecture notes, electronic lecture notes,
2. Slides of lectures and practices

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website at the beginning of the semester.

This Subject Datasheet is valid for:

Inactive courses

Seepage and groundwater hydraulics - BMEEOVVDT81

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes specified in Clause 2.2 above and the evaluation of student performance via the presentation and the discussions.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Exam presentation	EP	A.1-A.3; B.1-B.3; C.1-C.4; D.1, D.4
Activity during the discussions	A	A.1-A.3; B.4; C.1, C.5; D.3-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
EP	80
A	20
Összesen	**100%**

3.4 Requirements and validity of signature

At least 70% of the attendance of the classes are expected, and activity during the discussions after the presentation of the class mates.

3.5 Grading system

If the grade for the presentation is at least satisfactory, the the final grade is the weighted average value of the grades obtained, where the weights are according to the clause 3.3.

3.6 Retake and repeat

The presentation can be retaken once without any fee at the time given Detailed class schedule. The grade to be considered is the more favorable for the student.

3.7 Estimated workload

Tevékenység	Óra/félév
Contact hours	14×2=28
the independent study of given literature for the presentation	20
independent literatore research for the presentation	30
the preparation of the presentation	12
Összesen	**90**

3.8 Effective date

2 February 2022

This Subject Datasheet is valid for:

Inactive courses

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://edu.epito.bme.hu/course/view.php?id=5161

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

Hydrological modelling and forecasting - BMEEOVVDT82

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:

2025/2026 semester II

Hydrological modelling and forecasting - BMEEOVVDT82

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

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

SEDIMENT TRANSPORT MODELLING

1.2 Code

BMEEOVVDT83

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	Baranya Sándor
academic rank	Associate professor
email	baranya.sandor@emk.bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT83
https://edu.epito.bme.hu/course/view.php?id=2500

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

Recommended prerequisites:

- Modelling of Hydrosystems (BMEEOVVMV-1)
- Hydromorphology (BMEEOVVMV-2)
- Hydrology II (BMEEOVVAI41)

1.13 Effective date

1 September 2022

Sediment transport modelling - BMEEOVVDT83

2. Objectives and learning outcomes

2.1 Objectives

The course focuses on the numerical modelling of sediment transport in rivers. Starting from the initiation of sediment motion, the course will cover the modeling of bedload transport as well as suspended sediment transport. Large scale, 1D approach to more sophisticated 3D methods will be overviewed.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows the theoretical and empirical description of fluvial sediment transport.
2. Knows the conditions of the threshold of sediment movement.
3. Knows the state-of-the-art measurement methods of fluvial sediment transport.
4. Knows the calculation methods of fluvial sediment load.
5. Knows the role of bedforms in fluvial sediment transport.
6. Knows the natural morphological processes of rivers.
7. Knows how to model bedload transport and suspended sediment transport in 1D.

B. Skills

1. Able to assess which simplified description of flows can be used for solving specific engineering tasks.
2. Provides an empirical estimate of the fluvial suspended sediment load
3. Provides an empirical estimate of the fluvial bedload transport.
4. Able to set up schematized 1D sediment transport model of rivers.

C. Attitudes

1. Collaborates with the instructors and fellow students to expand knowledge.
2. Constantly acquires knowledge.
3. 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.
4. Open to learn new software skills.
5. Attempts to perform precise problem solutions.

D. Autonomy and Responsibility

1. Resolution to solving homework on one's own within feasible limits.
2. Accepts substantiated critical remarks.

2.3 Methods

Lectures on theory. Practical guidance about the steps needed for setting up schematized numerical sediment transport models. 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.	Introduction, basics of sediment transport
2.	Problems related to sediment transport
3.	Measurement methods of sediment transport
4.	Schematized modeling of river flow
5.	Threshold of movement
6.	Modelling of bedload transport 1.
7.	Modelling of bedload transport 2.
8.	Modelling of suspended sediment transport
9.	Role of bedforms
10.	Hydraulic resistance
12.	Modelling of river morphodynamics

| 13. | Multi-dimensional modeling of ST |
| 14. | Consultation with homework |

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

- Sedimentation Engineering: Processes, Measurements, Modeling, and Practice. Edited by Marcelo Garcia , Ph.D., P.E.
- 1D SEDIMENT TRANSPORT MORPHODYNAMICS with applications to RIVERS AND TURBIDITY CURRENTS by Gary Parker.
  http://hydrolab.illinois.edu/people/parkerg/morphodynamics_e-book.htm
- Numerical modelling and hydraulics by Nils Reidar Olsen.
  https://folk.ntnu.no/nilsol/tvm4155/flures6.pdf

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

Sediment transport modelling - BMEEOVVDT83

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 one homework assignment.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework	HW	A.2, A.4, A.5, A.7; B.2, B.3, B.4; C.1, C.4; D.1, D.2
Written exam	E	A.1-A.7; B.1; C.2, C.3, C.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	50%
E	50%
Sum	**100%**

3.4 Requirements and validity of signature

Not-relevant.

3.5 Grading system

Grade	Points (P)
excellent (5)	85%<=P
good (4)	70<=P<85%
satisfactory (3)	55<=P<70%
passed (2)	40<=P<55%
failed (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.

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	14×2=28
preparation for the final test	22
preparation for homework	25
study from notes, textbooks	15
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

LIMNOLOGY

1.2 Code

BMEEOVVDT84

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. János Józsa
academic rank	Professor
email	jozsa.janos@emk.bme.hu

1.8 Department

Department of Hydraulic and Water Resources Engineering

1.9 Website

https://epito.bme.hu/BMEEOVVDT84
https://edu.epito.bme.hu/course/view.php?id=4856

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The course offers an introduction to lake limnology, focussing on the governing physical processes in shallow lakes, but also covering water quality, ecology and aspects of lake management. General topics:

- micrometeorology: wind and surface shear
- hydrodynamics: wind-induced water motions: surface setup, currents, surface waves
- thermodynamics: energy budget, stratification, heat fluxes
- sediment dynamics: bed shear, sediment transport
- hydrology: water balance
- water quality and ecology

The topics will be mostly theoretical, illustrated with research results and applications at Hungarian lakes. The course intends to be useful to modellers of water systems.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. You will understand the physical processes governing water quality and ecology of shallow lakes.

B. Skills

    1.

C. Attitudes

    1.

D. Autonomy and Responsibility

    1.

2.3 Methods

Weekly lectures.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction
2.	Wind and wind stress over lake surfaces
3.	WInd induced surface motions (storm surge and seiche)
4.	WInd-induced lake currents
5.	Wind waves
6.	Mass transport
7.	Sediment dynamics
8.	Heat budget, fluxes
9.	Temperature dynamics in water
10.	Water budget
11.	Water quality, eutrophication
12.	(Case study)
13.	(Case study)
14.	Summary

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. Imboden, D.M. (2004): Motion of lake waters. In: O'Sullivan, P., & Reynolds, C. (Eds) The Lakes

Handbook, Volume 1: Limnology and Limnetic Ecology. Limnology, 5, 115-152.
2. Jozsa J. (2006): Shallow lake hydrodynamics - Theory, measurement and numerical model applications, A Hungarian-Finnish experience. Lecture notes.
3. Shanahan, P., Harleman, D. R. F., & Somlyódy, L. (1986). Wind-induced water motion. In *Modeling and managing shallow lake eutrophication* (pp. 204-255). Springer, Berlin, Heidelberg.
4. Lecture slides

2.6 Other information

2.7 Consultation

During the weekly consultation hours of the lecturers.

This Subject Datasheet is valid for:

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Evaluation of the participant's learning progress described in 2.2. is performed by an exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam	E	A.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	70<=P<85
satisfactory (3)	55<=P<70
passed (2)	40<=P<55
failed (1)	P<40

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	14×2=28
preparation for the final test	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

I. Subject Specification

1. Basic Data

1.1 Title

FORCE TRANSFER IN CONCRETE

1.2 Code

BMEEOEMDT71

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Consultation	3

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Balázs György
academic rank	Professor
email	balazs.gyorgy@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT71
https://edu.epito.bme.hu/course/view.php?id=5131

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Force transfer in concrete - BMEEOEMDT71

2. Objectives and learning outcomes

2.1 Objectives

The purpose of the subject is to understand bond, cracking, and anchorage characteristics of different reinforcement in concrete.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. Able to understand the physical and mechanical behavior

B. Skills

    1. Able to apply analytical and experimental methods described in the subject

C. Attitudes

    1. Able to further develop methods of analysis

D. Autonomy and Responsibility

    1. Able to estimate applicability for practical applications

2.3 Methods

Lectures

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	INTRODUCTION, IMPORTANCE OF BOND, TERMINOLOGY, HISTORY
2.	INFLUENCING FACTORS
3.	MATHEMATICAL DESCRIPTION OF BOND-SLIP LAW
4.	BOND UNDER CYCLIC LOADS
5.	INFLUENCE OF PRELOADING; Miner hypothesis
6.	BOND UNDER RANDOM LOADING
7.	BOND TESTS WITH ACOUSTIC EMISSION
8.	REVERSED CYCLIC BOND BEHAVIOUR
9.	BOND UNDER LONG TERM LOADS
10.	MODELLING OF SLIPPING CONTACT
11.	TRANSFER CONTROL OF PRESTRESSING TENDONS
12.	CRACKING AND TENSION STIFFENING
13.	BOND OF CORRODED REINFORCEMENT
14.	REVIEW AND PREPARATION OF EXAM

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

- pdf versions of the Lectures.
- Literature is provided for the preparation of the exam as well as for the classes.
- (Uploaded in the moodle system.)

2.6 Other information

2.7 Consultation

Arranged via e-mail.

This Subject Datasheet is valid for:

2025/2026 semester II

Force transfer in concrete - BMEEOEMDT71

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Exam, oral	E	A.1; B.1; C.1; D.1

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
E	100%
Összesen	**100%**

3.4 Requirements and validity of signature

Active presence during the semester.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	85-100
jó (4)	74-84
közepes (3)	62-73
elégséges (2)	50-61
elégtelen (1)	0-49

3.6 Retake and repeat

Possible during the examination period.

3.7 Estimated workload

Tevékenység	Óra/félév
Lectures + Study	28+14
Összesen	**42**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

MATERIALS OF ENVIRONMENTALLY COMPATIBLE CONSTRUCTION

1.2 Code

BMEEOEMDT81

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. Fenyvesi Olivér
academic rank	Associate professor
email	fenyvesi.oliver@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT81
https://edu.epito.bme.hu/course/view.php?id=2522

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Materials of environmentally compatible construction - BMEEOEMDT81

2. Objectives and learning outcomes

2.1 Objectives

Students become familiar with the durability and emission properties of construction materials. Aspects and requirements of the selection of construction materials based on energy and raw material demand and toxic emission. Types of air, water, soil water and soil pollutions. Life Cycle Analysis (LCA) and its influencing factors. Cradle to grave and Cradle to building in approach. Natural construction materials and technologies, high-tech materials, alternative building materials and their properties.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows the properties of special construction materials
2. Knows the application technologies of natural, high-tech and alternative construction materials
3. Is able to choose and compare the construction materials based on an environmental point of view for different building elements.

B. Skills

1. Is able to judge and compare the advanced material properties,
2. Is able to choose the proper construction material for the building elements,
3. Is able to apply the theoretical phenomenon during exact technical tasks.
4. Is able to make an LCA on building material.

C. Attitudes

1. ;Cooperates with the professor,
2. Participates in life-long learning (communication, knowledge, technical terms),
3. Open to use up to date information technology,
4. During homework intends to apply different types of gaining knowledge (notes, laboratory protocols, catalogues, online references).

D. Autonomy and Responsibility

1. Is able to work alone on homework,
2. Is open to receive critic and develop,
3. Is able to participate in problem-solving as part of a group,
4. Participate in professional debates,
5. Can account for his/her opinion.
6. Is able to make a presentation about a short topic.

2.3 Methods

Lectures with the active participation of students, homework and presentation, technical excursion.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Introduction, Homework issuance
2.	Air and water pollutions
3.	Soil and soil water pollutions
4.	Life cycle analysis - theory
5.	Life cycle analysis - modelling
6.	Natural building materials
7.	Waste materials, by-products in building products
8.	Hightech materials
9.	Alternative building materials
10.	Biodegradable thermal insulations
11.	Case studies

12.	Homework presentation
13.	Homework presentation
14.	Technical excursion: Skanzen Szentendre

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, videos, technical guides presented on the Moodle page of the subject.

2.6 Other information

-

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: fenyvesi.oliver@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 is specified in clause 2.2. above and the evaluation of student performance occurs via homework, presentation of assignments, examination and classwork.

3.2 Assessment methods

Evaluation form	Abbrev.	Assessed learning outcomes
1. homework	HW	A.1-A.3; B.1-B.4; C.1-C.3; D.1
1. presentation	P	A.1-A.3; B.1-B.4; C.1-C.4; D.1-D.6
Examination	E	A.1-A.3; B.1-B.4; C.1

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	30%
P	20%
Total achievable during the semester	**50%**
E	50%
Sum	**100%**

3.4 Requirements and validity of signature

Signification can be obtained by getting min. 50% of the available points on midsemester results (HW, P) and perform the required presence on contact hours.

3.5 Grading system

Grade	Points (P)
excellent (5)	85%<=T
good (4)	74%<=T<85%
satisfactory (3)	63%<=T<74%
passed (2)	50%<=T<63%
failed (1)	50%<T

3.6 Retake and repeat

1) The Homework can be submitted with a fee until the lecture on the 13. week in the study period. The presentation can not be delayed.

3.7 Estimated workload

Activity	Hours/semester
Contact hours	14×2=28
preparation for the lectures	14×0,5=7
homework	20
preparation for presentation	15
preparation for the examination	20
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

DURABILITY OF CONSTRUCTION MATERIALS

1.2 Code

BMEEOEMDT82

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. György L. BALÁZS
academic rank	Professor
email	balazs.gyorgy@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT82
https://edu.epito.bme.hu/course/view.php?id=5390

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Durability of construction materials - BMEEOEMDT82

2. Objectives and learning outcomes

2.1 Objectives

Durability is the resistance to degradation of products, materials, buildings and other built assets over time. This can be a difficult property to assess - whilst a tough material may be hard to the touch but it may also be non-durable if it decomposes or is eroded in a relatively short period of time.

The subject focuses on durability properties from the point of view of materials.

