

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Material Technology and Material Science (MTMS)

APPROVED

Faculty of Design and Engineering
“ 10 ” 06 2025 p.

CURRICULUM OF ACADEMIC DISCIPLINE

Building material science and welding in construction

Field of knowledge G " Engineering, manufacturing and construction "
Specialty G19 «Construction and civil engineering»
Academic program «Construction and civil engineering»
Faculty of Design and Engineering

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Description of the discipline **“Building material science and welding in construction”**

The course " Building material science and welding in construction " is a complex discipline that contains basic information about the methods of obtaining construction materials and methods of their physical, chemical and mechanical processing in order to give them the appropriate properties and formation necessary in construction.

The purpose of the discipline is the general technological training of a specialist in the field of construction, as well as the acquisition of skills in construction material science and the establishment of a base for studying the disciplines: "Reinforced concrete and stone structures", "Reliability of construction equipment", "Technology of construction production", "Wood structures and plastics", "Inspection and testing of buildings and structures".

Academic degree, specialty, academic programme		
Academic degree	Bachelor's	
Specialty	G19 «Construction and civil engineering»	
Academic programme	Construction and civil engineering	
Characteristics of the discipline		
Type	optional	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	7	
Course project (work) (if any)	-	
Form of assessment	Exam	Credit
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	Part-time
Year of study	1,2	1,2
Semester	2/3	2/3
Lectures	30/15 hr.	6/3 hr.
Practical classes and seminars	- hr.	- hr.
Laboratory classes	30/15 hr.	6/3 hr.
Self-study	15/15 hr.	48/54 hr.
Individual assignments	- hr.	- hr.
Number of hours per week for full-time students	4/2 hr.	-

1. Purpose, competencies and program results of the academic discipline

The **purpose** of the discipline is the general technological training of a future specialist in the field of construction, as well as the acquisition of skills in building materials science and the laying of a basis for studying the disciplines: “Reinforced concrete and stone structures”, “Reliability of construction equipment”, “Construction production technology”, “Wood and plastic structures”, “Inspection and testing of buildings and structures”.

Acquisition of competencies:

- integral competence (IC):

IC. The ability to solve complex specialized tasks of construction and civil engineering in the learning process, which involves the application of a set of theories and methods for determining the strength, stability, deformability, modeling, strengthening of building structures; subsequent safe

operation, reconstruction, erection and installation of buildings and engineering structures; the use of automated design systems in the field of construction.

- general competencies (GC):

GC2 – Knowledge and understanding of the subject area and professional activity.

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

GC7 – Interpersonal skills.

- special (professional) competencies of the specialty (GC):

GC1 – Ability to use conceptual scientific and practical knowledge in mathematics, chemistry and physics to solve complex practical problems in the field of construction and civil engineering.

GC4 – Ability to select and use appropriate equipment, materials, tools and methods for the design and implementation of technological processes in construction production.

GC7 – Ability to bear responsibility for developing and making decisions in the field of architecture and construction in unpredictable work contexts.

SC10 – Ability to ensure the organization and technology of construction production of agro-industrial, industrial, transport and civil facilities using modern energy-efficient technologies and structural materials.

Program learning outcomes (ELO):

ELO 01 – Apply basic theories, methods and principles of mathematical, natural, social and humanitarian and economic sciences, modern models, methods and software tools for decision-making support to solve complex construction and civil engineering problems.

ELO 02 – Participate in research and development in the field of architecture and construction.

ELO 04 – Design and implement technological processes of construction production, using appropriate equipment, materials, tools and methods.

ELO 07 – Collect, interpret and apply data, including by searching, processing and analyzing information from various sources.

ELO 08 – Rationally apply modern construction materials, products and structures based on knowledge of their technical characteristics and manufacturing technology.

2. The program and structure of the discipline

Modules and topics	Number of hours												
	Full-time							Part-time					
	Weeks	Total	Including					Total	Including				
			1	p	lab	ind	s.s.		1	p	lab	ind	s.s.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module 1. Raw materials and properties of building materials													
Topic 1. Classification, structure and composition of building materials	1	4	2	-	2	-	-	9	1	-	-	-	8
Topic 2. Carbon steels	2	7	2	-	2	-	3	11	1	-	2	-	8
Total for module 1	11		4	-	4	-	3	20	2	-	2	-	16
Module 2. Metallic materials													
Topic 1. Structure of metals and	3	8	2	-	6	-	-	10	1	-	1	-	8

