# Analysis of Rods and Frames - BMEEOTMMN63

## I. Subject Specification

1. Basic Data

1.1 Title

Analysis of Rods and Frames

1.2 Code

BMEEOTMMN63

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. Kovács Flórián |
| academic rank | Associate professor |
| email | kovacs.florian@emk.bme.hu |


1.8 Department

Department of Structural Mechanics

1.9 Website

https://epito.bme.hu/BMEEOTMMN63
https://edu.epito.bme.hu/course/view.php?id=2002

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

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

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

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

1.12 Prerequisites

1.13 Effective date

5 February 2020

2. Objectives and learning outcomes

2.1 Objectives

The goal of the subject is to get students to know the modeling possibilities of rod structures appearing in the structural engineering practice, the theoretical background of the models. Based on the linear mechanical model of the generalized beam element students will be acquainted with the calculation of the stiffness matrix and load vector of frame structures and their generalizations e.g. trusses, grids, and infilled frames. Higher-order analysis of kinematically indeterminate structures with high importance in engineering practice will be learnt.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the matrix-algebraic description of the static and geomatric state of a cantilever beam of linear elastic material with arbitrary axis and cross-section,
2. knows the meaning and the calculation method of the stiffnes matrix and equivalent load vector both of the element and of the structure,
3. is familiar with the consideration of eccentric and partial connections,
4. is familiar with the consideration of rigid and elastic supports,
5. knows the simplified models of special structure types,
6. understands the use of variational principles for the calculation of simple models,
7. is familiar with the modeling possibilities of infilled frames,
8. understands algorithms for the calculation of the shape of cable-stayed bridges and cable nets,

B. Skills

1. calculates the internal forces and displacements of a linear, prismatic, cantilever beam with the application of transmission matrices,
2. calculates the entries of a stiffness matrix of a beam member with special connection,
3. calculates the stiffness matrix and the equivalent load vector of frame structures, and considers the support conditions,
4. uses a simplified model reflecting the specialities of the mechanical problem,
5. calculates the displacements of beams on elastic foundation,
6. calculates the equilibrium shape of kinematically indeterminate bar-and-joint assemblies for a given load,

C. Attitudes

1. endeavors to discover and routinely use the tools necessary to the problem solving in structural mechanical,
2. endeavors to the precise and error-free problem solving,

3. aspires to prepare a well-organized documentation in writings, and pursues the precise self-expression in oral communication,

D. Autonomy and Responsibility

1. independently carries out the conceptual and numerical analysis of structural engineering problems, based on the literature,
2. is open to accept well-founded critical comments.

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. | Mathematical basics: matrix algebra, transformations |
| 2. | Basic concepts of the general beam model |
| 3. | Stiffness matrix and equivalent load vector of the beam element |
| 4. | Special connections: eccentric connection |
| 5. | Special connections: elastic and partial connection |
| 6. | Modeling the supports |
| 7. | Solution of frame structures with the matrix displacement method |
| 8. | Special case: planar frames |
| 9. | Special case: grids |
| 10. | Special case: trusses |
| 11. | Beams on elastic foundation, infilled frames |
| 12. | Higher order theories: cable-stayed bridges |
| 13. | Higher order theories: cable nets |
| 14. | Summary, examples |

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:

- Dawe, D.J.: Matrix and finite element displacement analysis of structures. Clarendon Press, Oxford, 1984;
- Menon, D.: Advanced Structural Analysis, Alpha Science, UK, 2009

Lecture notes: Kovács - Lengyel: Structural Analysis Theory

2.6 Other information

- Due to the strong connection between the 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: kovacs.florian@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.
- The duration of each mid-term test is 90 minutes.
- 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 test (summarizing check) | ZH1 | A.1-A.4; B.1-B.4; C.1-C.3; D.1-D.2 |
| 2nd mid-term test (summarizing check) | ZH2 | A.1-A.8; B.1-B.6; C.1-C.3; D.1-D.2 |

3.3 Evaluation system

| Abbreviation | Score |
|---|---|
| ZH1 | 50% |
| ZH2 | 50% |
| **Sum** | **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 signature
- In the case of complying with the requirements on attendance the results are determined as follows.
- Mid-term test result below 50% considered as unsuccessful.
- Both mid-term test must have a successful result to gain a semester mark.
- The semester result is computed by the weighted average A of the mid-term tests, as in section 3.3.:

| Grade | Points (P) |
|---|---|
| excellent (5) | 80%≤A |
| good (4) | 70%≤A<80% |
| satisfactory (3) | 60%≤A<70% |
| passed (2) | 50%≤A<60% |
| failed (1) | A<50% |

3.6 Retake and repeat

- In this subject each mid-term test can be retaken once. From the results of the original test and the retake the best counts.
- There is no second retake in this subject.

3.7 Estimated workload

| **Activity** | **Hours/semester** |
|---|---|
| contact lesson | 14×2=28 |
| preparation for lessons during the semester | 14×2=28 |
| preparation for the checks | 18+16=34 |
| **Sum** | **90** |

3.8 Effective date

5 February 2020

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