With the transferred knowledge, the student is able to understand and analyse the known and expected durability properties of the material systems. The knowledge can be used in estimating the service life of the materials and structures.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Able to understand the physical and chemical causes of the durability phenomenon
2. Able to understand how the degradation of materials will influence the service life of structures

B. Skills

1. Able to recognize and identify the different durability phenomena
2. Able to predict what happen due to the different environmental conditions

C. Attitudes

1. Continuously expands his/her knowledge
2. Strives for accurate and error-free problem recognition and evaluation

D. Autonomy and Responsibility

1. Able to independently evaluate durability issues
2. Accepts critical comments

2.3 Methods

Lectures

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introductory lecture and organizational aspects
2.	Service Life Design-I. (SLD-I) - Prof. Balázs
3.	Service Life Design-II. (SLD-II) - Prof. Balázs
4.	Nonmetallic reinforcements-I. - Prof. Balázs
5.	Nonmetallic reinforcements-II. - Prof. Balázs
6.	Maintain durability-I. - Prof. Balázs
7.	Maintain durability-II. - Prof. Balázs
8.	Deterioration processes of cementitious materials-I. Physical - Assoc. Prof. Katalin Kopecskó
9.	Deterioration processes of cementitious materials-II. Chemical - Assoc. Prof. Katalin Kopecskó
10.	Deterioration processes of cementitious materials-III. Biological - Assoc. Prof. Katalin Kopecskó
11.	Chloride induced corrosion and chloride transport in cementitious materials - Assoc. Prof. Katalin Kopecskó
12.	Other types of reinforcements, glass, polymer and natural fibres; glass corrosion - Assoc. Prof. Katalin Kopecskó
13.	Other durability issues-I. - Assoc. Prof. Salem Nehme
14.	Other durability issues-II. - Assoc. Prof. Salem Nehme

Durability of construction materials - BMEEOEMDT82

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

Lectures (pdf) uploaded here in the moodle system.

Sources uploaded here in the moodle system.

2.6 Other information

2.7 Consultation

At a pre-arranged time (via e-mail):

balazs.gyorgy@emk.bme.hu

kopecsko.katalin@emk.bme.hu

nehme.salem@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

Durability of construction materials - BMEEOEMDT82

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The learning outcomes stated in paragraph 2.2 are evaluated on the basis of an oral exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam	E	A.1-A.2; B.1-B.2; C.1-C.2; D.1-D.2

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
E	100
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	85 % <= E
good (4)	74 % <= E < 85%
satisfactory (3)	63 % <= E <74%
passed (2)	50 % <= E < 63%
failed (1)	E < 50 %

3.6 Retake and repeat

In the examination period.

3.7 Estimated workload

Activity	Hours/semester
Lecures	28
Individual learning	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Relationship between structure and behaviour of concrete - BMEEOEMDT83

I. Subject Specification

1. Basic Data

1.1 Title

RELATIONSHIP BETWEEN STRUCTURE AND BEHAVIOUR OF CONCRETE

1.2 Code

BMEEOEMDT83

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	Salem Nehme
academic rank	Associate professor
email	nehme.salem@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT83
https://edu.epito.bme.hu/course/view.php?id=5285

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The subject conveys knowledge about the special structure of concrete. In the framework of the subject, students can get to know the micro, meso and macro structure, as well as the effect of concrete porosity on its properties.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. It has an overview of the theory and methods of the special concrete structure,
2. It has an overview of the effect of concrete porosity on durability (environmental classes),
3. It has an overview about the particularities of the correlations of special concrete properties,
4. Knows the exposure classes according to the environmental effects on reinforced concrete structures.

B. Skills

1.

C. Attitudes

1.

D. Autonomy and Responsibility

1.

2.3 Methods

Lectures

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

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

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

2025/2026 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
		A.1-A.4; B.1; C.1; D.1

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
Sum	100%

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Sum	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

<div style="text-align: center;">

I. Subject Specification

</div>

1. Basic Data

1.1 Title

ADVANCED CONSTRUCTION MATERIALS

1.2 Code

BMEEOEMDT84

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. Balázs L. György
academic rank	Professor
email	balazs.gyorgy@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT84
https://edu.epito.bme.hu/course/view.php?id=5339

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

There are no prerequisites for PhD students.

1.13 Effective date

1 September 2022

Advanced construction materials - BMEEOEMDT84

2. Objectives and learning outcomes

2.1 Objectives

The main objective of the subject is to impart up-to-date knowledge about new construction materials that are the results of recent developments and the goals of further research.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Able to understand the role and purpose of application of the advanced construction materials in the system of the well-known materials.
2. Able to understand the micro- and macrostructural behaviour of the advanced construction materials by the physical and chemical explanations.
3. Able to understand how the application of advanced materials will influence the service life of structures.

B. Skills

1. Able to recognize and identify the advantages of advanced construction materials.
2. Able to compare the service life of the structures made of ordinary or advanced materials.

C. Attitudes

1. Continuously expands his/her knowledge.
2. Strives for accurate and error-free problem recognition and evaluation.

D. Autonomy and Responsibility

1. Able to work independently.
2. Accepts critical comments.

2.3 Methods

Lectures, individual learning

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction. Why and how can construction materials and technologies be further developed? / Dr. Balázs L. György
2.	Strengthening Materials and Methods I. / Dr. Balázs L. György
3.	Strengthening Materials and Methods II. / Dr. Sólyom Sándor
4.	Micromechanics of FRP and its constituents I.-II. / Dr. Balázs L. György
5.	Fire - advanced materials I. / Dr. Lublóy Éva
6.	Fire - advanced materials II. / Dr. Lublóy Éva
7.	Advanced Materials – LWAC, Recycling in Concrete I. / Dr. Nemes Rita
8.	Advanced Materials – LWAC, Recycling in Concrete II. / Dr. Nemes Rita
9.	Advanced glass materials in construction / Dr. Nehme

Advanced construction materials - BMEEOEMDT84

	Kinga
10.	Concrete as radiation protection / Dr. Nehme Salem
11.	Zero cement concrete / Dr. Kopecskó Katalin
12.	Advanced materials in road construction / Dr. Fenyvesi Olivér
13.	Shape Memory Alloys / Dr. Balázs L. György
14.	3D-printed concrete in construction / Dr. Sólyom Sándor - Dr. Balázs L. György

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

- pdf versions of the Lectures.
- Literature is provided for the preparation of the exam as well as for the classes.
- (Uploaded in the moodle system.)

2.6 Other information

2.7 Consultation

At a pre-arranged time (via e-mail): balazs.gyorgy@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

Advanced construction materials - BMEEOEMDT84

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Exam, oral	E	A.1-A.3; B.1-B.2; C.1-C.2; D.1-D.2;

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

Active presence during the semester.

3.5 Grading system

Grade	Points (P)
excellent (5)	85-100
good (4)	74-84
satisfactory (3)	62-73
passed (2)	50-61
failed (1)	0-49

3.6 Retake and repeat

Possible during the examination period.

3.7 Estimated workload

Activity	Hours/semester
Lectures	28
Individual learning	62
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

RHEOLOGICAL AND TEMPERATURE DEPENDENT MATERIAL PROPERTIES

1.2 Code

BMEEOEMDT85

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. Majorosné Dr. Lublóy Éva Eszter
academic rank	Associate professor
email	lubloy.eva@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT85
https://edu.epito.bme.hu/course/view.php?id=2518

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Rheological and temperature dependent material properties - BMEEOEMDT85

2. Objectives and learning outcomes

2.1 Objectives

During the course, students become acquaineted with the behavior of each material at high and low temperetures. Within the framwork of the course, we als cover rheology with time-dependent properties such as creep, shrinkage and relexation, we also deal with the reological propertise of self-compacting concretes.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the behavior of buildings materials at high and low temeperatures
2. know the effect of tempereture on changes in the properties of materials
3. know the reollogical properties of materials (relaxation, creep, shrinkage)
4. know the measurment methodes for self-compacting concretes, tehier principles and reological aspects

B. Skills

1. is able to recognize and identify the hazards of building materials under fire or low temperatures,
2. apply the selection of different measurement and evaluation methods efficiently and reasonably,
3. knows the types of deformation of building materials over time, can count on them and knows their effect on the structure.
4. is able to apply his / her knowledge in solving specific tasks.

C. Attitudes

1. eeks to learn about the structures taught in principle on the ground and
2. to apply the practice of field research,
3. trives for accurate and error-free problem identification and assessment

D. Autonomy and Responsibility

1. independently assesses problems,
2. openly accepts substantiated critical remarks,
3. takes a systemic approach to its thinking.

2.3 Methods

Lectures, communication in writing and orally. Case study processing.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1	Introduction, concepts overview
2	Basic rheological models
3	Creep
4	Shrinkage
5	Relaxation
6	Rheometer
7	Classification of building materials according to the standard and the possibilities of their classification. Test methods used for qualification
8	Behavior of concrete at high temperatures (strength characteristics, porosity, deformation). Effect of chemical and physical processes at high temperatures in concrete on mechanical properties.
9	Behavior of steel at high temperatures. Possibilities of fire protection of steel structures.
10	Behavior of wood at high temperatures.
11	Behavior of plastics at high temperatures. Possibilities

	and limitations of using plastics.
12	Behavior of reinforced concrete structures at high temperatures.
13	-
14	Accountability

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. Balázs L. Gy., Lublóy É. (2009), "Magas hőmérséklet hatása a vasbeton szerkezetek anyagaira" VASBETONÉPÍTÉS 2009/2, pp. 48-54, www.fib.bme.hu/vb2009_2_cikk/Vb2009_2.pdf
2. fib bulletin 38, (2007), "Fire design of concrete structures - materials, structures and modelling", Lausanne, ISBN: 978-2-88394-078-9
3. fib bulletin 46, (2008), "Fire design of concrete structures - materials, structural behaviour and assessment", Lausanne, ISBN: 978-2-88394-086-4.

2.6 Other information

-

2.7 Consultation

e-mail: Lubloy.eva@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

A 2.2. The assessment of the learning outcomes set out in point 1 is based on a summary dissertation and a study plan.

3.2 Assessment methods

Evaluation form	Jele	Assessed learning outcomes
test	T	A.1-A.4; B.1-B.4
homework	H	B.1-B.4; C.1-C.3; D.1-D.3

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
test	60%
hmework	40%
Sum	**100%**

3.4 Requirements and validity of signature

no signature can be obtrained

3.5 Grading system

Grade	Points (P)
excellent (5)	85% =<T
good (4)	74 % <= T < 85%
satisfactory (3)	63 % <= T <74%
passed (2)	50 % <= T < 63%
failed (1)	50% <T

3.6 Retake and repeat

For the first time during the diligence period, the locker can be replaced or repaired free of charge. In case of correction, the more favorable of the previous and the new result for the student is taken into account.

If the student is not able to obtain a grade other than insufficient with the replacement according to point 1, he / she - in addition to paying the fee specified in the regulations - will make a second attempt to correct the unsuccessful first replacement.

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
home studying of the written materia	14×0,5=7
home studying for exam	25
Sum	**60**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

EXPERTISE IN BUILDING DESIGN

1.2 Code

BMEEOEMDT86

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. Nagy Balázs
academic rank	Assistant professor
email	nagy.balazs@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT86
https://edu.epito.bme.hu/course/view.php?id=2517

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Expertise in building design - BMEEOEMDT86

2. Objectives and learning outcomes

2.1 Objectives

Aspects of a new building design technology (BIM) in building design, with a special focus on the potential application of numerical simulations (e.g. fire safety, building energy performance, sustainability, scheduling) and current issues. Analysis of the potential of information technology for the management of building design and implementation works and support for the cooperation of those involved in implementing facilities in virtual space.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has an overview of the application areas of BIM including scientific literature,
2. has an overview of the basic issues of BIM-based work, understands the principles of the profession and the importance of its main defining components,
3. knows the criteria for BIM tasks,
4. understands the relationship and interrelationship between 3D models and BIM applications,
5. has an overview of BIM applications represented by market stakeholders,
6. have an overview of the technical aspects of BIM tasks related to civil engineering,
7. know and understand the possibilities and the tasks of BIM-based design technology to be applied in building design.

B. Skills

1. communicates professionally on given topics, using BIM vocabulary correctly,
2. uses knowledge acquisition methods (notes, practical lesson sheets, catalogues, scientific literature, databases, internet resources) effectively in research tasks,
3. reliably evaluates the applications associated with BIM design technology used in building design,
4. able to apply theoretical knowledge critically and thoughtfully in the preparation of a given design task.

C. Attitudes

1. collaborate with the lecturer and fellow students in the development of their knowledge,
2. expand their knowledge through continuous learning and are open to new ways of acquiring information,
3. strive to use professional terminology.

D. Autonomy and Responsibility

1. works independently on a chosen study and research topic,
2. open to well-founded critical comments.

2.3 Methods

Lectures, IT tools and techniques, independent research tasks, work organisation techniques.

2.4 Course outline

Lectures are given in blocks (4x45 minutes):	Week	Topics of lectures and/or exercise classes
	1.	General overview of BIM and BIM-based building design projects. BIM in building construction and in building operation
	2.	BIM-based building design, architectural modelling principles, building energy-focused design
	3.	Building design support by collision analysis, quantification,

		scheduling and simulations.
	4.	Presentation of the student research tasks

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

Course materials are uploaded to the website (edu.epito.bme.hu).

2.6 Other information

Attendance is mandatory for 70% of the lectures.

2.7 Consultation

As stated on the department's website or agreed in advance by e-mail (nagy.balazs@emk.bme.hu)

This Subject Datasheet is valid for:

Inactive courses

Expertise in building design - BMEEOEMDT86

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes in section 2.2 is based on a final examination (E), one research task (HF), and active participation (A; partial assessment).

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Active participation	A	C.1-C.3; D.2
Research task	HF	A.1-A.7; B.1-B.4; C.1-C.3; D.1
Final examination	E	A.1-A.7; B.3-B.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

Abbreviation	Score
A	10%
HF	40%
E	50%
Sum	**100%**

3.4 Requirements and validity of signature

The signature obtained in the subject is valid for two semesters.

3.5 Grading system

Grade	Points (P)
excellent (5)	$90\% \leq P$
good (4)	$75\% \leq P < 90\%$
satisfactory (3)	$60\% \leq P < 75\%$
passed (2)	$50\% \leq P < 60\%$
failed (1)	$50\% \leq P$

3.6 Retake and repeat

- By its nature, active participation cannot be replaced, corrected or substituted.
- The research task may be submitted late, after the normal submission deadline until the last day of the repeat period.
- The final exam can be retaken or corrected free of charge until the end of the exam period.

