Structural Dynamics - BMEEOTMMN-1

I. Subject Specification

1. Basic Data

1.1 Title

Structural Dynamics

1.2 Code

BMEEOTMMN-1

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2
Seminar	1

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

name	Dr. Németh Róbert
academic rank	Associate professor
email	nemeth.robert@emk.bme.hu

1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMMN-1
https://fiek2.mywire.org/course/view.php?id=1998

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

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

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

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

1.12 Prerequisites

Recommended prerequisites:

- Dynamics of Structures (BMEEOTMAT43)

1.13 Effective date

5 February 2020

2. Objectives and learning outcomes

2.1 Objectives

The purpose of the course is that students become familiar with the dynamic tasks occurring in the structural engineering practice, and the mechanical-mathematical background of their solution methods. There will be emphasized: the differential equations used to describe the continuum of mechanical vibration and their analytical and numerical solution methods, free vibration of multiple degrees of freedom systems and its approximate solutions, computation methods of mass and stiffness matrix of the (finite element method) discretized structures, taking into account the damping, dynamic issues supporting effect of the soil, the mechanical background of earthquake analysis of structures and the efect of wind.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has a comprehensive knowledge of the partial differential equations of mechanical vibrations, and their solution methods,
2. knows the approximate solution methods of the generalized eigenvalue problem (Rayleigh-quotient, summation theorems),
3. aware of the methodology of the calculation of static and dynamic stiffness matrices, and the meaning of their entries,
4. understands the modeling of boundary conditions in the stiffness matrix both on element and structural level,
5. confidently knows the calculation of the damping matrix in case of proportional damping,
6. knows the method for the consideration af the supporting and damping effect of soils,
7. has a comprehensive overview of the analysis of support vibration, and the concepts used in a seismic analysis,
8. recognizes the dynamic effects of wind exerted on structures,

B. Skills

1. writes the frequency matrix of the free vibration problem from the boundary conditions of a continuum,
2. calculates selected entries of stiffness matrices,
3. creates a suitable mechanical model for the dynamic analysis of structures,
4. compiles the stiffness and mass matrix of a structure, considers the boundary conditions in them,
5. executes the discretized dynamic analysis of a mechanical problem with a finite element software,
6. takes the damping effect of the structure and the soil into account while performing a dynamic analysis,
7. performs real modal analysis on an engineering structure,
8. keeps in mind the mechanical background while performing the seismic analysis of a typical engineering structure,
9. analyses the response of a structure to the relevant effects of the wind load,

C. Attitudes

1. endeavors to discover and routinely use the tools necessary to the problem solving of structural mechanical problems,
2. endeavors to the precise and error-free problem solving,
3. aspires to prepare a well-organized documentation in writings,

D. Autonomy and Responsibility

1. independently carries out the conceptual and numerical analysis of structural engineering problems, based on the literature.

2.3 Methods

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

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Free and forced vibration of SDOF- and MDOF-systems
2.	Free longitudinal and transversal vibration of bars
3.	Forced vibration of continuum (harmonic forcing, moving loads)
4.	Numerical solution of the equation of motion: modal analysis, direct integral
5.	Approximate methods of the calculation of natural periods and modal shapes
6.	Calculation of a dynamic stiffness matrix, mass matrices
7.	Boundary conditions, real modal analysis
8.	Damping in the FEM analysis of frame structurees
9.	Proportional damping, rate independent damping, complex stiffness
10.	Dynamic stiffness and damping of soils
11.	Analysis of structures for support vibration
12.	Mechanical basis of earthquake analysis of structures
13.	Dynamic analysis of structures for wind loads
14.	Special dynamic loads of structures

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

Books:

- Chopra, A.K.: Dynamics of Structures Theory and Applications to Earthquake Engineering

- Györgyi J.: Szerkezetek dinamikája

Lecture notes: Kocsis - Németh: Hidden Beauty of Structural Dynamics

2.6 Other information

- Due to the strong connection between theory and practice, 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: nemeth.robert@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 three individual assignments.
- The duration of each mid-term test is 90 minutes.
- There is a 24 hours time span for the submission of each individual assignment, with an estimated workload of 60 min.
- There is no consultation on the topic of the HW between the issue and the due date.
- 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 check (summarizing check)	ZH1	A.1-A.4; B.1-B.5, B.7; C.3; D.1
2nd mid-term check (summarizing check)	ZH2	A.1-A.8; B.1-B.9; C.1-C.3; D.1
1st individual assignment	IA1	A.1-A.4; B.1-B.3; C.1-C.3; D.1
2nd individual assignment	IA2	A.1-A.7; B.1-B.8; C.1-C.3; D.1
3rd individual assignment	IA3	A.1-A.5; B.1-B.7; C.1-C.3; D.1

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	40%
ZH2	40%
IA1	10%
IA2	10%
IA3	10%
Total	**100%**

Only the best two individual assignments are considered (that is why the sum of the weights above is not 100%).

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

- In the case of complying with the requirements on attendance the results are determined as follows.
- An individual assignment is regarded as successful if it reaches at least 50%, below that it counts as 0%.
- No requirements are made on the number of successful individual assignments.
- No requirements are made on the successfulness of the midterm-tests.
- The semester performance is determined by the results of the mid-term checks and the best two individual assignments.
- The final result is computed by the weighted average A of the mid-term checks and the best two individual assignments as in section 3.3.:

Grade	**Points (A)**
excellent (5)	90%≤A
good (4)	75%≤A<90%
satisfactory (3)	65%≤A<75%
passed (2)	50%≤A<65%
failed (1)	A<50%

3.6 Retake and repeat

- There is no delayed submission of the individual assignments.
- The mid-semester checks can be retaken at the date announced at the beginning of the semester in one single summarizing retake (from the topics of the whole semester). The result of the retake overwrites the earlier result of both mid-term checks.
- There is no second retake in the subject.

3.7 Estimated workload

Activity	**Hours/semester**
contact lesson	14×3=42
preparation for lessons during the semester	14×2=28
preparation for the checks	2×15=30
preparation of homework	12
individual study of the prescribed material	20
Sum	**120**

3.8 Effective date

1 September 2021

This Subject Datasheet is valid for:

Inactive courses