Discrete Element Method - BMEEOTMMN64

I. 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

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

1.5 Evaluation

Midterm grade

1.6 Credits

3

1.7 Coordinator

name	Bojtárné 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/BMEEOTMMN64
https://edu.epito.bme.hu/course/view.php?id=2003

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Recommended elective in the Specialization in Geotechnics and Geology, Strcutural Engineering (MSc) programme

Recommended elective in the Specialization in Numerical modelling, Strcutural Engineering (MSc) programme

Recommended elective in the Specialization of Structures, Strcutural Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

5 February 2020

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

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

D. Autonomy and Responsibility

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/or 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

- Attendance at lectures and exercise classes is mandatory.
- 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.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

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 project homework.
- Mid-term tests are planned to be written online, according to the schedule of the course.
- The duration of each mid-term test is 90 minutes.
- The course project has to be prepared in scheduled steps (online and offline consultation is available). Students have to present their progress regularly, according to the detailed schedule. A final report on the course project has to be submitted by the deadline.
- 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	Abbreviation	Assessed learning outcomes
1st mid-term test (summarizing check)	Z1	A.1-A.4; C.2-C.3
2nd mid-term test (summarizing check)	Z2	A.1-A.2, A.5-A.6; C.2-C.3
homework (continuous partial check)	C	A.1-A.2; B.1-B.6; 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

Abbreviation	Score
ZH1	25%
ZH2	25%
HF	50%
Sum	**100%**

Bonus points can be received for extra difficult projects (max +10%).

3.4 Requirements 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
- Course project completed, submitted and presented by the deadline deserves 50 points, in installments specified in the detailed schedule.

- The course project has to be completely ready. Only fully completed projects can be accepted.
- The first test has to reach the satisfactory level (50%).
- The second test has to reach the satisfactory level (50%).
- 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.:

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

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.
- In case of late submission of the homework, 50% of the corresponding points will be received.

3.7 Estimated workload

Activity	**Hours/semester**
contact lesson	14×2=28
preparation for the checks	12+10=22
preparation of homework	40
Sum	**90**

3.8 Effective date

1 February 2021

This Subject Datasheet is valid for:

Inactive courses