3.7 Estimated workload

Activity	Hours/semester
participation in the lectures	4×4=16
preparation for the lectures	4×2=8
preparation of the research task	42
preparation for the exam	24
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Building energy modelling (BEM) - BMEEOEMDT87

I. Subject Specification

1. Basic Data

1.1 Title

BUILDING ENERGY MODELLING (BEM)

1.2 Code

BMEEOEMDT87

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. Szalay Zsuzsa
academic rank	Associate professor
email	szalay.zsuzsa@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT87
https://edu.epito.bme.hu/course/view.php?id=2516

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Building energy modelling (BEM) - BMEEOEMDT87

2. Objectives and learning outcomes

2.1 Objectives

The goal of the subject is to give an overview on energy calculation based on Building Information Modelling (BIM). Building Energy Modelling (BEM) assists the design of low energy and sustainable buildings and provides information on the comfort and energy use of buildings. Students will learn how to conduct a dynamic energy simulation and evaluate energy efficiency measures.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. understands the energy balance of a building,
2. is informed about building energy calculation methods,
3. has a knowledge about the connection of Building Information Models and energy calculation,
4. knows the main parameters influencing the energy balance of buildings,
5. is able to build an energy model of a building,
6. has an overview about possible energy saving measures.

B. Skills

1. efficiently uses information sources for learning (study aids, lecture notes, internet),
2. applies the basic design principles to save energy in buildings,
3. understands the methods for calculating energy use and comfort in buildings,
4. is able to interpret the results of building simulation,
5. is able to use energy calculation software tools.

C. Attitudes

1. is open to sustainable architecture and environmentally conscious thinking,
2. cooperates with the teacher and students to gain knowledge,
3. is willing to expand knowledge through continuous learning and is open to new learning methods,
4. strives to use professional terminology.

D. Autonomy and Responsibility

1. can prepare a task individually or in a small group,
2. is open to well-founded criticism.

2.3 Methods

Lectures, seminars, written and oral communication, IT tools and techniques, individual and group work.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Introduction, energy calculation methods in buildings
2.	Basic principles of heat balance in buildings
3.	Geometry modelling
4.	Principles of zoning
5.	Activities, occupancy, set-points
6.	Modelling of building constructions
7.	Modelling of openings and shading, surroundings
8.	Time schedules, user profiles
9.	Natural ventilation
10.	Modelling of HVAC systems and lighting
11.	Simulation outputs and interpretation
12.	Consultation of student works
13.	Summary
14.	Presentations of student works

Building energy modelling (BEM) - BMEEOEMDT87

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) Books:
1. Clarke, J.A.: Energy Simulation In Building Design, Butterworth-Heinemann, Oxford, 2004.
2. Hensen and Lamberts (ed.): Building Performance Simulation for Design and Operation, Spon Press, 2011.

b) Electronic materials at edu.epito.bme.hu

2.6 Other information

The use of a private laptop is recommended. Presence at 70% of the classes is compulsory.

2.7 Consultation

Consultation time:

according to the information on the department website, or

agreed in e-mail: szalay.zsuzsa@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Building energy modelling (BEM) - BMEEOEMDT87

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
		A.1-A.6; B.1-B.5; C.1-C.4; D.1-D.2

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Tervezéselmélet - BMEEOEMDT88

I. Subject Specification

1. Basic Data

1.1 Title

TERVEZÉSELMÉLET

1.2 Code

BMEEOEMDT88

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	DLA Patonai Dénes
academic rank	Professor emeritus
email	patonai.denes@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT88
https://edu.epito.bme.hu/course/view.php?id=2510

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Tervezéselmélet - BMEEOEMDT88

2. Objectives and learning outcomes

2.1 Objectives

Az építmény-tervezés elméleti tudásának fejlesztése.

A különböző megközelítések megismerése és összehasonlítása.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Az elméleti tudás matematikai alátámasztása
2. A döntési lehetőségek kiválasztása
3. A tudás más elméleti megközelítésének vizsgálata
4. A gyakorlatban bevált elméletek megismerése
5. Elmélet és gyakorlat kettőségének összehasonlítása
6. A gazdaságosság reláció fogalmának meghatározásai
7. Az optimális megoldás tudatos meghatározása

B. Skills

1. A lehetőségek helyes mérlegelése, feltérképezése
2. A tudás alapú kiválasztás megerősítése
3. A tudás és a kor lehetőségeinek összehangolása
4. A szerkezeti és formaérzék fejlesztése

C. Attitudes

1. A szerkezeti és formaérzék fejlesztése
2. Alapos tudásanyagra való igény
3. A tudásanyag folyamatos fejlesztésének igénye és képessége

D. Autonomy and Responsibility

1. Az elméleti tudás gyakorlati alkalmazásának képessége
2. Kooperációban a jó együttműködési képesség

2.3 Methods

Előadás, féléves feladat, tömbösített műhely-munka

2.4 Course outline

A különböző témakörök műhely-megbeszélései tömbösítve történnek (4x45 perc)

Hét	Előadások és gyakorlatok témaköre
1.	A hallgató profiljára a féléves feladat kiválasztása
2.	A hallgató profiljára a féléves feladat kiválasztása
3.	Tervezéselmélet bemutatása-matematikai háttere
4.	Tervezéselmélet bemutatása-matematikai háttere
5.	A feladat tanulmányának összegyűjtése és bemutatása
6.	A feladat tanulmányának összegyűjtése és bemutatása
7.	A kiadott feladatokra adott hallgatói válasz megerősítése
8.	A kiadott feladatokra adott hallgatói válasz megerősítése
9.	A hallgatói feladatokhoz illeszkedő előadás
10.	A hallgatói feladatokhoz illeszkedő előadás

Tervezéselmélet - BMEEOEMDT88

11.	Hallgatói feladat véglegesítése a teljesítéshez
12.	Hallgatói feladat véglegesítése a teljesítéshez
13.	Az elmélet és a gyakorlat célkitűzésének összegzése
14.	Az elmélet és a gyakorlat célkitűzésének összegzése

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

ARUP mérnökiroda munkássága

Otto Frei gondolkodásmódja-építészete

A szimbolikus építészet teóriái

2.6 Other information

2.7 Consultation

A műhely-beszélgetéseken, illetve előzetesen, e-mailben egyeztetve.

e-mail: patonai.denes@emk.bme.hu

This Subject Datasheet is valid for:

Nem induló tárgyak

Tervezéselmélet - BMEEOEMDT88

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények

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
Előadásokon való részvétel (pótlással)	30%
Feladat teljesítése beadással	70%
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	90%≤P
jó (4)	75%≤P<90%
közepes (3)	60%≤P<75%
elégséges (2)	50%≤P<60%
elégtelen (1)	P<50%

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Részvétel az órákon (pótlással)	14x2=28
Otthoni munka, feladatok elkészítése	40
Felkészülés a teljesítmény értékelésre	20

Tervezéselmélet - BMEEOEMDT88

Tervfeladat bemutatása	2
Összesen	90

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Nem induló tárgyak

I. Subject Specification

1. Basic Data

1.1 Title

TECHNICAL VALUE ANALYSIS

1.2 Code

BMEEOEMDT89

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. Dudás Annamária
academic rank	Associate professor
email	dudas.annamaria@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDT89
https://edu.epito.bme.hu/course/view.php?id=2514

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

This course will provide the doctoral student with in-depth knowledge in the following areas, which will enable the processing and demonstration of scientific results in the fields of building constructions value analysis, environmental renovation and property valuation. The course covers the following topics: the obsolescence of buildings, the failures affecting the obsolescence of buildings and building constructions. Condition assessment of building constructions, technologies for the preservation of building value and value impoving by reconstruction. The analysis of value and the methods of real estate valuation. Value enhancement through renovation, building rehabilitation and certification of structures. Methods of value analysis and property valuation. Environmentally friendly aspects in the building industry, healthy buildings and living/working circumstances. Building biology and indoor comfort.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Have an overview of the failures of building constructions.
2. Can properly assess the condition of building constructions according to various inspection criteria.
3. Know the consequences of constructional failures and damages.
4. Has an overview of the obsolescence of building structures, value prevention technologies, renovation options, taking into account environmental considerations.
5. Understands the advantages and disadvantages of assessment methods and the accuracy of estimation of the assessment methods used.
6. Knowledge of the characteristics of healthy buildings, building biology and comfort conditions.
7. Understands standards, regulations and the need to take them into account from a certification point of view.
8. Interprets in a creative way the expected trends in the development and improvement of the technical field.
9. Possesses the knowledge of research methodology necessary for independent research in the field of engineering.

B. Skills

1. Professionally summarise the topics of building construction value assessment.
2. Effectively use knowledge acquisition methods (textbooks, catalogues, scientific articles, online resources) in his/her work.
3. Reliably evaluate the results of valuation methods.
4. Can assess the condition of building structures and provide renovation solutions.
5. Ability to apply theoretical knowledge in a critical and considered context when assessing a given building/building structure.
6. Ability to carry out research in his/her field of specialisation, to solve specific problems encountered; to develop and apply new interdisciplinary methods.
7. Ability to develop and demonstrate new research techniques and approaches in a given discipline.

C. Attitudes

1. Collaborate with the teacher and fellow students in the development of knowledge.
2. Expands his/her knowledge through continuous learning and is open to new ways of acquiring information.
3. Strives to use professional terminology in a professional manner.
4. Is committed to and critical of professional, technological development and innovation in engineering.
5. Committed to quality standards.

D. Autonomy and Responsibility

1. Independently complete the study/topic of your choice.

2. Is open to well-founded critical comments.
3. Initiates new research in a creative way.
4. Has a high degree of autonomy in developing, representing and advocating professional views on broad and specific professional issues in the field of modern engineering.

2.3 Methods

Lectures, case studies, field trips, written and oral communication, optional independent and group work, work organisation techniques.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction. Objectives and tasks of technical value analysis
2.	The obsolescence of buildings, failures affecting the obsolescence of buildings and building structures.
3.	Condition assessment of building constructions.
4.	Diagnostics of building constructions in contact with soil, methods of renovation. Assessment of the condition of walls, slabs, roofs and windows.
5.	Technologies of value preservation.
6.	Value enhancement through renovation, building rehabilitation and certification of constructions.
7.	Environmentally consciousness in the building industry. Environmental building renovation aspects and methods. Circular economy.
8.	Methods of value analysis and real estate valuation.
9.	Special building construction solutions: modular construction, analysis of earth houses, container houses.
10.	Healthy buildings and living/working space
11.	Building biology and indoor comfort.
12.	Case studies.
13.	Educational field trip
14.	Research, evaluation of articles, methodology.

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

- Emmitt, Stephen, Barry's Introduction to Construction of Buildings John Wiley & Sons Inc, 2018, ISBN 9781118977163
- Emmitt, Stephen, Barry's Advanced Construction of Buildings John Wiley & Sons Inc, 2018, ISBN 9781118977101
- Ernst Neufert Győri Róbert (Szerk.) Építés- és tervezéstan, Dialóg Campus, 2014 ISBN 9786155376207
- Tom Woolley, Sam Kimmins, Rob Harrison, Paul Harrison: Green building handbook ISBN-13: 978-0419226901, ISBN-10: 0419226907
- Relevant scientific articles from the following journals: Building and Environment, Energy and Buildings, Journal of Cleaner Production, Construction and Building Materials, Journal of Cultural Heritage, Engineering Structures, Detail

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

Technical value analysis - BMEEOEMDT89

Special appointments can be requested via e-mail:

dudas.annamaria@emk.bme.hu, horn.valeria@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 in 2.2 is based on an examination and active participation in lectures. The lectures are at least. 70 % of the lectures must be attended.

3.2 Assessment methods

Evaluation form	Abbrev.	Assessed learning outcomes
active participation (continuous evaluation)	A	A.1-A.9; B.2, B.7; C.1-C.5; D.2-D.4
exam (summarizing evaluation)	E	A.1-A.9; B.1-B.7; C.3-C.5; D.1-D.2

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
A	10 %
During semester period - Sum	10 %
Exam	90 %
Sum	100 %

3.4 Requirements and validity of signature

Active participation in at least 70% of the lectures is required to obtain a signature.

The previously obtained semester results unlimitedly can be taken into account in the examination.

3.5 Grading system

Grade	Points (P)
excellent (5)	80 <= P
good (4)	70 <= P < 80%
satisfactory (3)	60 <= P < 70%
passed (2)	50 <= P < 60%
failed (1)	P < 50%

Exam and active participation are rated with a grade between 1 and 5.

For those who fulfil the attendance requirements, the grades are determined as above.

3.6 Retake and repeat

The active participation – due to its speciality – cannot be resubmitted or exchanged in any ways.

3.7 Estimated workload

Activity	Hours/semester
Participation in lectures	14×2=28
Preparation for the lessons	14×0,5=7
Preparation of the home assignments	55
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

ALKALI ACTIVATED MATERIALS IN CIVIL ENGINEERING

1.2 Code

BMEEOEMDTV1

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. Kopecskó Katalin
academic rank	Associate professor
email	kopecsko.katalin@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMDTV1
https://edu.epito.bme.hu/course/view.php?id=5137

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Alcali activated materials in civil engineering - BMEEOEMDTV1

2. Objectives and learning outcomes

2.1 Objectives

During the last decades, alkali-activated cements and concretes have attracted strong interests all over the world due to their advantages of low energy cost, high strength and good durability compared to portland cements. A major incentive for further development of such cement is generated by the annual output of fly ashes from power plants and other by-product materials, which is so enormous that there is a constant need to find new uses for them. Approximately 49% of the utility wastes are simply landfilled, 41% are contained in surface impoundments, and about 10% are disposed of by discharging into old quarry operations.

Although much of the development of alkali-activated or alkaline cements has been based on activated slags, there is great potential for the utilization of other by-products, instead of using ordinary Portland cement. Within the framework of the course, students get acquainted with the basics of the alkali-activated materials in civil engineering applications.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Alkali-activated materials in the system of binders.
2. Alkali-activated binders versus Portland cement.
3. Precursors and activators.
4. Waste materials as secondary raw materials.
5. Liquid and solid activators.
6. Reactions between the different precursors and activators.
7. Differences and similarities with ternary or quaternary blended cement.
8. Applications. Alkali-activated cement. One or two-phase cement.
9. Prefabrication with alkali-activated materials.
10. Alkali activated stabilization in geotechnics.
11. Alkali activated materials versus geopolymers.
12. Durability properties.
13. The subject includes knowledge of the materials dealing with the above topics.

B. Skills

1. able to explain the differences between the Portland cement bound systems and alkali-activated bound systems (advantages and disadvantages),
2. capable of analyzing the alkali-activated systems and processes in many aspects.

