NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Mechanics

REVIEWED
at the meeting of the Faculty of Design and Engineering

"__10__" ___06_____2025

CURRICULUM OF ACADEMIC DISCIPLINE

0k 14 Mechanics of materials and constructions

Area of knowledge	19 "Architecture and Construction"
Specialty	192 "Building and civil engineering"
Academic programme	Building and civil engineering
Faculty	Faculty of Design and Engineering

Developed by: Assoc. Prof. of Department of Mechanics, Ph. D. of Physical and Mathematical Sciences, Assoc. Prof. _____ Anastasiia KUTSENKO

Kyiv – 2025

Description of the discipline **Mechanics of materials and constructions**
(name)

Academic degree, specialty, academic programme			
Academic degree	Bachelor		
Specialty	19 "Architecture and construction"		
Academic programme	192 " Building and engineering of the city"		
Characteristics of the discipline			
Type	compulsory		
Total number of hours	180		
Number of ECTS credits	6		
Number of modules	5		
Course project (work) (if any)	*1*		
Form of assessment	*credit* / *exam*		
Indicators of the discipline for full-time and part-time forms of university study			
	Full-time		Part-time
Year of study	2		2
Semester	*3*	*4*	
Lectures	*30 hours.*	*30* hours.	
Practical classes and seminars	*30* hours.	*30* hours.	
Laboratory classes	-.	-	
Self-study	*30 hours.*	*15 hours.*	
Coursework	*15 hours.*		
Number of hours per week for full-time students	*4 hours*	4 *hours*	

1. Aim, objectives, competences and expected learning outcomes of the discipline

Aim is skills of solving problems of Mechanics of materials and structures and laying the basis for the study subjects: "Structural mechanics", "Concrete and masonry structures", "Metal and wooden structures".

Objectives are the study of the methods of calculation of structures for strength, rigidity and stability; the study of the stress-strain state of the beam at tension and compression, at direct shear, at torsion and at bend.

Acquisition of competences:

Integral competence (IC):

IC. It is the ability to solve complex specialized problems of construction and civil engineering in the learning process, which involves the application of a complex of theories and methods for determining the strength, stability, deformation, modeling, strengthening of building structures; further safe operation, reconstruction,

construction and installation of buildings and engineering structures; application of automated design systems in the branch of construction.

General competences (GC)::

GC1 – The ability to think abstractly, analyze and synthesize.

GC2 - The knowledge and understanding of the subject area and professional activity.

GC6 – The ability to search, to process and to analyze information from various sources.

GC7 –The interpersonal skills.

Special (professional) competences (SC):

SC1 – The ability to use conceptual scientific and practical knowledge in mathematics, chemistry and physics to solve complex practical problems in the branch of construction and civil engineering.

SC7 – The ability to take responsibility for making and making decisions in the branch of architecture and construction in unpredictable work conditions.

Expected Learning Outcomes (ELO):

ELO 2 – The participate in research and development in the branch of architecture and construction.

ELO 7 – The collect, the interpret and an apply data, including through the search, processing and analysis of information from various sources.

ELO 17 – The mastering of skills of effective independent work (course and thesis design) or in a group (laboratory work, including leadership skills in their implementation); efficiency of work in conditions of limited time with an emphasis on professional integrity and academic integrity.

2. The program and structure of discipline for

- full-time form of study;

Title of thematic modules and Topics	Hour numbers												
	Daily learning							Distance learning					
	weeks	total	including					Total	Including				
			l	p	lab	ind	s.st		l	p	lab	ind	s.st
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module 1: **Tension and Compression**													
Topic 1. Purpose and objectives of the course. The basic hypotheses and the definitions of the mechanics of materials and constructions.	1	2	2										
Topic 2. The relation among internal forces and tensions in case of tension or compression of the bar.	2	6	2	2		2							