alloys													
Topic 2. Carbon steels	4	4	2	-	2	-	2	10	1	-	1	-	8
Topic 3. Cast irons	5	6	2	-	2	-	-						
Topic 4. Theory of heat treatment	6	2	2	-	-	-	-						
Topic 5. Heat treatment technology	7	12	2	-	10	-	-						
Topic 6. Alloying	8	4	2	-	2	-	-						
Topic 7. Non-ferrous metals and their alloys	9	10	2	-	4	-	2						
Total for module 2	46		14	-	26	-	4	20	2	-	2	-	16
Module 3. Building solutions and mixtures													
Topic 1. Aggregates	10	2	2	-	-	-	-	7	1	-	1	-	5
Topic 2. Binders	11	2	2	-	-	-	-	6	-	-	1	-	5
Topic 3. Mixtures and solutions	-	4	-	-	-	-	4	7	1		-	-	6
Topic 4. Concretes	12	2	2	-	-	-	-						
Total for module 3	10		6				4	20	2	-	2	-	16
Module 4. Construction products and non-metallic materials													
Topic 1. Asbestos, silicate, gypsum and bitumen products	-	4	-	-	-	-	4	7	2	-	1	-	4
Topic 2. Ceramic materials and products. Polymeric materials	13	2	2	-	-	-	-	6	-	-	2	-	4
Topic 3. Rubber. Wood	14	2	2	-	-	-	-	8	-	-	-	-	8
Topic 4. Adhesive materials. Glass, paints, electrical insulating materials	15	2	2	-	-	-	-	8	-	-	-	-	8
Total for module 4	10		6	-	-	-	4	29	2	-	3	-	24
Total hours	75		30	-	30	-	15	60	6	-	6	-	48
Module 5. Welding theory and technology													
Topic 1.	1	3	1	-	2	-	-	7	1	-	-	-	6

Metallurgical processes in welding													
Topic 2. Electric arc welding	3	6	1	-	4	-	-	8	-	-	-	-	8
Topic 3. Gas welding	5	4	1	-	2	-	-	8	-	-	-	-	8
Topic 4. Special welding methods	7	6	1	-	2	-	2	8	-	-	-	-	8
Total for module 5	16		4	-	10	-	2	31	1	-	-	-	30
Module 6. Features of welding alloys and welded structures													
Topic 1. Features of welding alloys	9	7	2	-	-	-	5						
Topic 2. Welded structures	11	7	2	-	-	-	5						
Total for module 6	14		4	-	-	-	10						
Module 7. Stresses, strains, defects and quality control of welds													
Topic 1. Stresses and strains in welds	13	6	2	-	4	-	-						
Topic 2. Defects and quality control of welds	15	9	2	-	2	-	5						
Total for module 7	15		4	-	5	-	5						
Total hours	45		15	-	15	-	15	60	3	-	3	-	54
Total hours	120		45	-	45	-	30	120	9	-	9	-	102

3. Lecture topics

№	Topic title	Hours
1	Classification, structure and composition of building materials	2
2	Properties of building materials	2
3	Theory of alloys. Classification of metals. Properties of metals. Atomic-crystalline structure of metals. Defects of the internal structure of metals. Processes of melting and crystallization of metals. Main types of interaction of components in alloys.	2
4	Carbon steels	2
5	Cast irons	2
6	Theory of heat treatment.	2
7	Technology of heat treatment.	2
8	Alloying.	2

9	Aluminum, copper and alloys based on them	2
10	Fillers	2
11	Binders	2
12	Concretes	2
13	Ceramic materials and products. Polymeric materials	2
14	Rubber. Wood.	2
15	Adhesive materials. Glass. Paints. Electrical insulating materials	2
16	Metallurgical processes in welding	2
17	Electric arc welding	2
18	Gas welding	2
19	Special welding methods	2
20	Features of welding of alloys of different chemical composition	2
21	Welded structures	2
22	Stresses and deformations of welds	2
23	Defects of welds and their quality control	2

4. Laboratory topics

№	Topic title	Hours
1	Natural and artificial starting materials for construction	2
2	Determination of the hardness of construction materials	2
3	Macrostructural analysis of construction materials	2
4	Microstructural analysis of construction materials	2
5	Analysis of the phase diagram of "iron-carbon" alloys	2
6	Study of the microstructure of carbon construction steels	2
7	Study of the microstructure of cast irons	2
8	Bulk heat treatment of construction steels	2
9	Surface heat treatment of construction steels (hardening of steels)	2
10	Chemical-thermal treatment of construction steels	2
11	Heat treatment of reinforcing steels	2
12	The influence of heat treatment on the properties of construction steels	2
13	Study of the microstructure of alloyed steels	2
14	Study of the microstructure of copper and its alloys	2
15	Study of the microstructure of aluminum and its alloys. Babbitts	2
16	Metallurgical processes in welding	2
17	Construction of external characteristics of an electric welding transformer	2
18	Determination of modes and technological coefficients in electric arc welding of steel	2
19	Types of welded joints and methods of gas welding	2
20	Development of technology and modes of gas welding	2
21	Stress and deformation of welds	2
22	Defects of welds	2
23	Determination of defects in welded joints of building metal structures	2