C. Attitudes

1. develops his/her knowledge and is open to new information,
2. aspires to solve tasks accurately,
3. strive to maximize their abilities to make their homework at the highest possible level.

D. Autonomy and Responsibility

1. able to make state-of-the-art in a special field of the topic,
2. able to transfer the knowledge in the special field to the class during a short presentation,
3. take responsibility for the quality of your work and the ethical standards that set an example for your classmates, using the knowledge acquired during the course.

2.3 Methods

lectures and individual learning, review making and a short presentation by the PhD student.

2.4 Course outline

Alkali-activated materials in Civil Engineering practice, examples (geotechnics, prefabrication, etc.)	Hét	Előadások és g

	yakorlatok témaköre
1.	Introduction. Important terms: precursors and activator materials. Production and properties of some commonly used chemical activators. Liquid and solid activators.
2.	Precursors. Production and properties of cementing components used in alkali-activated cement and c

	oncrete - I.
3.	Precursors. Production and properties of cementing components used in alkali-activated cement and concrete - II.
4.	From binder to concrete 1. Hydration and microstructure of alkali-activated slag cement - I.
5.	From binder to concrete 1. Hydration and microstructure of alkali-activated

	slag cement - II.
6.	From binder to concrete 2. Properties of alkali-activated slag cement pastes and mortars - I.
7.	From binder to concrete 2. Properties of alkali-activated slag cement pastes and mortars - II.
8.	From binder to concrete 3. Properties of alkali-activated slag cement concrete - I.
9.	From

	binder to concrete 3. Properties of alkali-activated slag cement concrete -II.
10.	Durability of alkali-activated cements and concrete.
11.	Durability of alkali-activated cements and concrete.
12.	Other types of alkali-activated cementitious systems. Alkali-activated materials versus geopolymer.
13.	Geopolym

ers. S tanda rdizat ion.

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. pdf versions of the Lectures
2. Shi - Krivenko - Roy: Alkali-Activated Cements and Concretes, Taylor and Francis, p. 376.
3. Provis - Deventer: Geopolymers, Woodhead Publishing in Materials, p. 454.

2.6 Other information

2.7 Consultation

Appointments can be requested via e-mail: kopecsko.katalin@emk.bme.hu.

This Subject Datasheet is valid for:

2025/2026 semester II

Alcali activated materials in civil engineering - BMEEOEMDTV1

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes is specified in clause 2.2. above and the evaluation of student performance occurs via exams and homework. The homework will be presented in a short (10 minutes) presentation to the class.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Exam	E	A.1-A.12; B.1-B.2; C.1-C.2
Homework (+presentation)	H	A.1-A.12; B.1-B.2; C.1-C.3; D.1-D.3

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
E	50
H	50
Összesen	**100%**

3.4 Requirements and validity of signature

Active presence during the semester.

3.5 Grading system

Érdemjegy	Pontszám (P)
excellent (5)	85-100
good (4)	74-84
satisfactory (3)	62-73
passed (2)	50-61
failed (1)	0-49

3.6 Retake and repeat

Possible in the examination period (see in the Neptun system).

3.7 Estimated workload

Tevékenység	Óra/félév
Lectures	28
Individual study	16
Homework and presentation	46
Összesen	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

ROCK MECHANICAL MODELLING

1.2 Code

BMEEOGMDT71

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lab	2

1.5 Evaluation

Midterm grade

1.6 Credits

3

1.7 Coordinator

name	Balázs Vásárhelyi Ph.D.
academic rank	Associate professor
email	vasarhelyi.balazs@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

http://epito.bme.hu/geotechnika-es-mernokgeologia-tanszek
https://edu.epito.bme.hu/course/view.php?id=5410

1.10 Language of instruction

english

1.11 Curriculum requirements

-

1.12 Prerequisites

PhD education program

1.13 Effective date

10 February 2022

Rock mechanical modelling - BMEEOGMDT71

2. Objectives and learning outcomes

2.1 Objectives

The scope of this course is to familiarise students with the full range of rock mechanical modelling, with a particular focus on analysing the laboratory tests.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. knows about specialised laboratory investigations for rock mechanical modelling

B. Skills

1. is able to prepare rock mechanical models

C. Attitudes

1. ready to learn

D. Autonomy and Responsibility

1. is autonomous

2.3 Methods

Independent processing of data based on published literature

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction to rock mechanics
2.	Uniaxial compressive test – analysing the stress-strain curve
3.	Brazilian tensile test
4.	Triaxial test – failure criteria
5.	Rock mass classification systems – calculation from borehole
6.	Rock mechanical parameters of the rock mass
7.	Theories of shearing
8.	Unwedge analysis
9.	In situ stress
10.	Modelling a tunnel using RS2 software
11.	Rock mechanical modelling using RS2 software

Rock mechanical modelling - BMEEOGMDT71

12.	Rock mechanical modelling using RS2 software
13.	Rock mechanical modelling using RS2 software
14.	Rock mechanical modelling using RS2 software

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) Online materials

1. Papers, reports, etc.

2.6 Other information

All the material (papers, exam, files, etc) will be send by e-mail

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

Special appointments can be requested via e-mail: vasarhelyi.balazs@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

Rock mechanical modelling - BMEEOGMDT71

<div align="center">

II. Subject requirements

</div>

Assessment and evaluation of the learning outcomes

3.1 General rules

There is a written exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
written exam	E	A.1; B.1; C.1; D.1

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
E	10
Sum	**100%**

3.4 Requirements and validity of signature

Continuous e-mail contact

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	70<=P<85
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

1) There is no retake

3.7 Estimated workload

activity	hours/semester
participation of site and laboratory visits	14x2=28
preparation for the exam	50
in total	**78**

3.8 Effective date

10 February 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

SPECIAL GEOTECHNICAL TESTS

1.2 Code

BMEEOGMDT72

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lab	2

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Balázs Móczár Ph.D.
academic rank	Associate professor
email	balazs.moczar@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

https://epito.bme.hu/BMEEOGMDT72
https://edu.epito.bme.hu/course/view.php?id=5411

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Special geotechnical tests - BMEEOGMDT72

2. Objectives and learning outcomes

2.1 Objectives

The scope of this course is to familiarise students with the full range of field and laboratory geotechnical investigations, with a particular focus on specialised investigations not covered in the BSc and MSc courses

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

  1. knows about specialised laboratory and field geotechnical investigations

B. Skills

  1. is able to prepare geotechnical exploration plans

C. Attitudes

  1. ready to learn

D. Autonomy and Responsibility

  1. is autonomous

2.3 Methods

Showing laboratory test procedures and in situ geotechnical site investigations

2.4 Course outline

All classes are held in one week, immediately after the school, over 5 days. The basic programme for the week (day by day)

Monday: Site visit somewhere in the Budapest area. Geophisical subgrade surveying-testing: ground radar (GPR), electromagnetic and geoelectric tomography. Land seismic surveying
Tuesday: Site visit somewhere in the Budapest area. Drillings, soundings, compaction tests, sampling methods
Wednesday: Site visit somewhere in the Budapest area. Drillings, soundings, compaction tests, sampling methods
Thursday: Special laboratory testing: Triaxial tests, dynamic test, compression and consolidation tests, liquefaction tests
Friday: Special laboratory testing: Triaxial tests, dynamic test, compression and consolidation tests, liquefaction tests
The exact daily schedule will only be known the week before

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) Online materials:
  1. Electronic notes presented on the site and laboratory visits

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

Special appointments can be requested via e-mail: moczar.balazs@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

Special geotechnical tests - BMEEOGMDT72

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

There is a written exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
written exam	E	A.1; B.1; C.1; D.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

Participation in 100 % of on-site and laboratory investigations

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	70<=P<85%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

There is no retake

3.7 Estimated workload

Activity	Hours/semester
participation of site and laboratory visits	14×2=28
preparation for the exam	50
Sum	**78**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Hydrogeology of subsurface water - BMEEOGMDT81

I. Subject Specification

1. Basic Data

1.1 Title

HYDROGEOLOGY OF SUBSURFACE WATER

1.2 Code

BMEEOGMDT81

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. Görög Péter
academic rank	Associate professor
email	gorog.peter@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

https://epito.bme.hu/BMEEOGMDT81
https://edu.epito.bme.hu/course/view.php?id=2531

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2017

Hydrogeology of subsurface water - BMEEOGMDT81

2. Objectives and learning outcomes

2.1 Objectives

The goal of the subject is that the students are getting familiar with the properties, types, occurrences, and effects of subsurface water. It is important to introduce the relationship between civil engineering and hydrogeology fields so the students know how hydrogeology relates to their individual scientific topics. They learn the basic usage of hydrogeological modelling tools, and how groundwater and waterflow affect civil engineering works. It is also introduced what the effect of a civil engineering project on a protected or sensitive aquifer.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the classification of groundwater,

2. knows what the difference between porous media and rock masses in point of the groundwater is,

3. knows the speciality of karstic aquifers,

4. aware of the basic hydrogeological modelling methods,

5. knows how to deal with protected and sensitive aquifers in civil engineering point of view,

6. aware of the most important relations between the results of civil engineering works and the groundwater,

B. Skills

1. able to determine the hydrogeological parameters of a porous media,

2. able to use the model of karstic and jointed aquifers,

3. able to determine the effect of groundwater to civil engineering works,

4. able to do a presentation about a given topic,

5. able to express her/his thoughts orderly in written and oral.

C. Attitudes

1. improve her/his knowledge with continuous learning,

2. open to use the information technology tools,

3. pursue to know and use of the toolkit which need for the hydrogeological problem solution,

    4. pursue to the exact and errorless task solution.

D. Autonomy and Responsibility

    1. thinks through and solve independently the hydrogeological tasks and problems,

    2. open to accept the critical comments,

    3. use the systematic approaches in her/his mind

2.3 Methods

Lectures, practical tasks, communication in written and oral form, use of IT tools and technics, task solved independently and in groups as well, work organization technics.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction to subsurface water.
2.	Classification of ground water.
3.	Ground water in porous media: permeable and nonpermeable layers, confined, nonconfined aquifers.
4.	Ground water in rocks: karstic and fractured aquifers.
5.	The theory of double porosity.
6.	Protected and sensitive aquifers.
7.	Effect of civil engineering works on ground water.
8.	Hydrogeological modelling methods, seepage calculation.
9.	Civil engineering projects and ground water – Case study I.
10.	Civil engineering projects and ground water – Case study II.

11.   Civil engineering projects and ground water – Case study III.

12.   Presentations of students' individual projects – discussion I.

13.   Presentations of students' individual projects – discussion II.

14.   Summary of the subject, oral discussion of outcomes with the students.

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

Fetter C.W. (2001) Applied hydrogeology

b) Online materials

Lecture notes

2.6 Other information

The department provides the academic version of the introduced software.

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: gorog.peter@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Hydrogeology of subsurface water - BMEEOGMDT81

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes specified in clause 2.2. above and the evaluation of student performance occurs via tests, homework assignments.

3.2 Assessment methods

Evaluation form	abbrev.	assessed learning outcom
1. Homework	HW	A.1-A.6; B.1-B5; C.1-C.4;
2. Presentation	PR	A.1-A.6; B.1-B5; C.1-C.4;
3. Exam	EX	A.1-A.6; B.1-B5; C.1-C.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

abbreviation	score
HW	25%
PR	25%
EX	50%
Sum	**100%**

3.4 Requirements and validity of signature

It is required for the signature to fulfil the homework and presentation requirements.

3.5 Grading system

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

1) Homework – after the payment of the fee determinated in the regulation – can be submit with delay until 16.00 or in electronic format until 23.59 of the last day of the completion week.

2) The submitted and accepted homework can be corrected without any fee until the deadline described in the point 2.

3) The presentation can be retaken in the completion week free of charge. In case of correction the better result will be taking into account from the new and previous results.

3.7 Estimated workload

activity	hours/semester
contact hours	14×2=28
preparation for the courses	14×1=14
homework and presentation	24+12=36
home studying of the written material	12
in total	**90**

3.8 Effective date

1 September 2017

This Subject Datasheet is valid for:

Inactive courses

Stone in structures - BMEEOGMDT82

<center>**I. Subject Specification**</center>

1. Basic Data

1.1 Title

STONE IN STRUCTURES

1.2 Code

BMEEOGMDT82

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

3

1.7 Coordinator

name	Ákos Török, DSc
academic rank	Professor
email	torok.akos@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

http://epito.bme.hu/geotechnika-es-mernokgeologia-tanszek
https://edu.epito.bme.hu/course/view.php?id=5447

1.10 Language of instruction

english

1.11 Curriculum requirements

-

1.12 Prerequisites

PhD education program

1.13 Effective date

5 September 2022

2. Objectives and learning outcomes

2.1 Objectives

Stones are widely used in engineering structures, and the main focus of this course is to understand the behaviour of stones in the built environment. Weathering phenomena and the long- and short-term changes of rock properties are outlined with special emphasis on alteration and deterioration of stones (igneous, sedimentary and metamorphic). Understanding the structural aspects, load bearing capacities and practicing visual assessment of stone structures is also the scope. On-site and laboratory testing of stones with standardized and non-standardized techniques are also discussed.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the main lithotypes and their properties

2. knows the concept of mineral-rock and the importance of rock fabric

3. knows the main igneous rock types, their occurrence and their use in stone structures

4. knows the main sedimentary rock types their occurrence and their use in stone structures

5. knows the main metamorphic rock types their occurrence and their use in stone structures

6. knows the weathering features and diagnostics of stone structures

7. understand the durability of stones and the changes of physical properties

B. Skills

1. is able to identify and recognize rocks, describe them on site

2. is able to determine the most important weathering forms

3. capable of recognizing deterioration processes and interpreting them from an engineering perspective

4. suitable for carrying out local building stone diagnostic tasks and preparing an expert opinion

5. is able to express his thoughts in an orderly form orally and in writing

C. Attitudes

1. cooperates with the supervisor and fellow students during the expansion of knowledge

2. expands his knowledge by continuously acquiring knowledge

3. open to the use of technology tools

4. strives for accurate and error-free task solutions

5. strives to create harmony between geology and engineering sciences, to validate them in solving tasks

D. Autonomy and Responsibility

1. can independently determine the type of the given rock and think through the problems related to its properties and independently analyse it further based on given sources

2. takes into account the limitations of the knowledge of geological processes and the engineering design responsibility in predicting geological processes

3. accepts well-founded critical comments with an open mind

4. she/he uses the systemic approach in his thinking

2.3 Methods

Lectures, written and oral communication, use of IT tools and techniques.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	The topic of the subject is the methods of acquiring information on stone types
2.	Building materials of the earth's crust, minerals and rocks. The cycle of rock formation and its role of building stone occurrence
3.	Civil engineering aspects of stone structure description
4.	Plutonic igneous rocks in stone structures, their characterization, and their use in the construction industry
5.	Volcanic igneous rocks in stone structures, their characterization, and their use in the construction industry
6.	Pyroclastic igneous rocks in stone structures, their characterization, and their use in the construction industry
7.	Detrital sedimentary rocks in stone structures, their characterization, and their use in the construction industry
8.	Chemically/biologically precipitated sedimentary rocks in stone structures, their characterization, and their use in the construction industry
9.	Metamorphic rocks in stone structures, their characterization, and their use in the construction industry
10.	Weathering processes, physical/chemical/biological weathering forms
11.	Stone deterioration in the built environment.
12.	Lithological mapping of buildings, weathering and decay maps.
13.	On-site and laboratory tests of building stones of stone

Stone in structures - BMEEOGMDT82

	structures.
14.	Students' individual project works - presentations

Classes are held for 14 weeks. The basic programme for the 14 weeks (week per 3 hours)

The exact daily schedule will only be known the beginning of the period of Classes (on the first week)

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) Online materials

1. Electronic notes presented on the site

b) Books

1. Siegesmund, S. Snethlage, R. (eds) 2011. Stone in Architecture. Springer, Berlin, [DOI 10.1007/978-3-642-14475-2_2]

2. Přikryl R., Török Á. (eds.) 2010. Natural Stone Resources for Historical Monuments. Geological Society, London, Special Publications 333, 237p ISBN 978-1-86239-291-5.