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Topic 3. The method of calculating the bar on strength	3	8	2	4		2							
Topic 4. The method of calculating the bar on rigidity	4	6	2	2		2							
Topic 5. The first moment of area	5	8	2	2		4							
Total of module 1		30	10	10		10							
Module 2:**Torsion**													
Topic 1. The geometric characterizations of the plane cross sections.	6	6	2	2		2							
Topic 2. The geometric characterizations of the plane cross sections.	7	4	2	2									
Topic 3. The direct shear stresses.	8	6	2	2		2							
Topic 4. The definition of torsion.	9	6	2	2		2							
Topic 5. The method of calculating the bar on strength and rigidity by torsion	10	8	2	2		4							
Total of module 2		30	10	10		10							
Module 3: **Beam bending**													
Topic 1. The equation of Shearing force for the cantilever and simple beams	11	6	2		2	2							
Topic 2. The equation of Bending moment for the cantilever and simple beams.	12	6	2		2	2							
Topic 3. The calculation method cantilever beam on the strength by the normal stresses	13	6	2		2	2							

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Topic 4. The calculation method simple beam on the strength by the normal stresses.	14	6	2		2	2							
Topic 5. The calculation method simple beam on the strength by the normal stresses.	15	6	2		2	2							
Total of module 3		30	10		10	10							
Total for Semester 3		90	30		30	30							
Module 4. **Methods of defininding of beam deformations**													
Topic 1. Double – integration method.	1	6	2		2								
Topic 2. Verescagin´s rule.	2	6	2		2	2							
Topic 3. Castigliano´s theorem.	3	4	2		2	2							
Topic 4. The construction method of the diagram of shear-force and bending-moment for the cantilever frame	4	4	2		2								
Topic 5. The construction method of the diagram of shear-force and bending-moment for the simple frame.	5	4	2		2								
Topic 6. The curveted beam.	6	6	2		2	2							
Topic 7. The definitions of the statically indeterminate constructions.	7	4	2		2								
Topic 8. The application of the Castigliano´s theorem to the statically indeterminate constructions.	8	4	2		2								
Total of module 4		38	16		16	6							

1	2	3	4	5	6	7	8	9	10	11	12	13	14
The thematic module 5: **The complex deformations**													
Topic 1. The three moment's theorem.	9	4	2		2								
Topic 2. The application of the Verescagin´s rule to the statically indeterminate constructions.	10	5	2		2	1							
Topic 3. Analysis of Stress and Strain in the case of the action of compression and bending at one time	11	6	2		2	2							
Topic 4. Analysis of Stress and Strain in the case of the action of tension and bending at one time	12	6	2		2	2							
Topic 5. Analysis of Stress and Strain in the case of the action of two bending moments at one time, which acting in perpendicular planes	13	6	2		2	2							
Topic 6. The calculation method of column.	14	6	2		2	2							
Topic 7. Analysis of Stress and Strain in the case of the action of bending and torsion at one time.	15	6	2		2								
Total of module 5		37	14		14	9							
Total for Semester 4		75	30		30	15							
Total hours		165	60		60	45							

3. Topics of Lectures

№	Topic title	Hour numbers
3 semester		
1	Purpose and objectives of the course. The basic hypotheses and the definitions of the mechanics of materials and constructions.	2
2	The relation among internal forces and tensions in case of tension or compression of the bar.	2

