SUBJECT SPECIFICATION

1. BASIC DATA

1.1. Title

INTRODUCTION TO STRENGTH OF MATERIALS

1.2. Code

BMEEOTMAT42

1.3. Type

contact lesson unit

1.4. Contact hours

- seminars/exercise classes: 5 lesson/week

1.5. Evaluation

semester mark

1.6. Credits

6

1.7. Coordinator

Dr. Kovács Flórián, associate professor (@: kovacs.florian@epito.bme.hu)

1.8. Department

Department of Structural Mechanics (http://www.epito.bme.hu/me)

1.9. Website

http://www.epito.bme.hu/BMEEOTMAT42

1.10. Language of instruction

Hungarian and English

1.11. Curriculum requirements

- compulsory in the BSc Civil Engineering course

1.12. Prerequisites

- Required previous subjects
  - BMEEOTMAT41: Basics of statics and dynamics (completed)
  - BMETE90AX00: Matematics A1a (midterm signature)
- Recommended subjects
  - BMETE90AX00: Matematics A1a
- Exclusive subjects
  Strength of materials (BMEEOTMAT04)

1.13. Effective date

from 1 September 2017.

2. OBJECTIVES AND LEARNING OUTCOMES

2.1. Objectives

The aim of the subject is to introduce the fundamental concepts of strength of materials, the concepts of loads, stresses, strains, and displacements, as well as the relationships between them using which the basic problems, sizing, and checks can be carried out. Particular emphasis is made on the calculation of stresses and strains due to simple and complex internal forces of bars and beams. The presented methods enable the solution of certain statically indeterminate problems.

2.2. Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the concepts of loads, stresses, strains, and displacements,
2. knows the concept of a bar and a bar element,
3. knows the geometric quantities characterizing the cross-section of a beam, and the calculation methods,
4. knows the linearly elastic and the linearly elastic and perfectly plastic material models,
5. knows the internal forces arising in cross-sections of a beam, the resulting stresses, and the formulas for the calculation,
6. knows the deformations of cross-sections of a beam, the relationships to the internal forces and the strains in individual points,
7. knows how temperature affects the strains,
8. knows the stresses acting on an elementary cube and the concept of stress state,
9. clearly understands the dependance of stresses on direction, the concepts of principal stresses and principal directions,
10. knows the deformations of the elementary cube, the concept of strain state,
11. clearly understands the dependance of strains on direction, the concepts of principal strains and principal directions,

B. Skills

1. calculates the stresses and strains in bars under tension-compression, solves the sizing and checking problems,
2. calculates the stresses and strains arising from pure shearing, solves the sizing and checking problems,
3. calculates the stresses and strains arising from torsion for simple cross-sections, solves the basic sizing and checking problems,
4. calculates the stresses and strains arising from uniaxial bending, solves the sizing and checking problems,
5. recognizes the biaxial bending and calculates the associated stresses and strains, solves the sizing and checking problems,
6. calculates the stresses arising from shearing coupled with simultaneous bending,
7. calculates the stresses in cross-sections subjected to eccentric tension-compression in the cases of linearly elastic material and no-tension material,
8. determines the principal stresses and principal directions in any material point of a cross-section,

C. Attitudes

1. aims at accurate and flawless problem solving,
2. elaborates the solution such that it is clear to understand or possibly to continue,

D. Autonomy and responsibility

1. is prepared to recognize and correct errors,

2.3. Methods

Lectures and calculation practices based on the electronically distributed workbook, solving home works and practice problems in individual or team work.