5. Topics for self-study

№	Topic title	Hours
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1	Technological properties of materials	3
2	Aluminum deformed alloys strengthened by heat treatment	4
3	Building mortars and dry mixes	4
4	Asbestos, silicate, gypsum and bitumen products	4
5	Special welding methods	2
6	Features of welding nickel, titanium, lead, zirconium, tantalum, niobium and molybdenum and trusses of welded structures	5
7	Methods of reducing deformations and magnetic method of quality control of welds	5

6. Tools for assessing expected learning outcomes:

- exam;
- credit;
- module tests;
- presentation of laboratory works

7. Teaching methods

- 1) Verbal: -Lectures;
- 2) Visual:
 - Slides, video, visual material (perts, charts, stands).
- 3) Practical:
 - Laboratory work;
 - Training and factory practices;
 - Independent work.

8. Assessment of learning outcomes

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*

8.1. Distribution of points by types of educational activities

Type of educational activity	Learning outcomes	Evaluation
Module 1. Raw materials and properties of building materials		
Lecture 1	ELO 01, ELO 02, ELO 04, ELO 07, ELO 08 Know the basic classifications, structure and composition of building materials. Be able to choose the necessary methods for studying the properties of building materials based on knowledge of the operating conditions of a building structure.	-
Laboratory work 1		25
Lecture 2		-
Laboratory work 2		25
Self-study 1		20
Modular test 1		30
Total by module 1		100

Module 2. Metallic materials		
Lecture 3.	ELO 01, ELO 02, ELO 04, ELO 07, ELO 08 Know the basic relationships between the composition, structure and properties of steels and cast irons, alloyed steels, non-ferrous metals and alloys, as well as the patterns of changes in their properties under the influence of thermal, chemical or mechanical influences. Be able to choose the necessary steel and cast iron based on knowledge of the operating conditions of a building structure. Be able to choose the necessary heat treatment modes for building materials based on knowledge of the operating conditions of a building structure.	-
Laboratory work 3		5
Self-study 2		5
Lecture 4.		-
Laboratory work 4		5
Laboratory work 5		5
Laboratory work 6		5
Lecture 5.		-
Laboratory work 7		5
Lecture 6.		-
Laboratory work 8		5
Lecture 7.		-
Laboratory work 9		5
Lecture 8.		-
Laboratory work 10		5
Lecture 9.		-
Laboratory work 11		5
Laboratory work 12		5
Laboratory work 13		5
Laboratory work 14		5
Laboratory work 15	5	
Modular test 2	30	
Total by module 2	100	
Module 3. Building solutions and mixtures		
Lecture 10.	ELO 01, ELO 02, ELO 04, ELO 07, ELO 08 Know the main building solutions and mixtures, their purpose, properties. Be able to choose solutions and mixtures with the necessary properties and a specific purpose based on knowledge of the operating conditions of a building	-
Self-study 3		70
Lecture 11.		-
Lecture 12.		-

	structure.	
Modular test 3		30
Total by module 3		100
Module 4. Construction products and non-metallic materials		
Lecture 13.	ELO 01, ELO 02, ELO 04,	-
Lecture 14.	ELO 07, ELO 08	-
Lecture 15.	Know the main construction products and non-metallic materials, their purpose, properties. Be able to choose solutions and mixtures with the necessary properties based on knowledge of the operating conditions of construction products	-
Self-study 4		70
Modular test 4		30
Total by module 4		100
Educational work		70
Test		30
Total per course		100
3 semester		
Module 5. Welding theory and technology		
Lecture 16	ELO 01, ELO 02, ELO 04,	-
Laboratory work 16	ELO 07, ELO 08	10
Self-study 5	Know the classification of welding methods in construction. Classification and designation of welded joints.	20
Lecture 17		-
Laboratory work 17		10
Lecture 18		-
Laboratory work 18	Be able to calculate welded joints, welding modes for different welding methods.	10
Lecture 19		-
Laboratory work 19		10
Laboratory work 20		10
Modular test 5		30
Total by module 5		100
Module 6. Features of welding alloys and welded structures		
Lecture 20.	ELO 01, ELO 02, ELO 04,	-
Lecture 21.	ELO 07, ELO 08	-
Self-study 6	Know the features of welding different types of metals and the classification, features of the operation of building welded structures. Be able to calculate welding modes for different types of	70

	materials and welded structures.	
Modular test 6		30
Total by module 6		100
Module 7. Stresses, strains, defects and quality control of welds		
Lecture 22.	ELO 01, ELO 02, ELO 04, ELO 07, ELO 08 Know the classification of defects in welded joints, methods of quality control and testing.	-
Lecture 23.		-
Self-study 7		20
Laboratory work 21		10
Laboratory work 22		20
Laboratory work 23	Be able to choose methods of inspection of welded joints based on knowledge of the operating conditions of a building structure.	20
Modular test 7		30
Total by module 7		100
Educational work		70
Exam		30
Total per course		100

