

SUBJECT SPECIFICATION

1. BASIC DATA

1.1. Title

PLASTICITY

1.2. Code

BMEEOTMMN61

1.3. Type

module with associated contact hours

1.4. Contact hours

- lectures: 1 hours/week
- seminars/exercise classes: 1 hours/week

1.5. Evaluation

midterm grade

1.6. Credits

3

1.7. Coordinator

Dr. János Lógó, associate professor (@: logo.janos@epito.bme.hu)

1.8. Department

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

1.9. Website

<http://www.epito.bme.hu/BMEEOTMMN61>

1.10. Language of instruction

Hungarian and English

1.11. Curriculum requirements

- elective in the Structural engineering (MSc) programme

1.12. Prerequisites

- none

1.13. Effective date

from 1 September 2017.

2. OBJECTIVES AND LEARNING OUTCOMES

2.1. Objectives

The purpose of the subject is, that the students acquire the basic concepts and methods of plasticity. In the frame of this they will get to know the material models, yield and hardening conditions of plasticity. The torsion problem of prismatic bars, and planar problems of solids will be learnt through examples and applications. There will be an emphasis given to the plastic load bearing capacity of elasto-plastic frame structure, and their limit states.

2.2. Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. is familiar with the basic concepts of plasticity, the general formulas of the material models of elasto-plastic materials,
2. knows the Huber-Mises-Hencky yield condition,
3. knows the Tresca yield condition,
4. knows the basic equations of elasto-plastic materials,
5. is familiar with the pinciple of virtual displacements and the principle of virtual forces,
6. is familiar with the extremum priciples of elasticity,
7. knows the principle of constant stresses in plasticity, and its consequences,
8. is familiar with the static and kinematic principle of the plastic limit state analysis, and applies it for frame structures,
9. is familiar with the concept of shakedown
10. knows the basics of mathematical programming for the solution of plasticity problems,
11. is familiar with the theory of the torsion analysis of elaso-plastic prismatic bars,
12. is familiar with the problems of plasticity in the case of planar problems,

B. Skills

1. is able to write the general formulas describing the material laws of elasot-plastic materials,
2. is able to write the Huber-Mises-Hencky yield condition,
3. is able to write the Tresca yield condition,
4. analyses and compares the results of the Huber-Mises-Hencky and the Tresca yield conditions,
5. derives the static theorem of the constant stress of plasticity, and uses it accordingly,
6. speaks out the static theorem of plastic limit state analysis, and applies it to beam structures,
7. speaks out the kinematic theorem of plastic limit state analysis, and applies it to beam structures,,
8. derives the thorem of torsion of elasto-plastic prismatic bars, and applies its results correctly,
9. shows the shakedown anlysis with its static theorem and applies it for the shakedown analysis of a beam structure,
10. is able to solve planar problems of plasticity,

C. Attitudes

1. endeavors to discover and routinely use the tools necessary to the problem solving of plasticity problems,
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 exercise classes
1.	Introduction. Basic concepts. Material models of plasticity
2.	Yield and hardening conditions
3.	Deformation- and incremental theorems of plasticity
4.	Basic equations of elasto-plastic bodies
5.	Work and extremum theorems. Extremum theorems of plasticity
6.	Torsion of prismatic bars.
7.	Planar strain and stress state
8.	Planar strain and stress state
9.	Plastic load carryng capacity of elasto-plastic bar structures
10.	Plastic shakedown analysis. Static and kinematic theorems, application for bar structures.
11.	Application of mathematical programming in limit state analysis and shakedown analysis..
12.	Analysis of the state change of elasto-plastic frame structures
13.	Analysis of the state change of elasto-plastic frame structures
14.	Analysis of the state change of elasto-plastic frame 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: Kaliszky Sándor: Plasticity Theory and Engineering Applications. Akadémiai Kiadó, 1989.
Kaliszky Sándor: Képlékenységtan elmélet és alkalmazások. Akadémiai Kiadó, 1975.
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2.6. Other information

1. 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.
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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: logo.janos@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 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 (type)	abbrev.	assessed learning outcomes (2.2)
1st mid-term test (summarizing check)	ZH1	A 1-6, B 1-5, C 1-3, D 1-2
2nd mid-term test (summarizing check)	ZH2	A 7-12, B 6-10, C 1-3, D 1-2

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)	50%
ZH2 (2nd mid-term test)	50%
sum in the midterm	100%

3.4. Requirement 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.:

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

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	14x2=28
preparation for lessons during the semester	14x2=28
preparation for the checks	18+16=34
in total	90

3.8. Effective date

from 1 September 2017.