SUBJECT SPECIFICATION

1. BASIC DATA

1.1. Title

DISCRETE ELEMENT METHOD

1.2. Code

BMEEOTMMN64

1.3. Type

module with associated contact hours

1.4. Contact hours

- lectures: 1 hours/week
- seminars/exercise classes: 1 hours/week

1.5. Evaluation

midterm grade

1.6. Credits

3

1.7. Coordinator

Dr. Katalin Bagi, full professor (@: bagi.katalin@epito.bme.hu)

1.8. Department

Department of Structural Mechanics (http://www.epito.bme.hu/me)

1.9. Website

http://www.epito.bme.hu/BMEEOTMMN64

1.10. Language of instruction

Hungarian and English

1.11. Curriculum requirements

- elective in the Structural engineering (MSc) programme

1.12. Prerequisites

- none

1.13. Effective date

from 1 September 2017.

2. OBJECTIVES AND LEARNING OUTCOMES

2.1. Objectives

The goal of the subject is to get students to know the basics of the concept and methodology of the discrete element methods (DEM) occurring in the structural engineering practice, and allow an insight to the operation of a discrete element software. Students will learn the most important variations DEM, th applied equations of motion, their numeric solution methods with the limits of applicability, advantages and disadvantages. Students will analyse the model of a simple engineering problem.

2.2. Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the concept of DEM,
2. is familiar with the main element types of DEM and their equations of motion,
3. is familiar with the concept of BALL-type models and the main attributions of the softwares based on BALL-type models,
4. understands the basics of the UDEC and 3DEC algorithms,
5. knows the most frequent implicit algorithms (DDA, Contact Dynamics),
6. is familiar with Munjiza's combined FEM-DEM method,

B. Skills

1. applies software with the capabilities of 3DEC for the simulation of simple problems of DEM,
2. builds the geometrical model of a structure of a few dozen elements,
3. defines the necessary material parameters and boundary conditions in a DEM software in accordance to the current problem,
4. performs the simulation of the loading process,
5. displays the results of a calculation using the graphic capabilities of the software
6. is able to show the results in a compact, straightforward presentation.

C. Attitudes

endeavors to discover and routinely use the tools necessary to the problem solving of discrete element method problems, endeavors to the precise and error-free problem solving, aspires to prepare a well-organized documentation in writings, pursues the precise self-expression in oral communication,

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4. pursues the precise self-expression in oral communication,

D. Autonomy and responsibility

independently carries out the conceptual and numerical analysis of structural engineering problems, based on the literature is open to accept well-founded critical comments.

1. independently carries out the conceptual and numerical analysis of structural engineering problems, based on the literature
2. is open to accept well-founded critical comments.

2.3. Methods

Lectures, exercises, oral and written communication, application of IT tools and technologies.

2.4. Course outline

week	Topics of lectures and exercise classes
1.	Introduction to the DEM. Main elements and their equations of motion
2.	Overview of the applied numerical methods
3.	Explicit models: BALL-type softwares
4.	Explicit models: UDEC and 3DEC
5.	Summary: Basics of DEM
6.	Software: Introduction to a 3DEC-based software
7.	Individual projects: presentation 1. (geometric model)
8.	Individual projects: presentation 2. (material properties and loads)
9.	Individual projects: presentation 3. (initial results)
10.	Individual projects: submission
11.	Implicit models: the DDA algorithm
12.	Implicit models: the Contact Dynamics methods
13.	Combined FDEM
14.	Summary: Advanced DEM

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 notes: K. Bagi: The Discrete Element Method. Lecture Notes, Department of Structural Mechanics, Budapest University of Technology and Economics, 2016

2.6. Other information

1. Attendance at lectures and exercise classes is mandatory.
2. Students attending tests/exams must not communicate with others without explicit permission during the test/exam, and must not have an electronic or non-electronic device capable of communication switched on.

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: bagi.katalin@epito.bme.hu.

SUBJECT REQUIREMENTS

3. ASSESSMENT AND EVALUATION OF THE LEARNING OUTCOMES

3.1. General rules

- Evaluation of learning outcomes described in Section 2.2. is based on two mid-term written checks and one homework.
- The duration of each mid-term test is 90 minutes.
- The dates of checks and the deadlines of homeworks can be found in the "Detailed semester schedule" on the website of the subject.

3.2. Assessment methods

Evaluation form (type)	abbrev.	assessed learning outcomes (2.2)
1st mid-term test (summarizing check)	**ZH1**	A 1-4, C 2-3
2nd mid-term test (summarizing check)	**ZH2**	A 1-2, A 5-6, C 2-3
homework (continuous partial check)	**HF**	A 1-2, B 1-6, C 1-4, D 1-2

Dates and deadlines of evaluations can be found in the „Detailed course schedule” on the subject’s website.

3.3. Evaluation system

Evaluation	score
ZH1 (1st mid-term test)	25%
ZH2 (2nd mid-term test)	25%
HF (homework)	50%
sum in the midterm	100%

3.4. Requirement and validity of signature

There is no signature from the subject.

3.5. Grading system

- A minimum presence of 70% is required to gain a passing mark
- In the case of complying with the requirements on attendance the results are determined as follows.
- Mid-term test results below 50% cosidered as unsuccessful.
- Both mid-term test must have a successful result to gain a semester mark.
- Homework must be submitted and must be accepted as completed to gain a semester mark.
- The midterm result is computed by the results of the mid-term tests and of the homework.
- The semester result is computed by the weighted average A of the best mid-term test, the homework, and the oral exam as in section 3.3.:

Average	grade
80%≤A	5 (Excellent)
70%≤A<80%	4 (Good)
60%≤A<70%	3 (Satisfactory)
50%≤A<60%	2 (Passed)
A<50%	1 (Failed)

3.6. Retake and repeat

- In this subject each mid-term test can be retaken once. From the results of the original test and the retake the best counts.
- One unsuccessful mid-term test can be retaken second time for a fee.
- Homeworks not submitted by deadline can be submitted after paying late fee until the end of the last class of the semester.

3.7. Estimated workload

activity	hours/semester
contact lesson	**14x2=28**
preparation for the checks	**12x10=22**
preparation of homework	**40**
in total	**90**

3.8. Effective date

from 1 September 2017.