Numerical methods - BMEEOFTMK51

I. Subject Specification

1. Basic Data

1.1 Title

Numerical Methods

1.2 Code

BMEEOFTMK51

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lab	3

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

name	Dr Piroska Laky
academic rank	Associate professor
email	laky.piroska@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOFTMK51
https://fiek2.mywire.org/course/view.php?id=1971

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Structural Engineering (MSc) programme

Compulsory in the Infrastructure Engineering (MSc) programme

Compulsory in the Land Surveying and Geoinformatics (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2020

Numerical methods - BMEEOFTMK51

---

2. Objectives and learning outcomes

2.1 Objectives

The aim of this course is that students learn and apply at a good skill level the possibilities of numerical solution of engineering problems on computers. The principles of the most relevant numerical techniques including their advantages, disadvantages and applicability are presented during laboratory practices. Students may learn and apply mathematical procedures suitable for solving and visualizing technical problems on computer practices, mainly through examples from civil engineering. A further purpose of this course is to prepare the students for later independent research.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Has a skill level knowledge of a mathematical environment
2. Knows the basic commands of a mathematical environment including procedures, loops, branching, visualization opportunities, text data reading and writing possibilities
3. Can distinguish the different computation errors
4. Knows methods for solving system of linear equations
5. Understands the methods for finding the roots of system of non-linear equations
6. Is aware of the difference between the methods of interpolation and regression
7. Has a general knowledge of optimization methods
8. Is informed regarding various numerical derivation and integration procedures
9. Knows several methods for solving initial and boundary value problems in case of ordinary differential equation

B. Skills

1. Able to skillfully use a mathematical environment to solve engineering problems
2. Able to interpret the upcoming error/warning messages and to fix the specified errors
3. Able to knowingly use the software documentation, using which can find the necessary commands, interprets the algorithms and parameters used by the commands
4. Able to load text data into a mathematical environment
5. Routinely produce charts in a mathematical environment, and modifies them in line with expectations.
6. Able to choose the proper algorithm for the specific problem
7. Able to fit measurement data with an interpolating or regression curve/surface
8. Able to skillfully solve systems of linear or non-linear equations
9. Able to solve one or multivariate optimization problems with or without constraints
10. Able to differentiate/integrate numerically in case of a certain problem
11. Able to transform a higher order differential equation into a system of first order differential equations
12. Able to solve ordinary differential equations in case of initial or boundary value problem, even in single and bivariate case

C. Attitudes

1. Seeks the most efficient algorithm during the solution
2. Susceptible toward the simple and effective program codes
3. Attempts to write a well-documented script with comments understandable for others

D. Autonomy and Responsibility

1. Independently performs the solution of the problem assigned as homework
2. Openly receives the well-founded critical comments, accepts the proposals and integrates them during the further work
3. Independently checks in the documentation how to use the commands required to solve the tasks

2.3 Methods

Lectures and computer laboratory practices.

2.4 Course outline

Main topics of the lectures and labor practices (different number of lessons on even and uneven educational weeks, 1x2 and 2x2)

Week	**Topics of lectures and/or exercise classes**
1.	Introduction to a mathematical environment, conditionals and loops
2.	Loading and saving measurement data, graphics
3.	Computational errors
4.	Systems of linear equations
5.	Systems of non-linear equations
6.	Regression
7.	Interpolation
8.	Summary - overview
9.	Numerical derivation
10.	Numerical integration
11.	Optimization
12.	Ordinary differential equation I. (initial value problem)
13.	Ordinary differential equation II. (boundary value problem)
14.	Summary - overview

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 and online materials

1. Matlab documentation - https://www.mathworks.com/help/matlab/
2. Piroska Laky, Bence Ambrus: Numerical methods for Civil Engineers, Lecture notes by Piroska Laky (translated to English by Bence Ambrus), 228 pages (available in the educational framework)
3. Todd Young and Martin J. Mohlenkamp (2018): Introduction to Numerical Methods and Matlab Programming for Engineers, Ohio University, 172 oldal (http://www.ohiouniversityfaculty.com/youngt/IntNumMeth/book.pdf)
4. Amos Gilat, Vish Subramaniam (2011): Numerical methods, An introduction with Applications Using MATLAB, John Wiley & Sons, ISBN 978-0-470-87374-8, 460 oldal

b) Presentations, descriptions, tasks available on the educational framework

2.6 Other information

The use of own laptops during labor practices is allowed if the used softwares are previously installed.

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:

2023/2024 semester I

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 two midterm tests, homework assignments and the activity on labour practices.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Practice exercises (Minor homeworks, formative assessment)	P	A.1-A.9; B.1-B.12; C.1-C.3; D.1-D.3
1. Midterm test (Summative assessment)	MT1	A.1-A.6; B.1-B.8; C.1-C.3
2. Midterm test (Summative assessment)	MT2	A.6-A.9; B.1-B.12; C.1-C.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
P	30%
MT1	35%
MT2	35%
Sum	**100%**

For the practice exercises 0-30 %, for each midterm tests 0-35 % of the total sum is available. The condition for successful completion of the subject is to achieve a score of at least 15 points out of 35 points (~42%) in each of the Midterm tests and 50% of the total score.

3.4 Requirements and validity of signature

Signature could not be obtained from the subject.

3.5 Grading system

Grade	Points (P)
excellent (5)	86<=P
good (4)	73<=P<86%
satisfactory (3)	60<=P<73%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Retake and repeat

1. Both midterm tests have a retake possibility. The actual dates of the retakes can be found in the „Detailed course schedule" on the subject's website. The result of the last test will be the final result for each test.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×3=42
preparation for the courses	14×1=14
preparation for the tests	2×24=48
practice exercises	16
Sum	**120**

3.8 Effective date

1 September 2020

This Subject Datasheet is valid for:

2023/2024 semester I