SUBJECT DATASHEET

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
lectures	1
laboratory	1

1.5 Evaluation

midterm grade

1.6 Credits

3

1.7 Coordinator

name:	Dr. András Mahler
academic rank:	associate professor
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1.8 Department

Department of Engineering Geology and Geotechnics (www.gmt.bme.hu)

1.9 Website

www.epito.bme.hu/BMEEOGMMG63

1.10 Language of instruction

Hungarian and/or English

1.11 Curriculum requirements

Optional in the Structural engineering (MSc) programme

1.12 Prerequisites

None

1.13 Effective date

Sepember 1, 2017.

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 the 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 by using different commercially available software. The students get to know the special elements and material models that are typically used in 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 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 finite element method

C. Attitudes
   a) cooperates with other students and the lecturer during learning,
   b) expands her/his knowledge by continuous learning ,
   c) is open to use new tools of information technology,
   d) 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 system approach in their thinking.

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.	Process of modeling 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 modeling in engineering geology and geotechnics.
5.	Non-linear material models and their parameters.

6. Primary consolidation, geosynthetics.
7. Finite element modeling of deep excavations, unloading, deformations, stability.
8. Finite element modeling of raft foundations, interface parameters.
9. Finite element modeling of pile foundations, "embedded pile" element type.
10. Modeling 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

a) Textbooks
   1. Chen, W.F., LIU, X.L. (1990) Limit analysis in soil mechanics, Elsevier
   2. Jing, L. Stephanson, O. (2007). Fundamentals of discrete elements modelling, Elsevier

b) Online materials
   1. Lecture notes

2.6 Other information

1) It is recommended to attend to the classes with notebook to use the introduced numerical methods.
2) 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

II. SUBJECT REQUIREMENTS

3 ASSESSEMENT 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 Assesement methods

Evaluation form	abbrev.	**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 midterm tests and 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 is less than the 50% of the obtainable points. In case of the homework to reach the 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 the 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 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 supplementary period.
2) The submitted and accepted homework can be corrected without any fee until the deadline described in the point 1.

3) The midterm test can be retaken in the last practical week free of charge. In case of correction the better result will be taking into account from the new and previous results.
4) In case of failing the retake described in the point 3. there is a possibility for second retake – after the payment of the fee determinated in the regulation – in the supplementary period.

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
in total	**90**

3.8 Effective date

Sepember 1, 2017.