3	The method of calculating the bar on strength	2
4	The method of calculating the bar on rigidity	2
5	The first moment of area	2
6	The geometric characterizations of the plane cross sections.	2
7	The geometric characterizations of the plane cross sections.	2
8	The direct shear stresses.	2
9	The definition of torsion.	2
10	The method of calculating the bar on strength and rigidity by torsion	2
11	The equation of Shearing force for the cantilever and simple beams	2
12	The equation of Bending moment for the cantilever and simple beams.	2
13	The calculation method cantilever beam on the strength by the normal stresses	2
14	The calculation method simple beam on the strength by the normal stresses.	2
15	The calculation method simple beam on the strength by the normal stresses.	2
4 semester		
16	Double – integration method.	2
17	Verescagin´s rule.	2
18	Castigliano´s theorem.	2
19	The construction method of the diagram of shear-force and bending-moment for the cantilever frame	2
20	The construction method of the diagram of shear-force and bending-moment for the simple frame.	2
21	The curveted beam.	2
22	The definitions of the statically indeterminate constructions.	2
23	The application of the Castigliano´s theorem to the statically indeterminate constructions.	2
24	The three moment's theorem.	2
25	The application of the Verescagin´s rule to the statically indeterminate constructions.	2
26	Analysis of Stress and Strain in the case of the action of compression and bending at one time	2
27	Analysis of Stress and Strain in the case of the action of tension and bending at one time	2
28	Analysis of Stress and Strain in the case of the action of two bending moments at one time, which acting in perpendicular planes	2
29	The calculation method of column.	2
30	Analysis of Stress and Strain in the case of the action of bending and torsion at one time.	2

4. Topics of Practical classes

№	Topic title	Hour numbers
3 semester		
1	The calculation of the bar on strength.	2
2	The calculation of the bar on rigidity.	2
3	The geometric characterizations of the plane cross sections.	6
4	The direct shear stresses.	2
5		2
6	The method of calculating the bar on strength and rigidity by torsion.	2
7	The construction of diagram of Shearing force for the cantilever and simple beams.	2
8	The construction of diagram of Bending moment for the cantilever and simple	2

	beams.	
9	The calculation of cantilever beam on the strength by the normal stresses.	4
10	The calculation of simple beam on the strength by the normal stresses.	4
4 semester		
1	The calculation of beam strain by Verescagin´s rule.	2
2	The calculation of beam strain by the method of initial parameters.	2
3	The calculation of beam strain by the Castigliano´s theorem.	2
4	The construction of the diagrams of shear-force and bending-moment for the cantilever frame	2
5	The construction of the diagrams of shear-force and bending-moment for the simple frame.	2
6	The curveted beam.	2
7	The definitions of the statically indeterminate constructions.	2
8	The application of the Castigliano´s theorem to the statically indeterminate constructions.	4
9	The three moment's theorem.	2
10	The application of the Verescagin´s rule to the statically indeterminate constructions.	4
11	The calculation of column.	2
12	The calculation of beam in the case of at one time action of bending and torsion.	4

5. Topics for self-study

№	Topic title	Hour numbers
3 semester		
1	The calculation of the bar on strength and rigidity.	4
2	The geometric characterizations of the plane cross sections.	8
3	The direct shear stresses.	2
4	The method of calculating the bar on strength and rigidity by torsion.	6
5	The calculation of cantilever beam on the strength by the normal stresses.	5
6	The calculation of simple beam on the strength by the normal stresses.	5
4 semester		
1	The calculation of beam strain by Verescagin´s rule.	2
2	The calculation of beam strain by the Castigliano´s theorem.	2
3	The curveted beam.	2
4	The application of the Verescagin´s rule to the statically indeterminate constructions.	1
5	Analysis of Stress and Strain in the case of the action of compression and bending at one time	2
6	Analysis of Stress and Strain in the case of the action of tension and bending at one time	2
7	Analysis of Stress and Strain in the case of the action of two bending moments at one time, which acting in perpendicular planes	2
8	The calculation method of column.	2

6. Tools for assessing expected learning outcomes:

- exam;
- credit;
- module tests;
- graphic design works;presentation of laboratory and practical works;
- other types.

7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration, demonstration);
- video method (remote, multimedia, web-based, etc.);
- self-study (completing assignments);
- individual research work;

