Methods of Engineering Analysis - BMEEOHSMK51

I. Subject Specification

1. Basic Data

1.1 Title

Methods of Engineering Analysis

1.2 Code

BMEEOHSMK51

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	Dr. László Gergely Vigh
academic rank	Associate professor
email	vigh.laszlo.gergely@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSMK51
https://fiek2.mywire.org/course/view.php?id=2448

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Structural Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2020

2. Objectives and learning outcomes

2.1 Objectives

The objective of the course is that the student shall understand and be aware of the principles and basis of practical methods of engineering analysis and assessments, statistics, probability theory, reliability analysis, numerical methods, risk analysis and optimization. It also serves as the basis of the subsequent MSc subjects on modelling, design and programming.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. is aware of the principles and basic terms of statistics and probability theory, knows the basic statistical analysis and assessment methods,
2. is aware of the uncertainties in engineering problems, the distribution functions that are typical in civil engineering problems, and the model development methods,
3. is aware of the terms of failure probability and reliability index, the principles of basic reliability analysis methods (FORM, SORM and Monte Carlo analysis),
4. is aware of the definition of risk, principles of risk analysis and decision making analysis,
5. knows the principles of finite difference, finite volume and finite element methods in solution of partial differentiate equations,
6. understands the objective function of optimization, can distinguish local and global optimum, and is aware of the principles of the most important classic optimization techniques,

B. Skills

1. applies the statistical and analysis methods for assessment of measuring results,
2. is able to develop models,
3. solves simple reliability problems by FORM and Monte Carlo methods using specific softwares,
4. computes risk on the basis simple logic tree,
5. is able to formulate numerical solution for simple PDEs
6. is able to present his/her results in proper written form,

C. Attitudes

1. follows the lectures, makes effort to understand the study material,
2. collaborates with the teacher in gaining knowledge,
3. is continuously gaining knowledge,
4. is open to the use of IT tools and equipments,
5. aims accuracy in his/her calculations/solutions,

D. Autonomy and Responsibility

1. is independent in problem statements and solutions,
2. aims understanding the complexity, comprehensiveness of the problems and recognizing the synergies.

2.3 Methods

Theoretical lectures and practical seminars are basically not separated, but are held in hybrid way. Theoretical parts emphasize the principles; rigorous mathematical derivation is not addressed. Practical parts illustrate the practical application of the methods, incorporating the use of specific practical tools. Active involvement in and communication during the lectures are expected, helping the understanding of the study material. Homeworks help strenghtening the skills, while control tests support in deepen the knowledge.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Introduction.
2.	Problem statement in engineering, model development.
3.	Uncertainties in engineering problems.
4.	Mechanical model, numerical analysis methods.
5.	Basis of statistics and probability theory.
6.	Statistical analysis in practice.
7.	Summary. HW practice.
8.	Finite difference method.
9.	Basics of finite volume method and finite element method.
10.	Methods of reliability analysis: practical use of FORM, SORM, Monte Carlo analysis.
11.	Optimization. Basics of linear programming and gradient method.
12.	Acceptable risk. Risk assessment, decision making.
13.	Spectral analysis of digital signals.
14.	Summary. HW practice.

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, literature:

- Wilcox: Numerical methods for PDEs. Unit 2, 16.90 Computational Methods in Aerospace Engineering, MITOpenCourseware.
- Hoffman – Frankel: Numerical methods for engineers and scientists. CRC Press, 2001.
- Faber: Risk and safety in civil, environmental and geomatic engineering
- Sorensen: Structural reliability theory and risk analysis
- Lyons , R.G.: Understanding Digital Signal Processing . Prentice Hall, 2001.
- Rao, S.R.: Engineering optimization – Theory and practice. Fourth Edition. Wiley, 2009.

b) Online materials:: materials uploaded to the web site of the subject, e.g.:

- Lecture notes, electronic lecture notes,
- slides of lectures and practices,
- solved problems
- midterm test samples with solution

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the information system. Special appointments can be requested via e-mail. Consultation during lecture breaks is also available.

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 midterm stests, homework assignments and continuous performance assessments.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
continuous assessment	A	A.1-A.6; B.1-B.6; C.1-C.5; D.1-D.2
Midterm test #1 (25-minute test)	MT1	A.1-A.2; B.1-B.2; C.5; D.1
Midterm test #2 (25-minute test)	MT2	A.3-A.6; B.3-B.5; C.5; D.1
Homework #1	HW1	B.1, B.2, B.6; C.2-C.5; D.1-D.2
Homework #2	HW2	B.2-B.3, B.6; C.2-C.5; D.1-D.2
Homework #3	HW3	B.2, B.4, B.6; C.2-C.5; D.1-D.2
Homework #4	HW4	B.2, B.5, B.6; C.2-C.5; D.1-D.2

Note: homeworks are defined as per TVSZ (Code of Studies) 110.§ (3) b) type.
The homeworks are mandatory. The dates of midterm tests and deadlines of assignments/homework can be found in the detailed course schedule on the subject's website. The numbering of MT and HW may be different that in the table above if the respective lectures are reordered in a particular semester.
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
MT1	15%
MT2	15%
HW1	15%
HW2	15%
HW3	15%
HW4	15%
A	10%
Total in semester	**100%**
Sum	**100%**

3.4 Requirements and validity of signature

No signature can be obtained.

3.5 Grading system

To obtain successful grade, attendance requirement must be fulfilled.
Semester grade is failed, if any of the following applies:

- An MT or HW is failed if the gained points do not achieve 40% of the achievable points.
- Any homework contains work by others without proper citation (plagiarism).

- The total points HW1 + HW2 + HW3 + HW4 + MT1 + MT2 + A do not reach 40% of the achievable points.

The final grade is computed on the basis of the sum of MT1 + MT2 + HW1 + HW2 + HW3 + HW4 + A, as follows:

Grade	**Points (P)**
excellent (5)	85<=P
good (4)	70<=P<85%
satisfactory (3)	55<=P<70%
passed (2)	40<=P<55%
failed (1)	P<40%

3.6 Retake and repeat

1. Late submission of homeworks – with penalty fee applied – is normally possible two weeks after the normal deadline. In case the normal deadline of a homework falls on the last week of the study period, the late submission deadline is the last day of the supplementary week, at 12:00. Schedule and details on the homework submissions can be found on the web site of the subject.
2. Each MT can be repeated (2nd attempt) during the supplementary week; the exact date and time of the repetition is announced on the web site of the subject. The new result overwrites the result of the 1st attempt.
3. “Continuous performance assessment” A cannot be repeated, cannot be substituted with other forms of activity.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×2=28
preparation for the lectures and for continuous performance assessments	12×0.5+2×8=22
preparation for the tests	5
homework	35
home studying of the written material	90
Sum	**14×2=28**

3.8 Effective date

1 September 2020

This Subject Datasheet is valid for:

2023/2024 semester I