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

Special appointments can be requested via e-mail: torok.akos@emk.bme.hu

This Subject Datasheet is valid for:

2025/2026 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

There is an oral exam

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
study + presentation on the assigned area	HW	A.1-A.6; B.1-B.7; C.1-C.6; D.1-D.4
oral exam		B.1-B.7; C.1-C.3, C.5; 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

Abbreviation	Score
Sum	**100%**

3.4 Requirements and validity of signature

Participation in 100 % of on-site

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	74<=P<84%
satisfactory (3)	62<=P<73%
passed (2)	50<=P<61%
failed (1)	P<50%

3.6 Retake and repeat

There is no retake

3.7 Estimated workload

Activity	Hours/semester
participation of site	14x2=28
mid-semester preparation for lessons	14x1=14
doing homework	20
independent learning of designated written curriculum	12
Sum	**74**

3.8 Effective date

5 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

GEOTECHNICAL FINITE ELEMENT ANALYSIS

1.2 Code

BMEEOGMDT83

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	András Mahler
academic rank	Associate professor
email	mahler.andras@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

https://epito.bme.hu/BMEEOGMDT83
https://edu.epito.bme.hu/course/view.php?id=5446

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Geotechnical finite element analysis - BMEEOGMDT83

2. Objectives and learning outcomes

2.1 Objectives

The scope of this course is to familiarise students with advanced finite element modelling techniques, with particular focus on unsaturated soil behaviour and soil dynamics.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

> 1. knows about unsaturated soil characteristics (SWCC, matric suction, stress variables)
> 2. knows about modelling techniques used for time-history analyses

B. Skills

> 1. is able to prepare geotechnical finite element model for advanced geotechnical problems such as ones involving unsaturated soil behaviour or dynamic problems

C. Attitudes

> 1. ready to learn

D. Autonomy and Responsibility

> 1. is autonomous

2.3 Methods

Lectures on special modeling concepts, unsaturated soil behaviour, a modeling dynamic problems.

2.4 Course outline

All classes are held in one week, immediately after the school, over 3 days. The basic programme for this period (day by day)

1st day: Lectures on unsaturated soil mechanics covering the following topics physical background, stress variables, seepage calculation, strength and deformation properties.

2nd day: Finite element modelling of unsaturated soil behaviour. Two related sample problem will be explained and analysed with active participation of the students.

3rd day: Finite element modelling of soil dynamical problems. Two related sample problem will be explained and analysed with active participation of the students.

The detailed daily schedule is announced on the week before

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) Online materials:
> 1. Online lecture videos on unsaturated

b) Written materials:
> 1. Unsaturated Soil Mechanics in Engineering Practice (2012). D. G. Fredlund, H. Rahardjo, M. D. Fredlund, Print ISBN:9781118133590 Online ISBN:9781118280492 DOI:10.1002/9781118280492
> 2. Plaxis tutorial

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: mahler.andras@emk.bme.hu

Geotechnical finite element analysis - BMEEOGMDT83

This Subject Datasheet is valid for:

2025/2026 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Written test

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Written test	T	A.1-A.2; B.1; C.1; D.1

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
T	100%
Sum	**100%**

3.4 Requirements and validity of signature

Succesful test

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	70<=P<85%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

There is one retake.

3.7 Estimated workload

Activity	Hours/semester
Participation on the lectures	14×2=28
Preparation for the test	50
Sum	**78**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

ENGINEERING GEOLOGICAL RISK ASSESSMENT

1.2 Code

BMEEOGMDTV1

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

3

1.7 Coordinator

name	Ákos Török, DSc
academic rank	Professor
email	torok.akos@emk.bme.hu

1.8 Department

Department of Engineering Geology and Geotechnics

1.9 Website

http://epito.bme.hu/geotechnika-es-mernokgeologia-tanszek
https://edu.epito.bme.hu/course/view.php?id=2528

1.10 Language of instruction

english

1.11 Curriculum requirements

-

1.12 Prerequisites

PhD education program

1.13 Effective date

1 September 2022

Engineering geological risk assessment - BMEEOGMDTV1

2. Objectives and learning outcomes

2.1 Objectives

The scope of this course is to familiarise students with the full range of geological hazards and risks, with a particular focus on problems or activities that may potentially be harmful to the population and damaging the built and natural environment. It presents the impact of geological processes on engineering facilities (unexpected and quantifiable geological risks).

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. how geological hazards appear and their expected effects

2. understanding the catastrophes that have caused damage to the largest engineering facilities that has ever occurred on Earth

3. knows major features in terms of geological risk

4. prepares a written report (study) on the given topic with independent work

5. gives a presentation on the given topic (oral report, at least 15 slides)

B. Skills

1. is able to characterize the main engineering geological risk factors

2. is able to characterize the appearance of geological hazards and their forecasted effects

3. is able to present examples of events that have caused disasters in the past

4. is able to search for and interpret data from any field

5. is able to collect geological and geomorphological data of any area based on both digital and paper-based data

6. is able to process a given topic independently

7. is able to present a given geological phenomenon in writing (study) and orally (lecture).

8. knows and is able to apply the steps of the national disaster risk assessment process

C. Attitudes

1. expands his knowledge by continuously acquiring knowledge

2. open to the use of technology tools

3. open to independent research work

4. strives for accurate and error-free task solutions

5. interested in geological processes

6. open to expanding his field trip knowledge

D. Autonomy and Responsibility

1. the student will independently search for the previous data from the area assigned to him, available on the Internet and in printed form

2. accepts well-founded critical comments with an open mind

3. independently prepares a written paper presenting the geological and geomorphological characteristics of the assigned area and the disaster situation that has developed, and presents it to fellow students

4. behaves responsibly during field trips, takes care of the physical integrity of both himself and his co-workers

2.3 Methods

Presenting the geological hazards and risks on the example of case studies

Lectures, written and oral communication, use of IT tools and techniques, self-made assignment, field trip.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Overview of the course topics, description of natural hazards, sources of danger that can be traced back to geological causes
2.	Main terminology, hazard, vulnerability, exposure and risk in earth sciences – individual project topics
3.	Geological hazard characterization
4.	Geological phenomenon and engineering geological hazards, differences and causes
5.	Seismic hazards and their main causes, engineering geological aspects of earthquakes
6.	Mass wasting and slope movements – main types
7.	Mining activity as a geological hazard
8.	Volcanic activity and their effects, hazardous volcanic eruption
9.	Impact of climate changes and weathering related engineering geological hazards
10.	Hydrogeological hazards and risks
11.	Vulnerability of geological environment
12.	Engineering geological hazard assessment techniques
13.	Case studies
14.	Presentation of student tasks – oral presentations

Engineering geological risk assessment - BMEEOGMDTV1

Classes are held for 14 weeks. The basic programme for the 14 weeks (week per 3 hours)

The exact daily schedule will only be known the beginning of the period of Classes (on the first week)

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) Online materials

1. Electronic notes presented on the site

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

Special appointments can be requested via e-mail: torok.akos@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Engineering geological risk assessment - BMEEOGMDTV1

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

There is an oral exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
study + presentation on the assigned area	HW	A.1-A.6; B.1-B.7; C.1-C.6; D.1-D.4
oral exam	E	B.1-B.7; C.1-C.3, C.5; 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

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

3.4 Requirements and validity of signature

Participation in 100 % of on-site

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	74<=P<84%
satisfactory (3)	62<=P<73%
passed (2)	50<=P<61%
failed (1)	P<50%

3.6 Retake and repeat

1) There is no retake

3.7 Estimated workload

Activity	Hours/semester
participation of on-site	14x2=28
mid-semester preparation for lessons	14x1=14
doing homework	20
independent learning of designated written curriculum	12
Sum	**74**

3.8 Effective date

1 September 2022

Engineering geological risk assessment - BMEEOGMDTV1

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

FRAGILITY ASSESSMENT

1.2 Code

BMEEOHSDT71

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. László Gergely Vigh
academic rank	Associate professor
email	vigh.laszlo.gergely@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

http://epito.bme.hu/node/16225?language=en
https://edu.epito.bme.hu/course/view.php?id=2475

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Fragility assessment - BMEEOHSDT71

2. Objectives and learning outcomes

2.1 Objectives

The motivation of the studies is to understand the meaning of „extreme event", what is the failure probability/risk, what is the reliability of the structure, what is the acceptable risk, how to mitigate risk, development of standards for practicing engineers, assuring acceptable risk level, conventions for reliability analysis. The objective of the course is that the student shall understand and be aware of the principles and basis of fragility and risk assessment methods, fragility and hazard curves and the associated challenges, reliability analysis of complex systems, incorporation of time dependency, finding optimum risk, resilience assessment.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. is aware of the principles and basic terms of statistics and probability theory, knows the basic statistical analysis and assessment methods,
2. knows the principles of fragility and risk assessment,
3. is aware of the uncertainties in engineering problems, the distribution functions that are typical in civil engineering problems, and the model development methods,
4. is aware of the terms of failure probability and reliability index, the principles of basic reliability analysis methods (FORM, SORM and Monte Carlo analysis),
5. knows the principles of resilience assessment

B. Skills

1. identifies failure modes,
2. applies the statistical and analysis methods for assessment of measuring results,
3. solves reliability problems by FORM and Monte Carlo methods using specific softwares,
4. uses reliability analysis for systems,
5. completes fragility assessment,
6. creates fragility curve,
7. is able to present his/her results in proper written form,

C. Attitudes

1. follows the lectures, makes effort to understand the study material,
2. collaborates with the teacher in gaining knowledge,
3. is continuously gaining knowledge,
4. is open to the use of IT tools and equipments,
5. aims accuracy in his/her calculations/solutions,

D. Autonomy and Responsibility

1. is independent in problem statements and solutions,
2. aims to understand the complexity, comprehensiveness of the problems and recognize the synergies

2.3 Methods

Theoretical lectures and practical seminars are basically not separated, but are held in hybrid way. Theoretical parts emphasize the principles; rigorous mathematical derivation is not addressed. Practical parts illustrate the practical application of the methods, incorporating the use of specific practical tools. Active involvement in and communication during the lectures are expected, helping the understanding of the study material. Homeworks help strenghtening the skills.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction
2.	Reliability analysis (background lecture) - 1
3.	Reliability analysis (background lecture) - 2

Fragility assessment - BMEEOHSDT71

4.	Problem statement, challenges in fragility assessment
5.	Challenges in fragility assessment
6.	Fragility curve
7.	Hazard curve
8.	Failure mode, systems
9.	Reliability analysis of systems
10.	Computational practice
11.	Time dependancy
12.	Partial factors, optimum risk
13.	Resilience assessment
14.	Resilience assessment

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, literature:

- Faber: Risk and safety in civil, environmental and geomatic engineering
- Sorensen: Structural reliability theory and risk analysis
- Rao, S.R.: Engineering optimization – Theory and practice. Fourth Edition. Wiley, 2009.

b) Online materials:: materials uploaded to the web site of the subject, e.g.:

- Lecture notes, electronic lecture notes,
- slides of lectures and practices,
- solved problems
- background materials on reliability analysis

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the information system. Special appointments can be requested via e-mail. Consultation during lecture breaks is also available.

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 specified in clause 2.2. above and the evaluation of student performance occurs via homeworks, class work (active involvement in lectures) and examination.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework	HW	A.1-A.5; B.1-B.7; C.1-C.5; D.1-D.2
active involvement in lectures	A	A.1-A.5; B.1-B.7; C.1-C.5; D.1-D.2
oral exam	E	A.1-A.5; B.1-B.7; C.1-C.5; D.1-D.2

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	40%
A	10%
Total in semester	**50%**
E	50%
Sum	**100%**

There is no individual criteria for HW and A. To obtain successful grade, the sum of HW and A shall be equal to or exceed 50% of the achievable points, and E shall be equal to or exceed 50% of the achievable points.

3.4 Requirements and validity of signature

To obtain signature, the sum of HW and A shall be equal to or exceed 50% of the achievable points.
In case of re-application for the subject the results obtained during the new semester overwrite the results obtained during any previous semesters (except for the examination course).
Semester results achieved earlier can be considered retroactively in the evaluation process of further semester in accordance to the rules of the Code of Studies and Exams (BME TVSZ).

3.5 Grading system

Grade	Points (P)
excellent (5)	85<=P
good (4)	75<=P<84,5%
satisfactory (3)	60<=P<74,5%
passed (2)	50<=P<59,5%
failed (1)	P<50%

3.6 Retake and repeat

1. Late submission of homework is possible till 12:00 on the last day of the supplementary week. For the effective schedule of the homework assignments and due dates, consult the detailed course schedule of the course on the subject website.
2. "Active involvement in lectures" A cannot be repeated, cannot be substituted with other forms of activity.

