Dynamics of Structures - BMEEOTMAS43

I. Subject Specification

1. Basic Data

1.1 Title

Dynamics of Structures

1.2 Code

BMEEOTMAS43

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2

1.5 Evaluation

Midterm grade

1.6 Credits

3

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/BMEEOTMAS43
https://fiek2.mywire.org/course/view.php?id=1378

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Civil Engineering (BSc) programme

1.12 Prerequisites

Weak prerequisites:

- Structural Analysis I. (BMEEOTMAT43)
- Mathematics A2a - Vector Functions (BMETE90AX02)

Recommended prerequisites:

- Structural Analysis II. (BMEEOTMAS42)
- Matematics A3 for civil engineers (BMETE90AX07)

1.13 Effective date

5 February 2020

2. Objectives and learning outcomes

2.1 Objectives

The aim of the subject is to introduce the basic concepts of mechanical vibration analysis of civil engineering structures, analysis of free and excited vibrations of SDOF, MDOF, and continuum structures using manual or computer methods, especially the mechanical background of support vibration and earthquake analysis.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the terms used in the analysis of mechanical vibrations,
2. knows the differential equations describing the vibrations of SDOF, MDOF, and continuum systems, and the physical meaning of the quantities within,
3. knows the equations describing the free motions of systems, the concept of free vibration and the solution of the differential equation,
4. knows the equations describing the motion of systems subjected to harmonic excitation, the concept of harmonic vibration and the solution of the differential equation for systems with single or multi degrees of freedom,
5. knows the equations describing the motion of systems subjected to arbitrary excitation in time, the concept of arbitrary vibration and the solution of the differential equation for systems with single degree of freedom,
6. knows the equations describing the motion of systems subjected to variable displacement of supports in time, the concept of vibration due to support movement and the solution of the differential equation with respect to displacements and deformations for systems with single or multi degrees of freedom,
7. clearly understands the mechanical meaning of concepts related to earthquake analysis,
8. clearly understands the concept of equivalent static loads.

B. Skills

1. is able to model real systems as systems with single or multi degrees of freedom,
2. calculates the equivalent quantities (mass, stiffness) of the mechanical model in the case of small number of degrees of freedom,
3. calculates the eigenfrequencies and vibration modes of the mechanical model in the case of small number of degrees of freedom,
4. calculates the responce of the mechanical system to dynamic loads in the case of small number of degrees of freedom,
5. is able to solve complex, computationally demanding problems using his/her IT knowledge,
6. is able to express his/her thoughts in an organized way,

C. Attitudes

1. aims at learning and routinely using tools required for solving mechanical vibration problems,
2. aims at accurate and flawless problem solving,

D. Autonomy and Responsibility

1. is able to individually analyse dynamics problems and tasks and to solve them using the given resources,
2. is open to valid criticism,
3. applies a systematic approach in his/her reasoning.

2.3 Methods

Lectures, solution of practice problems in individual or team work.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Structures with single degree of freedom: modelling, free vibration
2.	Structures with single degree of freedom: harmonic excitation
3.	Structures with single degree of freedom: damped vibration
4.	Structures with single degree of freedom: support vibration
5.	Partial summary
6.	Structures with multi degree of freedom: modelling, system matrices
7.	Structures with multi degree of freedom: free vibration
8.	Structures with multi degree of freedom: excited vibrations
9.	Structures with multi degree of freedom: support vibration
10.	Partial summary
11.	Vibration of bar structures: finite element modelling
12.	Vibration of bar structures: continuum vibration
13.	Vibration of bar structures, repetition
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

Books: Györgyi J.: Dinamika (Műegyetemi Kiadó, 2003)
Online materials: Németh R.: Lecture slides (https://edu.epito.bme.hu/course/view.php?id=1378)

2.6 Other information

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:

2023/2024 semester I

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 checks and three individual assignments.
- The duration of each mid-term check is 90 minutes.
- There are a 16 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 the checks 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)	ZH1	A.1-A.7; B.1-B.4; C.1-C.2; D.1-D.3
2nd mid-term test (summarizing check)	ZH2	A.1-A.8; B.1-B.6; C.1-C.2; D.1-D.3
1st individual assignment (formative assessment)	IA1	A.1-A.5; B.1-B.4; C.1-C.2; D.1-D.3
2nd individual assignment (formative assessment)	IA2	A.1-A.6; B.1-B.6; C.1-C.2; D.1-D.3
3rd individual assignment (formative assessment)	IA3	A.1-A.8; B.1-B.6; C.1-C.2; D.1-D.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
ZH1	40%
ZH2	40%
IA1	10%
IA2	10%
IA3	10%
Sum	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

- No requirements are made on the successfulness of the tests.
- An individual assignment is regarded as successful if it reaches at least 50%.
- 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 lessons	14×2=28
preparation for lessons during the semester	14×1=14
preparation for the checks	5×4=20
study of the assigned written sources	22
checks and assignments	6
Sum	**90**

3.8 Effective date

1 September 2021

This Subject Datasheet is valid for:

2023/2024 semester I