8.2. Distribution of points received by students

Student rating, points	National grading of exams and credits
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactorily

8.3. EVALUATION POLICY

<i>Deadline and resubmission policy:</i>	The student must submit the work within the deadlines set by the teacher. Works submitted after the deadlines without good reason are evaluated with a lower grade. Re-siting of modules is carried out with the permission of the lecturer if there are good reasons (for example, illness).
<i>Academic Integrity Policy:</i>	Cheating during tests and exams is prohibited (including using mobile devices). Coursework, essays must have correct text references to the literature used
<i>Attendance Policy:</i>	The student is obliged to attend all classes every day according to the established schedule, not to be late, to have an appropriate appearance. For objective reasons (for example, illness, international internship) training can take place individually (in online form in agreement with the dean of the faculty)

9. Teaching and learning aids

- E-learning of the academic discipline “Construction Materials Science and Welding in Construction”
- Part 1. <http://elearn.nubip.edu.ua/course/view.php?id=1168>
- Part 2. <http://elearn.nubip.edu.ua/course/view.php?id=2257>
 - lectures and presentations (in electronic form);
 - textbooks and manuals;
 - guidelines for studying a discipline by full-time and part-time students;
 - stands, posters;
 - equipment and various device.

10. Recommended sources of information

1. Афтанділянц Є.Г., Зазимко О.В., Лопатько К.Г. Будівельне матеріалознавство та зварювання в будівництві. Навчальний посібник. К.: НУБіП України, 2018.- с. 523.
2. Новомлинець, О. О. Будівельне матеріалознавство : навч. посіб. для здобувачів вищої освіти спец. 192 – Будівництво та цивільна інженерія / О. О. Новомлинець, М. М. Корзаченко, А. І. Сергеев. – Чернігів : НУ «Чернігівська політехніка», 2021. – 420 с.
3. Будівельне матеріалознавство. Лабораторний практикум для студентів спеціальності «Будівництво та цивільна інженерія» / С.М. Скребнєва, В.В. Грабовчак, А.І. Глушаниця/ – К.: НАУ, 2019. – 88 с.
4. Афтанділянц Є.Г., Зазимко О. В., Лопатько К.Г. Технологія конструкційних матеріалів і матеріалознавство. Навчальний посібник. Металознавство. Київ, НУБіП України. 2020- с.334.
5. Афтанділянц Є.Г., Зазимко О. В., Лопатько К.Г. Технологія конструкційних матеріалів і матеріалознавство. Курс лекцій. Частина II. **Металознавство**. Київ, НУБіП України. 2020- с.356.
6. Опальчук А.С., Афтанділянц Є.Г., Роговський Л.Л., Семеновський О.Є., Клендій М.Б., Біловод О.І., Дудніков І.А., Матеріалознавство і технологія конструкційних матеріалів: підручник для вищих навчальних закладів III-IV ступенів акредитації; за ред. А.С. Опальчука і О.Є. Семеновського. – Ніжин: Видавець ПП. Лисенко М.М., 2013. – 752 с.
7. Спеціальні види бетонів: характеристика основних складів - <https://probud.in.ua/spetsialni-vidi-betoniv-harakteristika-osnovnih-skladiv.html>
8. Марки сталей і сплавів: властивості та характеристики <https://metinvestholding.com/ua/products/steel-grades>
9. Що таке чавун? Характеристики металу, особливості виробництва і застосування <https://metinvest-smc.com/ua/articles/chto-takoe-chugun-kharakteristiki-metalla-osobennosti-proizvodstva-i-primeneniya/>
10. Сплави кольорових металів <https://uk.wikipedia.org/wiki/%D0%A1%D0%BF%D0%BB%D0%B0%D0%B2%D0%B8%D0%BA%D0%BE%D0%BB%D1%8C%D0%BE%D1%80%D0%BE%D0%B2%D0%B8%D1%85%D0%BC%D0%B5%D1%82%D0%B0%D0%BB%D1%96%D0%B2>
11. Керамічні матеріали <https://www.pharmencyclopedia.com.ua/article/3477/keramichni-materiali>
12. Композиційні матеріали <https://mozok.click/1786-kompozicyn-materali.html>

13. Теплоізоляційні матеріали https://euroterm.com/brand-thermaflex/?gclid=EAIaIQobChMI15zGpYzl8QIVHQCIAx0gKg9iEAAYASAAEgJj1vD_BwE
14. Світлопрозорі конструкції. <https://stroyrec.com.ua/sv%D1%96tloprozor%D1%96-konstrykc%D1%96%D1%97-ogliad-pol%D1%96mernih-sv%D1%96tloprozorih-mater%D1%96al%D1%96v/>