3.7 Estimated workload

Activity	Hours/semester
contact hours	14×2=28
preparation for the lectures	14×0.5=7
homework	25
home studying of the written materials	5
preparation for the exam	25

Fragility assessment - BMEEOHSDT71

Sum	90

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

Reinforced concrete modelling - BMEEOHSDT81

I. Subject Specification

1. Basic Data

1.1 Title

REINFORCED CONCRETE MODELLING

1.2 Code

BMEEOHSDT81

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	István Sajtos, PhD
academic rank	Associate professor
email	sajtos.istvan@epk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSDT81
https://edu.epito.bme.hu/course/view.php?id=2541

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

There are no subject prerequisites. Students participating in the course must be proficient in the design and analysis of reinforced concrete structures. The students should know the design principles and analysis methods of load-bearing structures based on Eurocode, and the basis of the finite element method. Intermediate English language knowledge is expected.

1.13 Effective date

1 September 2022

Reinforced concrete modelling - BMEEOHSDT81

2. Objectives and learning outcomes

2.1 Objectives

The aim of the PhD course is to gain knowledge on fracture mechanics based numerical modelling of concrete and reinforced concrete structures. The course will introduce the elements of reinforced concrete numerical modelling with the practical application possibilities and limitations. The effects of concrete constituents on capacity and ductility and their possible numerical models will be discussed The fracture mechanics-based models of reinforced concrete are also introduced (linear elastic-, and non-linear fracture mechanics models). Students who complete the course gain knowledge in the following topics:

- numerical modelling possibilities of reinforced concrete structures;
- linear and non-linear behaviour of concrete structures;
- numerical models of cracks;
- models of secondary effects; strain softening, dowel action; creep and shrinkage; size effect; aggregate interlock;
- effect of concrete constituents on capacity and ductility of concrete,
- models of cracks based on linear elastic fracture mechanics;
- models of cracks based on nonlinear fracture mechanics;
- models of crack propagation.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge
1. knows numerical modelling techniques,
2. knows linear and nonlinear behaviour of concrete structures,
3. knows numerical modelling possibilities of cracks,
4. knows the secondary effects: strain softening, dowel action; creep and shrinkage; size effect; aggregate interlock,
5. knows the effects and modelling possibilities of concrete constituents on strength and ductility of concrete,
6. knows linear elastic fracture mechanics models of cracks,
7. knows nonlinear fracture mechanics models of cracks,
8. knows the criteria of crack propagation.

B. Skills
1. able to apply numerical modeling techniques in practice,
2. able to design reinforced concrete structures based on a numerical model, selecting the appropriate model level and creating the numerical model,
3. able to carry out the designing of reinforced concrete structures based on the results of the numerical model, evaluate the results from a theoretical point of view,
4. able to model cracks in reinforced concrete structures and determine their effect on load-bearing capacity.

C. Attitudes
1. cooperates with the teacher and fellow students during the expansion of knowledge,
2. open to using numerical tools,
3. pursue to use of advanced design methods,
4. strives for accurate and error-free task solutions,

D. Autonomy and Responsibility
1. independently performs numerical modeling problems and designing of structures based on calculation results,

2. accepts and considers new designing procedures, their principles, and correctness with an open mind.

2.3 Methods

Lectures, practical analysis, communication in writing and orally, using IT tools and techniques.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction: micro-, meso-, macro models of concrete, reinforced concrete
2.	Models of reinforced concrete - linear elastic models
3.	Models of reinforced concrete - nonlinear behaviour models (discrete crack model, smeared crack model)
4.	Models of reinforced concrete - nonlinear models (secondary effects: softening for tension and compression, the effect of confinement, tension stiffening, aggregate interlock, shear friction, dowel action, size effect, creep and shrinkage)
5.	Structure of cement and concrete and its effect on the strength and ductility - uniaxial compression
6.	Structure of cement and concrete and its effect on the strength and ductility - uniaxial tension
7.	Structure of cement and concrete and its effect on the strength and ductility - shearing
8.	Structure of cement and concrete and its effect on the strength and ductility - multiaxial stress state
9.	Fracture mechanics of reinforced concrete - linear elastic models
10.	Fracture mechanics of reinforced concrete - nonlinear models
11.	Fracture mechanics of reinforced concrete - approximate non-linear fracture models

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) Books:

- S. Kumar - S.V. Barai: Concrete Fracture Models and Applications, Springer-Verlag, Berlin, 2011.
- J.G.M. van Mier: Fracture Processes of Concrete, CRC Press, 1997.
- B.L. Karihaloo: Fracture Mechanics of Concrete, Addison-Wesely Longman Ltd., 1995.
- A.R. Ingraffea: Computational Fracture Mechanics, Chp.11 in: ed. E Stein et al: Encyclopaedia of Computational Mechanics, Vol.2: Solids and Structures, John Wiley and Sons, 2004.
- R. Lackner et al: Computational Concrete Mechanics, Chp.15 in: ed. E Stein et al: Encyclopaedia of Computational Mechanics, Vol.2: Solids and Structures, John Wiley and Sons, 2004.
- Structural Concrete: Journal of the fib

b) Downloadable materials:

- Slides of lecture materials
- Kármán T.: Mitől függ az anyag igénybevétele? Magyar Mérnök és Építészegylet Közlönye, 44 (10), 1910, p.212-226.

2.6 Other information

Reinforced concrete modelling - BMEEOHSDT81

2.7 Consultation

Appointments for consultation:

according to the announcement on the department's web page, or

asking for an appointment in e-mail; e-mail: sajtos.istvan@epk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

Reinforced concrete modelling - BMEEOHSDT81

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The evaluation of the learning outcomes stated in point 2.2 is done on the basis of a project task (report) and the result shown in the exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework – project task (report)	HW	A.1-A.8; B.1-B.4; C.1-C.4; D.1-D.2
Exam (performance evaluation)	E	A.1-A.8; B.1-B.4; C.1-C.4; D.1-D.2

The time of the evaluations held during the semester is in the "Semester schedule", which is available on the subject's website.

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	20%
Sum during the semester	**20%**
E	80%
Sum	**100%**

The condition for passing the subject is that the student achieves 50% of the scores on the homework.
Insufficient performance in the exam will result in a fail grade.

3.4 Requirements and validity of signature

The condition for obtaining the signature is that, according to point 3.3, the student achieves at least 50% of the points that can be obtained during the semester on the homework.

Mid-semester results previously obtained from the subject, which can be taken into account when determining the exam grade, can be accepted for up to 6 semesters.

3.5 Grading system

The grades of those who meet the attendance requirements are determined according to the following criteria:
The final grade is calculated based on the weighted average of the homework and the exam according to point 3.3:

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

According to the Study Rules.

3.7 Estimated workload

Activity	Hours/semester
attendance of the lectures	12×2=24
preparing project task	36
self- learning of written course material	6
preparing for exam	24
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

MECHANICS OF COMPOSITES

1.2 Code

BMEEOHSDT82

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	Kollár László
academic rank	Professor
email	kollar.laszlo@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSDT82
https://edu.epito.bme.hu/course/view.php?id=5442

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

2 February 2022

Mechanics of composites - BMEEOHSDT82

2. Objectives and learning outcomes

2.1 Objectives

Understanding the behavior of structures made of composite material. Importance of manufacturing, material properties, role of constituents. Why to use and not to use. Modelling of beams, plates and the simple structures. The most important assumptions of numerical solutions are introduced. Understanding failure of composites. See detailed topics.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. will learn the methods of structural design and calculation of composite structure
2. will learn the behaviour of composite structures,
3. will learn the typical behaviour of composite plates and beams
4. will learn the calculation of failure,
5. It is expected that students are capable to analyze a simple composite structure, and after learning a FE code, even a complex structure

B. Skills

1. The focus is on understanding, and on capability to apply the knowledge to new problems
2. see knowledge and topics,

C. Attitudes

1. cooperates with the lecturer and with fellow students,
2. is ready to apply numerical computational tools,
3. is intent on understanding the behaviour of composite structures,
4. is intent on problem solving,
5. is attending to the classes as a responsible member of the community.

D. Autonomy and Responsibility

1. is open to the new information,
2. is able to think in system.

2.3 Methods

Lectures and oral communications, hoping the active contribution of students

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Introductions: definition of composites, types, materials, why to use, typical examples, mayor differences compared to traditional building materials, manufacturing
2.	cont.
3.	Material law: anisotropic-, orthotropic- transversely isotropic-, isotropic materials, constrains on engineering constants
4.	cont.
5.	Micromechanics: rule of mixtures, improvements, Halpin-Tsai equation,
6.	cont.
7.	Macromechanics: theory of thin laminated plates, A-B-D matrices, special layups
8.	cont.
9.	Failure criteria: maximum stress and strain, quadratic

	(Tsai-Wu), composite plate with holes
10.	cont.
11.	Composite structures: plates, pressure vessel, composite beams (tension, bending, shear, torsion)
12.	cont.
13.	Stability analysis: plate buckling, column buckling, local buckling of thin walled beams
14.	cont.

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

- Kollár and Springer: Mechanics of Composite Structures, Cambridge University Press, 2004.

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

2025/2026 semester II

Mechanics of composites - BMEEOHSDT82

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
		A.1-A.5; B.1-B.2; C.1-C.5; D.1-D.2

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

2 February 2022

This Subject Datasheet is valid for:

2025/2026 semester II

Computational analysis and design - BMEEOHSDT85

I. Subject Specification

1. Basic Data

1.1 Title

COMPUTATIONAL ANALYSIS AND DESIGN

1.2 Code

BMEEOHSDT85

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	9
Seminar	4
Consultation	1

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Balázs Kövesdi
academic rank	Associate professor
email	kovesdi.balazs@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSDT85
https://edu.epito.bme.hu/course/view.php?id=5443

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

There are no subject prerequisites. Students participating in the course must be proficient in the design of steel and reinforced concrete structures, especially in the dimensioning of bridge structures. Students must know the basics of structural design based on Eurocode, the theoretical and practical basics of structural design, and the basics of the finite element method. Required knowledge of the English language: intermediate B2 level.

1.13 Effective date

1 September 2022

Computational analysis and design - BMEEOHSDT85

2. Objectives and learning outcomes

2.1 Objectives

The purpose of the PhD course is to describe the application of advanced numerical modeling and experiment-based design of steel structures. In the framework of the course, the most advanced numerical modeling-based design procedures applicable in the current steel structural design, their practical applicability and limitations will be presented. In addition, methods of the correct application of experimental results supplementing numerical modeling-based design is introduced. Various experimental-based model validation techniques and design process development procedures are also presented. The practical applicability of the advanced design procedures is presented through examples of bridge structures. The course includes an explanation of the applicability of advanced numerical methods in the production technology of steel structures and welding simulation. Students who complete the course acquire knowledge in the following topics:

- application of advanced numerical modeling techniques in civil engineering structures;
- finite element model-based design of bridge structures and numerical simulation of modern bridge construction methods;
- components of bridge monitoring systems, design and application of their measurement results;
- application of experimental and/or measurement results in the design of steel structures;
- development of Eurocode-based design procedures based on numerical simulation and experiments;
- manufacturing technology developments based on numerical modeling - welding simulation.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows advanced numerical modeling techniques,
2. knows the options for finite element model-based design of bridge structures and how to use them,
3. knows the components of bridge monitoring systems, the applicability of measurement results in design,
4. knows the possibility of developing Eurocode-based design procedures based on numerical simulation and experiments,
5. knows the possibilities of numerical modeling-based production technology developments (e.g. welding simulation) and their applicability in design.

B. Skills

1. able to apply advanced numerical modeling techniques in practice,
2. capable of advanced, numerical model-based modeling of steel structures, selecting the appropriate model level and creating the numerical model,
3. able to perform steel structural design based on the results of the numerical model, evaluate the results from a design theory point of view,
4. is able to take numerical model-based production technology innovations into account in the design process.

C. Attitudes

1. cooperates with the lecturer and fellow students in expanding knowledge,
2. open to the use of numerical tools,
3. open to the use of advanced sizing methods,
4. strives for accurate and error-free task solutions.

D. Autonomy and Responsibility

1. Independently thinks through the numerical modeling problems and design of steel structures based on the calculation results,
2. accepts and considers new dimensioning procedures with an open mind, their principles and correctness.

Computational analysis and design - BMEEOHSDT85

2.3 Methods

Lectures, calculation exercises, project assignment, written and oral communication, use of IT tools and techniques.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Introduction - application of advanced numerical modeling techniques for civil engineering structures
2.	Finite element model-based design - basic assumptions and design methods
3.	Finite element model-based design of bridge structures, accurate calculation methods
4.	Development and numerical simulation of modern bridge construction methods
5.	Advanced numerical model-based fatigue assessment of bridge structures
6.	Development of Eurocode-based design procedures using numerical analysis
7.	Modelling of cyclic behaviour in the design of steel grades
8.	Structural analysis based on monitoring systems and measurement methods, processing and application of measurement results
9.	Production technology developments with numerical simulation - description of the welding simulation process - its theoretical background and application
10.	Project work description - presentation of numerical model-based design examples

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. L. Dunai; B. Kövesdi (Lecture notes): Numerical model based design - slideshows.
2. ECCS: Commentary and worked examples to EN 1993-1-5 "Plated Structural Elements".
3. B. Johannson, R. Maquoi, G. Sedlacek, C. Müller, D. Beg: Commentary and worked examples to EN 1993-1-5 "plated structural elements", Joint report, JRC Scientific and Technical Reports, First Edition, 2007.
4. prEN 1993-1-14: Eurocode 3 - Part 1-14: "Design assisted by finite element analysis", CEN.

2.6 Other information

2.7 Consultation

At a pre-arranged time with the course coordinator (Dr. Balázs Kövesdi, kovesdi.balazs@emk.bme.hu) and lecturer (Dr. László Dunai, dunai.laszlo@emk.bme.hu).

This Subject Datasheet is valid for:

2025/2026 semester II

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The learning outcomes stated in point 2.2 are evaluated on the basis of a project work and the result shown in the exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Project work	HF	A.1-A.4; C.1-C.4
Exam	V	A.1-A.5; B.1-B.4; D.1-D.2

The exact time of the evaluations held during the semester, and the deadlines for homework assignments and submissions, are contained in the "Detailed Semester Timetable", which is available on the subject's website. 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
HF	20%
V	80%
Sum	**100%**

The condition for passing the subject is that the student achieves 50% of the available score on the homework. Insufficient performance in the exam will result in an Insufficient grade.

3.4 Requirements and validity of signature

The condition for obtaining the signature is that the student submits the project assignment.
Midterm results previously obtained from the subject, which can be taken into account when determining the exam grade, can be accepted retroactively for up to 6 semesters.

