Numerical Methods in Geotechnics - BMEEOGMMB61

I. Subject Specification

1. Basic Data

1.1 Title

Numerical methods in geotechnics

1.2 Code

BMEEOGMMG63

1.3 Type

Module with associated contact hours

1.4 Contact hours

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

1.5 Evaluation

Midterm grade

1.6 Credits

3

1.7 Coordinator

name	Dr. 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/BMEEOGMMG63
https://fiek2.mywire.org/course/view.php?id=3575

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Optional in the Structural Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is that the students get to know the use of numerical methods that aid geotechnical and engineering geological design. The students get familiar with the advantages and disadvantages of analytical methods and applications of finite element methods to geotechnical and engineering geological problems using different commercially available software. The students get to know the special elements and material models that are typically used in the case of FE modelling of geotechnical problems. The students get to know the most frequently used rock mechanical methods for modelling fractured rocks.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows how to create a model for a specific problem in geotechnics or engineering geology,
2. knows the advantages and disadvantages of analytical geotechnical methods,
3. knows the special element types used in geotechnical FE modelling,
4. knows how to take into account the anisotropic behaviour of jointed rocks,
5. knows the typically used geotechnical non-linear material models.

B. Skills

1. Is able to use analytical geotechnical software,
2. is able to use proper material model and parameters based on geotechnical test results,
3. is able to model soil/rock behaviour using the finite element method.

C. Attitudes

1. Cooperates with other students and the lecturer during learning,
2. expands her/his knowledge by continuous learning,
3. is open to using new tools of information technology,
4. tries for accurate and errorless problem-solving.

D. Autonomy and Responsibility

1. Is able to individually solve geotechnical problems and find solutions to tasks based on the information made available,

2. is open to well-founded criticism,
3. is able to work as part of a group, together with their classmates, on the solutions for various problems,
4. applies a system approach in their thinking.

2.3 Methods

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

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Process of modelling in engineering geology and geotechnics.
2.	Design of retaining structures and pile foundations using analytical geotechnical software.
3.	Slopes stability calculation using numerical methods.
4.	Finite element modelling in engineering geology and geotechnics.
5.	Non-linear material models and their parameters.
6.	Primary consolidation, geosynthetics.
7.	Finite element modelling of deep excavations, unloading, deformations, stability.
8.	Finite element modelling of raft foundations, interface parameters.
9.	Finite element modelling of pile foundations, "embedded pile" element type.
10.	Modelling possibilities of fractured rock masses (hybrid finite element, discrete element methods)
11.	Analytical methods in tunnel design.
12.	Numerical methods in tunnel design (2D solution for a 3D problem)
13.	Dimensioning of rock pillars.
14.	Modelling of discontinuity sets in rock slope stability analysis (hybrid finite element modelling and discontinuity layout optimization methods).

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:

Chen, W.F., LIU, X.L. (1990) Limit analysis in soil mechanics, Elsevier

Jing, L. Stephanson, O. (2007). Fundamentals of discrete elements modelling, Elsevier

Online materials:

Lecture notes

2.6 Other information

It is recommended to attend classes with a notebook to use the introduced numerical methods.
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: mahler.andras@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

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

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
1. midterm test	MT1	A.1-A.5; B.1-B.3
2. homework	HW	A.1-A.5; B.1-B.3; 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

Abbreviation	Score
MT1	60%
HW	40%
Sum	**100%**

The midterm test is failed if the sum points of the tests are less than 50% of the obtainable points. In the case of homework, reaching 50% of the points is also required.

3.4 Requirements and validity of signature

There is no signature for this subject.

3.5 Grading system

Determination of the final grade is according to the below-described considerations:
The final grade is the average value of the result of the midterm test and the homework weighted according to clause 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

1. Homework – after the payment of the fee determined in the regulation – can be submitted with a delay until 16.00 or in electronic format until 23.59 on the last day of the supplementary period.
2. The submitted and accepted homework can be corrected without any fee until the deadline described in point 1.
3. The midterm test can be retaken in the last practical week free of charge. In the case of correction, the better result will be taken into account from the new and previous results.

4. In case of failing the retake described in point 3. there is a possibility for a second retake – after the payment of the fee determined in the regulation – in the supplementary period. 3.7.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×2=28
preparation for the courses	14×2=28
preparation for the tests	10
homework	24
Sum	**90**

3.8 Effective date

1 September 2022

This Subject Datasheet is valid for:

Inactive courses