2.4. Course outline

week	Practice topics
1.	Internal force diagrams (repetition). Introduction: the subject matter of strength of materials, fundamental concepts, the linearly elastic material model
2.	The concept of a beam and beam element, its internal forces and deformations. The concept of centric tension-compression, basic equations, introductory numerical examples, calculation of deformations: homogeneous and inhomogeneous beams, the effect of temperature change
3.	The concept of pure shearing, screws, rivets, basic examples. Checking of simple connections for centric tension-compression and pure shearing
4.	Torsion of cross-sections with rotational symmetry, the concept of polar moment of inertia, calculation of deformations. Torsion of thin-walled open and closed cross-sections, rectangular cross-sections, examples
5.	Calculation of stresses arising from torsion, examples.
6.	Basic equations of uniaxial bending, the concept of moments of inertia. The fundamentals of calculation of inertia, examples
7.	Uniaxial bending, calculation of normal stresses and deformations. Uniaxial bending of inhomogeneous cross-sections, calculation of normal stresses and deformations
8.	Simple problems for the calculation of displacements in the cases of cantilever beams and simply supported beams. Biaxial bending. Eccentric tension-compression: fundamental relationships for the calculation of stresses, the concept of neutral axis
9.	The concept of Cullmann's kernel. Cross-section with no-tension material, calculation of stresses in structures (column, wall)
10.	The reciprocity of shear stresses. Bending and shearing: Zhuravskii's theory, introductory examples
11.	Calculation of stresses in beams with solid cross-sections under simultaneous bending and shearing. Simultaneous bending and shearing of thin-walled cross-sections, the concept of shear centre
12.	Calculation of internal forces in characteristic cross-sections of spatial bar structures, examples. The concept of principal stresses and principal directions, introductory examples. Bending and shearing, complex internal forces
13.	Bending, tension, shearing, torsion, numerical examples. Determination of principal stresses and principal directions
14.	Determination of principal stresses and principal directions in points of beams, examples. Stress states of points of beams.

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:
  Kaliszky S., Kurutzné Kovács M., Szilágyi Gy.: Szilárdságtan, 2000;
  Beer, Johnston: Mechanics of materials;
  Budynas: Advanced Strength and Applied Stress Analysis;
  Popov: Mechanics of materials;
  Gere – Goodno: Mechanics of Materials. Cengage Learning, 2015

2.6. Other information

1. Students attending checks must not communicate with others during the check without explicit permission, and must not hold any electronic or other communication device 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.

SUBJECT REQUIREMENTS

3. ASSESSMENT AND EVALUATION OF THE LEARNING OUTCOMES

3.1. General rules

- Evaluation of learning outcomes described in Section 2.2. is based on three mid-term written checks.
- The duration of each mid-term test is 90 minutes.
- Mid-term tests below 50% are regarded unsuccessful.
- 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 (type)	abbrev.	assessed learning outcomes (2.2)
1st mid-term test (summarizing check)	**ZH1**	A 1-7, B 1-3, C 1-2, D 1
2nd mid-term test (summarizing check)	**ZH2**	A 1-7, B 4-5, C 1-2, D 1
3rd mid-term test (summarizing check)	**ZH3**	A 1-11, B 1-8, C 1-2, D 1

Dates and deadlines of evaluations can be found in the „Detailed course schedule” on the subject’s website.

3.3. Evaluation system

Evaluation	score
ZH1 (1st mid-term test)	33,3%
ZH2 (2nd mid-term test)	33,3%
ZH3 (3rd mid-term test)	33,4%
sum in the midterm	100%

3.4. Requirement and validity of signature

There is no signature from the subject.

3.5. Grading system

- In the case of complying with the requirements on attendance the results are determined as follows.
- The semester is accomplished successfully if all mid-term tests are accomplished successfully.
- the final result is computed by the weighted average A of the mid-term tests as in section 3.3.:

Average	grade
80%≤A	5 (Excellent)
70%≤A<80%	4 (Good)
60%≤A<70%	3 (Satisfactory)
50%≤A<60%	2 (Passed)
A<50%	1 (Failed)

3.6. Retake and repeat

- Each of the mid-semester tests can be retaken only once at dates announced at the beginning of the semester.
- In the case of each test, the better one of the results of ordinary test and its retake is considered.
- At the end of the semester a second retake of one of the tests is available to the students, if only one of the tests has no successful result at that time (i.e. two test are successful after the first retakes).
- The result of the second retake replaces that of the remaining unsuccessful test.

3.7. Estimated workload

activity	hours/semester
contact lessons	**35x2=70**
preparation for lessons during the semester + home works	**35x1=35**
preparation for the checks	**3x15=45**
study of the assigned written sources	**30**
in total	**180**

3.8. Effective date

from 1 September 2017.