3.5 Grading system

Grade	Points (P)
excellent (5)	$80 <= P$
good (4)	$70 <= P < 80\%$
satisfactory (3)	$60 <= P < 70\%$
passed (2)	$50 <= P < 60\%$
failed (1)	$P < 50\%$

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
lectures	10×2=20
project work	5×10=50
preparation for exam	1×8=8
independent learning of designated written curriculum	12
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

SEISMIC DESIGN PRINCIPLES

1.2 Code

BMEEOHSDT86

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	Kollár László
academic rank	Professor
email	kollar.laszlo@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSDT86
https://edu.epito.bme.hu/course/view.php?id=2546

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

2 February 2022

Seismic design principles - BMEEOHSDT86

2. Objectives and learning outcomes

2.1 Objectives

Understanding the behavior of structures subjected to earthquakes. Importance of ductility. Modelling of steel structures. Design methods and their interpretation in the EC. Design principles.
See detailed topics.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. will learn the methods of earthquake resistant design
2. will learn the behavior of structures subjected to earthquake
3. will learn the typical seismic analyses
4. will learn the to design for ductility
5. will learn basic seismic design principles

B. Skills

1. The focus is on understanding, and on capability to apply the knowledge to new problems
2. see knowledge and topics,

C. Attitudes

1. cooperates with the lecturer and with fellow students,
2. ready to apply numerical computational tools,
3. is intent on understanding the behavior of structures subjected to eaerthquakes,
4. is intent on problem solving,
5. is attending to the classes as a responsible member of the community.

D. Autonomy and Responsibility

1. is open to the new information,
2. is able to think in system.

2.3 Methods

Lectures and oral communications, hoping the active contribution of students

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Earthquakes: sources, plate tectonics, messages of Karl Popper and Thomas Kuhn, measuring (scale and magnitude), seismic waves.
2.	Basics of vibration: basic notions, free and forced vibration, sources and role of damping, resonance, MDOF and continuous systems, summation theorems to calculate the eigenfrequency, modal analysis.
3.	cont.
4.	Design methods: basic methods in EC, support excitation by non-harmonic motion, amplification factors and response spectrum, response spectrum analysis, capacity design, performance based seismic engineering.
5.	cont.
6.	Design principles: messages of EC, favorable and unfavorable structures, Hugo Bachmann's advices, numerical considerations (based on Hugo Bachmans's advices).

7.	cont.
8.	Seismic resistant steel frames, development of design methodology, basic definitions and principles, structural damage definitions and parameters.
9.	cont.
10.	Dissipative structural typologies, dissipative joints and elements, behavior factor, capacity design approach.
11.	Global ductility of moment resistant frames, definitions, parameters affecting global ductility, illustration by examples, methods to determine global ductility.
12.	Local ductility of structural elements and joints, definitions, illustration by two-flange model, role of plastic plate buckling, methods to determine local ductility, cyclic ductility.
13.	Evaluation of behavior factor (q-factor) on the basis of global and local ductility.
14.	cont

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

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

Seismic design principles - BMEEOHSDT86

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
		A.1-A.5; B.1-B.2; C.1-C.5; D.1-D.2

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

2 February 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

FUNCTIONAL ANALYSIS

1.2 Code

BMEEOTMDT71

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	Kovács Flórián
academic rank	Associate professor
email	kovacs.florian@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT71
https://edu.epito.bme.hu/course/view.php?id=2554

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2017

Functional Analysis - BMEEOTMDT71

2. Objectives and learning outcomes

2.1 Objectives

The aim of the subject is to give mathematical formulation for concepts widely used in engineering, more specifically, in structural analysis: proving the existence and uniqueness of solutions to problems that are intuitively accepted in the procedure of the design.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the definitions of some basic mathematical concepts (linear space, operator, norm, convergence, distribution, boundary value problem).

B. Skills

1. is able to identify mathematical structures beyond engineering problems,
2. is able to use the concepts of strong and weak solutions to a BVP in structural analysis,
3. is able to consider mechanical problems in an abstract approach.

C. Attitudes

1. aims at strict logical problem-solving.

D. Autonomy and Responsibility

1. is able to individually think over boundary value problems.

2.3 Methods

1. Lectures with theoretical knowledge and computational examples

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Vector spaces, subspaces, linear manifolds
2.	Dimension, spanning sets, and (algebraic) basis
3.	Linear operator
4.	Normed spaces
5.	Convergence, complete spaces
6.	Continuous and bounded linear operator
7.	Dense sets, separable spaces
8.	Inner product, Hilbert space
9.	Sets of measure zero, measurable functions
10.	The space L2
11.	Generalized derivatives, distributions, Sobolev spaces
12.	Weak (or generalized) solutions
13.	Orthogonal systems, Fourier series
14.	The projection theorem, the best approximation

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

- Popper, Gy.: Some concepts of functional analysis using Mathematica.
- Lecture notes, BME (2006).

2.6 Other information

2.7 Consultation

The instructor is available for consultation during office hours. Special appointments can be requested via e-mail: kovacs.florian@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

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
		A.1; B.1-B.3; C.1; D.1

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév
Összesen	

3.8 Effective date

1 September 2017

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

MATERIAL MODELS IN MECHANICS

1.2 Code

BMEEOTMDT72

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. Tóth Brigitta
academic rank	Associate professor
email	toth.brigitta@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT72
https://edu.epito.bme.hu/course/view.php?id=5440

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Material Models in Mechanics - BMEEOTMDT72

2. Objectives and learning outcomes

2.1 Objectives

The modeling of different materials is one of the most difficult questions of mechanics. This lecture explains the basic (micro and macro) physical reasons of the different material behaviors, starting from the elastic state until the (plastic and/or fracturing) collapse. It introduces the thermodynamical principles of the constitutive equtaions, explains the different micromechanical and phenomenological modeling of material behaviors and their numerical applications for the different finite element simulations too.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

  1. A general theoretical overview about the different versions of engineering material models and the knowledge of the applicability of these models in the engineering design processes.

B. Skills

  1. The correct application of the material models in the different engineering problems,
  2. The knowledge of the conditions of the good applications.
  3. The ability of the selection among the advantageous or/and disadvantaged material models.

C. Attitudes

  1. Individually creates linear and nonlinear elastic, elasto-plastic and fracturing material models in case of practical engineering problems.

D. Autonomy and Responsibility

  1. Endeavors to discover and routinely use the tools necessary to the problem solving of material modeling of mechanics.
  2. Endeavors to the precise and error-free problem solving for material modeling.

2.3 Methods

Presentations.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	The history of the material modeling, the new trends.
2.	The effect of the microstucture for the material behaviors.
3.	The basic strength parameters in the function of the microstructure.
4.	The basic physical charactereistics of the material models. Micromodels.
5.	The classification of the elastic material models. The Cauchy models.
6.	The Green hyperelastic models. The stability conditions of the constitutive equations.
7.	The large strain hyperelastic models. Hypoelastic models.
8.	The basic parameters of the plastic behavior. The yield and hardening conditions. The deformation theory.
9.	The incremental theory of the plasticity . The effect of the large plastic strains.
10.	Return mapping algorithms. Te special version of quasi-static and cyclic models of elastic-plastic metals.
11.	Elastic-plastic models of the concretes and soils.

12.	Complex models of rigid materials. The models of continuum damage mechanics.
13.	Speficic models of CDM.
14.	Paremeter determination of the material models.

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

- Bojtar: Material models. Lecture notes.
- Ashby-Jones: Engineering materials 1-3. Elsevier.
- Callister: Material science and engineering. John Wiley.

2.6 Other information

2.7 Consultation

At the appointed time.

This Subject Datasheet is valid for:

2025/2026 semester II

Material Models in Mechanics - BMEEOTMDT72

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Oral exam	1	A.1; B.1, B.2, B.3; C.1; D.1, D.2

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
1	100
Összesen	**100%**

3.4 Requirements and validity of signature

The succesfull oral exam.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	100-86
jó (4)	85-70
közepes (3)	69-60
elégséges (2)	59-50
elégtelen (1)	<50

3.6 Retake and repeat

If it is necessary, the oral exam should be repeated.

3.7 Estimated workload

Tevékenység	Óra/félév
Individual work.	40
Összesen	**40**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

NUMERICAL METHODS

1.2 Code

BMEEOTMDT73

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. Németh Róbert
academic rank	Associate professor
email	nemeth.robert@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT73
https://edu.epito.bme.hu/course/view.php?id=2556

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

5 February 2020

Numerical Methods - BMEEOTMDT73

2. Objectives and learning outcomes

2.1 Objectives

Extend the knowledge of linear algebra by understanding the algorithmic properties of typical numerical methods

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

    1. knows the basic methods for the solution of typical civil engineering problems

B. Skills

    1. is able to formulate the basic algorithms

C. Attitudes

    1. ready to learn

D. Autonomy and Responsibility

    1. is autonomous

2.3 Methods

Lecture presentation of the deivation of algorithms

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Review of linear algebra 1.
2.	Review of linear algebra 2.
3.	Non-homogeneous linear equations - Factorization methods 1.
4.	Non-homogeneous linear equations - Factorization methods 2.
5.	Non-homogeneous linear equations - iterative methods 1.
6.	Non-homogeneous linear equations - iterative methods 2.
7.	Eigenvalue problems - manual solution, power iteration
8.	Eigenvalue problems - inverse iteration, subspace iteration
9.	Eigenvalue problems - Rayleigh-Ritz method, polynomial iteration
10.	Eigenvalue problems - transformation methods
11.	Nonlinear equations - minimization in 1D, Newton-type methods
12.	Nonlinear equations - gradient-type methods
13.	Nonlinear equations - Gaussian section, Quasi-Newton methods, Implicit Function Theorem
14.	Summary

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

- Gene H. Golub - Charles F. Van Loan: Matrix Computations, The Johns Hopkins University Press, Baltimore, 2013

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: nemeth.robert@epito.bme.hu.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

There is an oral exam, where the student presents the solution of a numerical problem from his/her research, then related questions must be answered.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Oral exam	E	A.1; B.1; C.1; D.1

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

Presence on the lectures

3.5 Grading system

Grade	Points (P)
excellent (5)	90=P
good (4)	75<=P<90
satisfactory (3)	65<=P<75
passed (2)	50<=P<65
failed (1)	P<50

3.6 Retake and repeat

There is no retake

3.7 Estimated workload

Activity	Hours/semester
participation on the lectures	14×2=28
homeworks	14×0.5=7
preparation for the exam	55
Sum	**90**

3.8 Effective date

5 February 2020

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

MECHANICS OF MASONRY STRUCTURES

1.2 Code

BMEEOTMDT81

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. Bagi Katalin
academic rank	Professor
email	bagi.katalin@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT81
https://edu.epito.bme.hu/course/view.php?id=2557

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Mechanics of Masonry Structures - BMEEOTMDT81

2. Objectives and learning outcomes

2.1 Objectives

The course consists of two main parts. The first part introduces those methods that are particularly suitable for the analysis of masonry arches and vaults. The second part gives an overview on the most important types of masonry arches and vaults, with their typical crack patterns.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows what are the special features of masonry as a building material, in comparison to other types of construction materials (concrete, steel, etc)
2. understands the fundaments of graphical statics
3. knows how to analyse a system of solid bodies with the help of graphical statics
4. knows the most important graphostatic methods of masonry analysis
5. knows the main shell theories (membrane, Kirchhoff-Love, Mindlin-Reissner, higher order shear theories)
6. knows the two theorems of Limit State analysis and understands the limitations of their applications
7. knows what is a discrete element model and what are the main advantages and disadvantages of the different DEM techniques
8. knows what are the most important types of masonry vaults, how they carry and distribute their loads, and what are their typical crack pattern

B. Skills

1. is able to recognize the main types of vaults and arches;
2. is able to approximate the internal forces and the main crack patterns under selfweight for any of the considered vaults;
3. is able to select the most appropriate method that fits to the analysed problem;
4. is able to express his/her thoughts in an organized way in oral and written communication.

C. Attitudes

1. aims at learning and routinely using tools required for solving masonry mechanics problems,
2. aims at accurate and flawless problem solving

D. Autonomy and Responsibility

1. is able to individually think over masonry mechanics problems and to solve them using the given resources,
2. is open to valid criticism.

2.3 Methods

Lectures, oral and written communication, use of IT devices and techniques, optional practice problems solved individually and in teams (home practice).

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Fundaments of masonry mechanics
2.	Graphic methods I.
3.	Graphic methods II.
4.	Shell theories
5.	Limit state analysis
6.	The Discrete Element Method
7.	Summary 1
8.	Arches
9.	Domes

Mechanics of Masonry Structures - BMEEOTMDT81

10.	Barrel vaults and cross vaults
11.	Fan vaults
12.	Other types of vaults
13.	Students presentations
14.	Summary 2

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 for every class are available on the course website. Suggested literature can be found here.

2.6 Other information

Attendance at lectures is compulsory.

Students failing to prove to have attended at least 70% of the lectures based on their records of absences cannot obtain registry other than "Megtagadva" or "Nem teljesítette".

Students attending checks must not communicate with others during the check without explicit permission, and must not hold any electronic or other communication device switched on.

2.7 Consultation

The instructor is available for consultation in Teams or in personal presence. Special appointments can be requested via e-mail: bagi.katalin@emk.bme.hu .

This Subject Datasheet is valid for:

Inactive courses

Mechanics of Masonry Structures - BMEEOTMDT81

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The evaluation of learning outcomes described in Section 2.2. is based on two mid-term exams. The dates of the mid-term exams can be found in the "Detailed semester schedule" on the website of the subject.
A mid-term exam is successful if the scores reach or exceed 50%.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
1st mid-term exam	MT1	A.1-A.7
2nd mid-term exam	MT2	A.8; B.1-B.4; C.1-C.2; D.1-D.2

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
MT1	50%
MT2	50%
Sum	100%

3.4 Requirements and validity of signature

To obtain a signature, all of the following requirements must be fulfilled:

- comply with the requirements on attendance, and
- both mid-term exams have to be successful.

3.5 Grading system

In the case of complying with the requirements on attendance, the results are determined as follows.
In the case of both mid-term exams being successful, the final result is computed by the weighted average points (P) of the two mid-term exams:

Grade	Points (P)
excellent (5)	$80\% \leq P$
good (4)	$70\% \leq P < 80\%$
satisfactory (3)	$60\% \leq P < 70\%$
passed (2)	$50\% \leq P < 60\%$
failed (1)	$P < 50\%$

3.6 Retake and repeat

Both mid-term tests can once be retaken during the education period or during the repetition week. If one of the mid-term exams remains unsuccessful after the retake, one further retake can be done during the examination period. This option does not exist if both midterm exams remain unsuccessful by the end of the repetition week.

