Numerical Methods - BMEEOAFMB51

I. Subject Specification

1. Basic Data

1.1 Title

Numerical Methods

1.2 Code

BMEEOAFMB51

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lab	2

1.5 Evaluation

Exam

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/BMEEOAFMB51
https://edu.epito.bme.hu/course/view.php?id=3562

1.10 Language of instruction

english

1.11 Curriculum requirements

Compulsory in the Construction Information Technology 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 subject is for the students to learn and apply the possibilities of computer numerical solutions of engineering problems at a good skill level. The basic principles, advantages, disadvantages and applicability of the most relevant numerical techniques are presented during the laboratory exercises. Students can primarily learn about and apply mathematical procedures suitable for solving and visualizing technical problems using computers through civil engineering examples. Another goal of the course is to prepare students for later independent research.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. The student is familiar with the general principles, rules and procedures of mathematics, science and informatics in connection with the design and construction of civil engineering facilities,
2. Has the informatics knowledge necessary for the development of technical systems and process automation,
3. Has skill-level knowledge of a mathematical environment,
4. Can differentiate between errors in numerical calculations,
5. Knows methods for solving systems of linear and non-linear equations,
6. Is aware of the difference between interpolation and regression methods,
7. Has an overview of some optimization methods
8. Is informed about different numerical derivation and integration procedures
9. Knows some methods of solving ordinary differential equations

B. Skills

1. Is able to apply the necessary natural science and IT principles in the design and construction of buildings,
2. Is able to skillfully use a mathematical environment to solve engineering problems
3. Is able to interpret the error messages that arise and correct the errors based on them
4. Is able to use the documentation effectively, find the necessary commands, interpret the algorithms and parameters used by the commands
5. Routinely creates graphs in a mathematical environment, parametrizes them in accordance with expectations,
6. Is able to choose the proper algorithm for the specific problem
7. Is able to fit an interpolation or regression curve/surface to measurement data
8. Is able to skillfully solve systems of linear or non-linear equations
9. Can determine the extreme values of a given function/curve/surface,
10. Is able to differentiate and integrate numerically when solving a given problem,
11. Is able to solve ordinary differential equations;

C. Attitudes

1. Open to the application of new IT tools, methods and procedures in his own specialization,
2. Receptive to simple and efficient 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

2.3 Methods

Lectures and computer laboratory practices.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Introduction to a mathematical environment
2.	Introduction to numerical methods, calculation errors.
3.	Roots of nonlinear equations
4.	Systems of linear equations
5.	Solving nonlinear systems of equations
6.	Univariate interpolation, regression
7.	Bivariate regression, interpolation
8.	Midterm Test
9.	Numerical derivation, integration
10.	Unconstrained optimization
11.	Constrained optimization
12.	Ordinary Differential Equations I.(initial value problem)
13.	Ordinary Differential Equations II. (boundary value problem)
14.	Summary

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:

2024/2025 semester II

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 a midterm test, practice exercises and an exam at the end.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Practice exercises (Minor homeworks, formative assessment)	P	A.1-A.9; B.1-B.11; C.1-C.3; D.1-D.2
Midterm test (Summative assessment)	MT	A.1-A.6; B.1-B.8; C.1-C.3
Exam	E	A.1-A.9; B.1-B.11; 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%
MT	30 %
E	40 %
Sum	**100%**

The minimum requirement for the midterm test is 40 % (12 points from 30).
The minimum requirement for the exam is 50 % (20 points from 40).

3.4 Requirements and validity of signature

The condition for obtaining the signature is that the student achieves at least 50% of the points that can be obtained during the semester (30 points out of 60) and that the midterm test (MT) is successful.
The midterm result that can be taken into account at the examination grade previously obtained from the subject can be accepted retroactively for 4 semester.

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%

The final grade is calculated from the sum of the points obtained during the semester (60%) and the points obtained in the exam (40%).

3.6 Retake and repeat

1. The actual date of the retake 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 the test.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×2=28
preparation for the courses	14×2=28
practice exercises	10×1=10
preparation for the tests	1×24=24
preparation for exam	1×30=30
Sum	**120**

3.8 Effective date

1 September 2022

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