8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
3 semester		
Module 1. **Tension and compression**		
Practical work 1.	ELO 2, 7, 17. **Student should be know:** the basic hypotheses and the definitions of the mechanics of materials and constructions **Student should be able to:** built the diagrams of internal forces and tensions in case of tension or compression of the bar.	**8**
Practical work 2.		**8**
Practical work 3.		**8**
Practical work 4.		**8**
Practical work 5.		**8**
Module work 1.		**20**
Module work 2.		**30**
Testing Module 1		**10**
Total for module 1		**100**
Module 2. **Torsion**		
Practical work 6.	ELO 2, 7, 17. **Student should be know:** the main geometric characterizations of the plane cross sections; the relation among internal forces and tensions in cases of direct shear and torsion. **Student should be able to:** built the diagrams of internal forces and tensions in case of torsion of the bar.	**5**
Practical work 7.		**5**
Practical work 8.		**5**
Practical work 9.		**5**
Practical work 10.		**5**
Module work 3.		**25**
Module work 4.		**30**
Testing Module 2		**20**
Total for module 2		**100**

Module 3. **Beam bending**		
Practical work 11.	ELO 2, 7, 17. **Student should be know:** the equations of bending moment and shearing force for the cantilever and simple beams. **Student should be able to:** built the diagrams of internal forces and tensions in case of bending of the beam.	**10**
Practical work 12.		**10**
Practical work 13.		**5**
Practical work 14.		**10**
Practical work 15.		**10**
Module work 5.		**20**
Module work 6.		**25**
Testing Module 3		**10**
Total for module 3		**100**
Class work	**(M1 + M2 + M3)/3*0,7 ≤ 70**	
Credit		**30**
Total for 3 semester	**(Class work + credit) ≤ 100**	
Course project/work		**100**
4 semester		
Module 4. **Methods of defininding of beam deformations**		
Practical work 16.	ELO 2, 7, 17. **Student should be know:** the basis methods for definition the deformations of beam and frame. The definitions of the statically indeterminate constructions; the three moment's theorem. **Student should be able to:** define the deformations of beam and frame by different methods.	**10**
Practical work 17.		**10**
Practical work 18.		**10**
Practical work 19.		**10**
Practical work 20.		**12**
Practical work 21.		**12**
Practical work 22		**12**
Practical work 23.		**12**
Testing Module 4		**12**
Total for module 4		**100**
Module 5. **The complex deformations**		
Practical work 16.	ELO 2, 7, 17. **Student should be know:** Stress and Strain in the case of the action of complex deformations of construction. **Student should be able to:** calculate beam and frame by acting of complex Stress and Strain.	**10**
Practical work 17.		**10**
Practical work 18.		**10**
Practical work 19.		**10**
Practical work 20.		**12**
Practical work 21.		**12**
Practical work 22		**12**
Practical work 23.		**12**
Module work 7.		**12**
Testing Module 5		
Total for module 5		**100**
Class work	**(M1 + M2 + M3)/3*0,7 ≤ 70**	
Exam		**30**
Total for 4 semester	**(Class work + credit) ≤ 100**	

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment policy

Deadlines and exam retaking rules	*EXAMPLE:* works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	*EXAMPLE:* cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	*EXAMPLE:* Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids

1. e-learning course of the discipline

- https://elearn.nubip.edu.ua/course/view.php?id=3933;
- https://elearn.nubip.edu.ua/course/view.php?id=3934;

2. Mechanics of materials: Theory and Problems. Textbook / A. Kutsenko, M. Bondar, V. Pryshliak. 2d. Edition, – Kyiv, 2020. – 598 p.

10. Recommended sources of information

1. Beer F.P., Johnston E.R., et. al.: Mechanics of materials., 8th Edition, Graw – Hill.Inc., 2020. – 896 p.
2. John C.J., Ross C.T.F.: Strength of Materials and Structures. Arnold. – 719 p.
3. R. C. Hibbeler. Mechanics of Materials. The 7th Edition.pdf – 1724 p https://drive.google.com/file/d/0Bx1MM7wb0GgSR2tjV1lrVHpDTEU/view?resourcekey=0-DD5wLrtza9lI5b-rwDPHqg
4. Sharma S.C.: Strength_of_materials. Web Course. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IITROORKEE/strength%20of%20materials /homepage.htm
5. Educational videos of mechanics of materials https://www.bing.com/videos/search?q=mechanics+of+material+PDF&qpvt=mechanics+of+material+pdf&FORM=VDRE