3.7 Estimated workload

Activity	Hours/semester
contact lessons	14×2=28
preparation for lessons during the semester	12×3=36
preparation for the check	2×13=26
Sum	90

3.8 Effective date

1 September 2022

Mechanics of Masonry Structures - BMEEOTMDT81

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

THIN WALLED STEEL STRUCTURES

1.2 Code

BMEEOTMDT82

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. Ádány Sándor
academic rank	Professor
email	adany.sandor@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT82
https://edu.epito.bme.hu/course/view.php?id=2558

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The aim of the subject is to discuss the behaviour of thin-walled members, particularly that of cold-formed steel members. Special emphasis is given to stability behaviour, as well as to state-of-the-art numerical methods that can beneficially used in stability analysis.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the most important specialties of cold-formed steel members,
2. knows the characterizing behaviour types of cold-formed steel members,
3. knows the characteristics of the typical buckling types of thin-walled members,
4. knows the special numerical methods that can beneficially applied in the stability analysis of thin-walled members, and understands the basic concepts of these methods,
5. understands the design approaches for stability of cold-formed steel members,
6. understands the basics of Eurocode design for cold-formed steel members.

B. Skills

1. is able to use special numerical methods for the stability analysis of thin-walled members,
2. is able to perform design calculations for cold-formed steel members,
3. is able to individually research a topic related to thin-walled members, by collecting and evaluating relevant background literature,
4. is able to prepare a summary/presentation on a topic related to thin-walled members.

C. Attitudes

1. openness to elaborate new problems,
2. awareness of the importance of knowing the mechanical/mathematical background of numerical/design procedures/tools,
3. awareness of the importance of seemingly small (mechanical/mathematical) details when approaching a practical problem.

D. Autonomy and Responsibility

1. completing literature review individually,
2. elaboration a topic individually,
3. preparation a scientific presentation individually.

2.3 Methods

Lectures, and individual work: preparation of a summary/presentation on a selected topic.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Cold-formed steel members. CFS products, applications. Characteristics of CFS members. Design concepts for stability.
2.	Introduction to stability analysis. Illustration on Euler column buckling.
3.	The semi-analytical finite strip method, with sin-cos longitudinal functions.
4.	Signature curve.
5.	Generalization of shape functions.
6.	The constrained finite strip method (cFSM). Examples.
7.	cFSM interpretation, generalization, application.
8.	The constrained finite element method (cFEM). From

	cFSM to cFEM. Constraining a shell element. Constraining one band. Constraining a member. Examples.
9.	The spline finite strip method.
10.	CFS design. EC3 basics for CFS. Effective cross-section. Cross-section checks. Stability checks. Purlin design.
11.	Flange curling. Shear lag.
12.	Web breathing. Special fastening techniques in cold-formed steel structures.
13.	Behaviour and design of cold-formed steel members and sheets subjected to direct transverse forces.
14.	Summary

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

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
exam	E	A.1-A.6; B.1-B.4; C.1-C.3; D.1-D.3

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
E	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points (P)
excellent (5)	
good (4)	
satisfactory (3)	
passed (2)	
failed (1)	

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
Sum	

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

I. Subject Specification

1. Basic Data

1.1 Title

STRUCTURAL OPTIMIZATION

1.2 Code

BMEEOTMDT83

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. Lógó János
academic rank	Professor
email	logo.janos@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDT83
https://edu.epito.bme.hu/course/view.php?id=5438

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Structural Optimization - BMEEOTMDT83

2. Objectives and learning outcomes

2.1 Objectives

The purpose of the subject is, that the students acquire the basic concepts and methods of structural optimization. In the frame of this they will get to know the mathematical background. Namely: optimality conditions and duality with coverage of the nature, interpretation, and value of the classical Fritz John (FJ) and the Karush-Kuhn-Tucker (KKT) optimality conditions; the interrelationships between various proposed constraint qualifications; and Lagrangian duality and saddle point optimality conditions

Algorithms and their convergence, with a presentation of algorithms for solving both unconstrained and constrained linear and nonlinear programming problems.

Optimality criteria methods. Minimum weight design. Fundamental theories in topology optimization. Stress-constrained topology optimization. Governing equations. The "singularity problem" in stress-constrained optimization. Handling of constraints via local and global approaches. Mixed finite elements for the optimal design of structures. The displacement-based FEM. Analysis and design of no-tension structures, by formulating optimization problems. A constrained force density method (FDM).

Energy-based method, based on topology optimization, for the finite element analysis of no-tension solids (walls and vaults).

Overview of the currently used methods in SHM: Damage-sensitive sensor placement for sparsity constrained optimization; Modelling of damage in circular flange bolted connections.

Numerical Methods in Probabilistic Topology Optimization.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the fundamental mathematical theories of operational calculus,
2. knows the fundamental theories of structural design of elastic bar structures with the displacement method in matrix algebraic formulation,
3. knows the fundamental theories of structural design of elasto-plastic bar structures with the displacement method in matrix algebraic formulation,
4. knows the knows the fundamental theories of structural design of elastic membrane structures in matrix algebraic formulation,
5. knows the derivations of the optimality conditions of different structural models and their mathematical formulations,
6. knows the main steps of the finite element based optimization ,
7. knows the main steps of the finite element based topology optimization,
8. knows the main steps of the finite element based stress-constrained topology optimization
9. knows the main steps of the finite element based probabilistic topology optimization,

B. Skills

1. is able to derive the general formulas describing a structural optimization problem by the use of elasto-plastic materials,
2. is able to derive optimality condition in topology design
3. is able to solve a linear programming problem by the use of simplex method,
4. derives the static theorem of the constant stress of plasticity, and uses it accordingly,
5. derive the static theorem of plastic limit state analysis, and applies it to beam structures,
6. speaks out the kinematic theorem of plastic limit state analysis, and applies it to beam structures,
7. derives the fundamental formulations of topology design of membrane structures
8. derives the fundamental formulation of topology design of membrane structures by the use of stress constraints
9. shows the shakedown analysis with its static theorem and applies it for the shakedown analysis of a beam structure,

C. Attitudes

1. co-operates with the teachers in improving his/her knowledge,

2. expands his/her knowledge by constant learning,
3. endeavors to discover and routinely use the tools necessary to the problem solving of optimization problems,
4. aspires to prepare a well-organized documentation in writings, and pursues the precise self-expression in oral communication
5. is open to the use of IT devices

D. Autonomy and Responsibility

1. is able to individually think over the extremum problems of structural mechanics and to solve them using the given resources,
2. is open to valid criticism,
3. applies a systematic approach in his/her reasoning

2.3 Methods

Lectures with theoretical knowledge and computational examples, written and oral communication, use of IT devices and techniques, optional practice problems solved individually.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Optimization of structures: basics. Governing equations. Problem formulation.
2.	Solution of the minimization problem. Applications.
3.	Stress-constrained topology optimization. Governing equations.
4.	The "singularity problem" in stress-constrained optimization. Handling of constraints via local and global approaches.
5.	Problem formulations. Applications.
6.	Mixed finite elements for the optimal design of structures. The displacement-based FEM.
7.	The use of "truly-mixed" fem is investigated to address specific applications.
8.	Analysis and design of no-tension structures, by formulating optimization problems. A constrained force density method (FDM).
9.	Energy-based method, based on topology optimization, for the finite element analysis of no-tension solids (walls and vaults).
10.	Introduction to Structural Health Monitoring
11.	Overview of the currently used methods in SHM: Damage-sensitive sensor placement for sparsity constrained optimization; Modelling of damage in circular flange bolted connections.
12.	Overview of the currently used methods in SHM: Detectability of loosened bolts in lap connections. Substructural methods for damage localization in skeletal structures.
13.	Reviewing Numerical Methods in Probabilistic Topology Optimization
14.	Summary

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

Structural Optimization - BMEEOTMDT83

a) Suggested readings:

- [Mokhtar S. Bazaraa](), [Hanif D. Sherali](), [C. M. Shetty](): Nonlinear Programming: Theory and Algorithms, 3rd Edition, Wiley, ISBN: 978-0-471-48600-8
- Prekopa A: Stochastic Programming, ISBN-13: 978-0792334828
- Kirsch, U. : Structural Optimization. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-84845-2_1

b) Online materials:

- on the website of the subject https://edu.epito.bme.hu/course/view.php?id=5438

c) Lecture notes:

- on the website of the subject https://edu.epito.bme.hu/course/view.php?id=5438

2.6 Other information

The exam is a ppt. presentation . Topic is a virtual optimization work based on the own research activity.

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail

This Subject Datasheet is valid for:

2025/2026 semester II

Structural Optimization - BMEEOTMDT83

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The exam is a ppt. presentation . Topic is a virtual optimization work based on the own research activity.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
ppt presentation	ppt	A.1-A.9; B.1-B.9; C.1-C.5; D.1-D.3

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
ppt. presentation	100%
Sum	**100%**

3.4 Requirements and validity of signature

Attending the classes

3.5 Grading system

Grade	Points (P)
excellent (5)	80%≤P
good (4)	70%≤P<80%
satisfactory (3)	60%≤P<70%
passed (2)	50%≤P<60%
failed (1)P	<50%

3.6 Retake and repeat

general rules of study are apply

3.7 Estimated workload

Activity	Hours/semester
contact lessons	14×2=28
preparation for lessons during the semester	14×2=28
preparing to exam	34
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

2025/2026 semester II

I. Subject Specification

1. Basic Data

1.1 Title

CABLE AND TENSILE MEMBRANE STRUCTURES

1.2 Code

BMEEOTMDTV1

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. Hincz Krisztián Gyula
academic rank	Associate professor
email	hincz.krisztian@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDTV1
https://edu.epito.bme.hu/course/view.php?id=2560

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Cable and Tensile Membrane Structures - BMEEOTMDTV1

2. Objectives and learning outcomes

2.1 Objectives

The aim of the subject is to introduce the fundamental concepts of the design and analysis of tensile structures. The main structural types, the different materials, and the most often used numerical methods are introduced. The formfinding methods, the cutting pattern generation, and the structural analysis of membrane structures are presented in detail.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the main structural groups of tensile structures
2. knows the advantages and disadvantages of the different tensile structures
3. knows the main steps of the design and analysis of tensile structures
4. knows the most often used numerical methods for the analysis of tensile structures
5. knows the main properties of the membrane materials

B. Skills

1. can design basic membrane structures

C. Attitudes

1. aims at accurate and flawless problem solving

D. Autonomy and Responsibility

1. is able to individually think over structural design problems of tensile structures and to solve them using the given resources

2.3 Methods

Lectures with theoretical knowledge and computational examples, written and oral communication, use of IT devices and techniques, optional practice problems solved individually.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	Tensile structures, Introduction
2.	Cables, cable nets
3.	Membrane structures, Inflated structures
4.	Tensile membrane structures, design steps
5.	Formfinding, numerical methods
6.	Cutting pattern generation
7.	Static analysis
8.	Wind load, wind tunnel tests
9.	Wind load, CFD
10.	Membrane materials
11.	Membrane materials
12.	Model making
13.	Model making
14.	Preliminary examination

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

2.6 Other information

2.7 Consultation

The instructor is available for consultation during office hours, as advertised on the department website. Special appointments can be requested via e-mail: hincz.krisztian@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

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Oral exam	V	A.1-A.5; B.1; C.1; D.1

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
V	100%
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points
excellent (5)	80-100
good (4)	70-79
satisfactory (3)	60-69
passed (2)	50-59
failed (1)	0-49

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
contact lessons	28
preparation for the exam	28
Sum	**56**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses

I. Subject Specification

1. Basic Data

1.1 Title

FRACTURE MECHANICS

1.2 Code

BMEEOTMDTV2

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. Lakatos Éva
academic rank	Associate professor
email	lakatos.eva@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMDTV2
https://edu.epito.bme.hu/course/view.php?id=2561

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

Fracture Mechanics - BMEEOTMDTV2

2. Objectives and learning outcomes

2.1 Objectives

This lecture explains the basic (micro and macro) physical reasons of the different crack problems of the engineering structures, starting from the elastic and homogeneous situations until the plastic and/or nonhomogeneous (granular, reinforced) materials. It introduces the continuummechanical aspects of the numerical simulations and explains the different micromechanical and phenomenological modeling of crack problems. Very important part of the lecture is the numerical analysis of the crack behavior (application of the finite element solution) and the discussion of the fatigue effect for the crack propagation.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. General theoretical overview about the different versions of engineering crack models.
2. The knowledge of the applicability of these models in the engineering design processes.

B. Skills

1. The correct application of the fracture mechanical models in the different engineering problems,
2. The knowledge of the conditions of the application of models of the fracture mechanics.
3. The ability of the selection among the different crack propagation models.

C. Attitudes

1. Individually creates linear and nonlinear elastic, elasto-plastic and fracturing material models in case of practical fracture mechanical problems.

D. Autonomy and Responsibility

1. Endeavors to discover and routinely use the tools necessary to the problem solving of fracture mechanical modeling.
2. Endeavors to the precise and error-free problem solving for fracture mechanical problems.

2.3 Methods

Presentations and discussion of different scientific papers.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	The basic principles and the history of fracture mechanics.
2.	The fracture and the internal microstructure of material.
3.	Stress functions for analysis of crack tops.
4.	Stress intensity factor.
5.	Application of energy methods for analysis of cracks.
6.	Analysis of cracks at elastic-plastic materials. Other methods.
7.	Laboratory experiments for determination of K, J and CTOD.
8.	Numerical methods in the fracture mechanics.
9.	Quasi-static strength analysis in the fracture mechanics. Special effects.
10.	Analysis of cyclic loading in fracture mechanics.
11.	Analysis of cracks in quasi-brittle (concrete, rock, etc.) materials.
12.	Analysis of fracture of wood structures.

13.	Presentations of the students" state reports.
14.	Preparation for the oral exam.

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

- Bojtár: Fracture Mechanics. Lecture notes.
- Anderson: Fracture Mechanics. CRC Press.
- Miushelisvili: Some basic problems of the mathematical theory of the elasticity. Nordhoff Publishers.

2.6 Other information

2.7 Consultation

Consultations are possible in every periods of the semester.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

Oral exam.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Oral exam	1	A.1, A.2; B.1, B.2, B.3; C.1; D.1, D.2

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
1	100
Összesen	**100%**

3.4 Requirements and validity of signature

A minimum presence of 70% is required to gain a signature.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	100-86
jó (4)	85-70
közepes (3)	69-60
elégséges (2)	59-50
elégtelen (1)	<50

3.6 Retake and repeat

A repetation is necessary **in case of a failed exam.**

3.7 Estimated workload

Tevékenység	Óra/félév
Individual work	40
Összesen	**40**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses