NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Material Technology and Material Science (MTMS)

" APPROVED "
Dean of the Faculty Design and Engineering
_____ Zinoviy RUZHYLO
"___" _____2024

"APPROVED"
at a meeting of the department MTMS
Minutes № 15 of "14"05 2024
Head of Department
_____ Kostiantyn LOPATKO

"REVIEWED "
Guarantor of the "Construction and civil engineering"
_____ Yevhen DMYTRENKO

CURRICULUM OF ACADEMIC DISCIPLINE

" Building material science and welding in construction "

Field of knowledge 19 "Architecture and construction"
Specialty 192 «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	192 «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. 1. Aim, objectives, competences and expected learning outcomes of the discipline

Aim of the discipline is the general technological training of the future 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", "Constructions with wood and plastics", "Inspection and testing of buildings and structures".

Objectives of studying the discipline is to study:

- methods of obtaining building materials;
- structure, properties and purpose of building materials;
- basics of construction materials processing;
- structure, properties and purpose of metal materials for construction

Acquisition of competencies:

Integral competence (IC):

IC. The ability to solve complex specialized construction and civil engineering tasks in the learning process, which involves the application of a complex of theories and methods for determining the strength, stability, deformability, modeling, strengthening of building structures; further safe operation, reconstruction, construction and installation of buildings and engineering structures; application 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 (SC):

SC1 – 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.

SC4 – Ability to choose and use appropriate equipment, materials, tools and methods for designing and implementing technological processes of construction production.

SC7 – Ability to take responsibility for making 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 construction materials.

Expected learning outcomes (ELO):

ELO01 – Apply basic theories, methods and principles of mathematical, natural, social, humanitarian and economic sciences, modern models, methods and decision support software to solve complex construction and civil engineering problems.

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

ELO04 – Design and implement technological processes of construction production, using appropriate equipment, materials, tools and methods.

ELO07 – Collect, interpret and apply data, including through the search, processing and analysis of information from various sources.

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

2. The program and structure of the discipline for:

– full-time (part-time) form of study;

– reduced full-time (part-time) form of study.

Modules and topics	**Number of hours**												
	Full-time							**Part-time**					
	Weeks	Total	Including					In 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. **Metal science**													
Topic 1. Classification, structure and	1-2	16	4	-	10	-	2	9	1	-	-	-	8

composition of building materials													
Topic 2. Carbon steels and cast irons	3-4	10	4	-	4	-	2	11	1	-	2	-	8
Total for module 1	26		8	-	14	-	4	-	20	2	-	2	-
Module 2. **Heat treatment of building materialss**													
Topic 3. The theory of heat treatment	5-6	4	1	-	2	-	1	10	1	-	1	-	8
Topic 4. Technology of heat treatment	7-8	5	1	-	2	-	-2	10	1	-	1	-	8
Total for module 2	9		2	-	4	-	-3	-	20	2	-	2	-
Module 3. **Alloy and non-ferrous alloys, inorganic and organic binders, aggregates, concretes, ceramic and polymeric materials**													
Topic 5. The alloying theory	9-12	12	4	-	6	-	2	7	1	-	1	-	5
Topic 6. Non-ferrous metals and alloys	13	6	2	-	2	-	2	6	-	-	1	-	5
Topic 7. Inorganic and organic binders, aggregates, concretes, ceramic and polymeric materials	14-15	22	14		4	-	4	7	1		-	-	6
Total for module 3	40		20	-	12	-	8	-	20	2	-	2	-
Total hours	75		30	-	30	-	15	-	60	6	-	6	-
Module 4. **Welding technology in construction**													
Topic 8. Formation of welded joints and weldability of metal. Classification of welding methods in construction	1-2	5	2	-	2	-	1	7	2	-	1	-	4
Topic 9. Arc welding: manual arc welding with a fusible electrode, automatic arc welding with a fusible electrode, arc welding in shielding gases, arc welding with a non-fusible electrode, special types of arc welding.	3-4	6	2	-	2	-	2	6	-	-	2	-	4
Topic 10. Plasma welding. Electroslag welding. Gas welding.	5-6	6	2	-	2	-	2	8	-	-	-	-	8
Topic 11. Hot welding tools. Cold welding tools. Radiation welding. Inspection of welded	7-8	6	2	-	2	-	2	8	-	-	-	-	8

joints													
Total for module 4	23		8	-	8	-	7	-	29	2	-	3	-
Module 5. **Welding in construction**													
Topic 12. Classification of welded structures. Features of welding of different types of metals. Basic types of welded joints. Operation of welded joints under different load conditions.	9-10	6	2	-	2	-	2	7	1	-	-	-	6
Topic 13. Construction welded metal structures: frames of industrial buildings, welded beams, trusses and columns, sheet solid building structures	11-12	6	2	-	2	-	2	8	-	-	-	-	8
Topic 14. Machine-building welded structures and pipelines	13-14	6	2	-	2	-	2	8	-	-	-	-	8
Topic 15. New technologies in construction.	15	4	1	-	1	-	2	8	-	-	-	-	8
Total for module 5	22		7	-	7	-	8	-	31	1	-	-	-
Total hours	45		15	-	15	-	15	-	60	3	-	3	-
General hours	120		45	-	45	-	30	-	120	9	-	9	-

3. Topics of laboratory (practical, seminar) classes

№	Topic title	Hours
1	Macrostructural analysis of metals and alloys	2
2	Microstructural analysis of metals and alloys.	2
3	The study diagrams of binary alloys	2
4	The thermal method of analysis of metals and alloys. Construction of diagrams of tin-zinc alloys.	2
5	The analysis of state diagram of iron-carbon alloys	2
6	Study of the microstructure of carbon steels at equilibrium state	2
7	Study of microstructure of cast irons	2
8	Structural changes in the carbon steel at heating.	2
9	Annealing and normalization of carbon steels. Study of microstructure and hardness changes	2
10	Quenching of carbon steels	2
11	Tempering of quenching steels	2

12	Determination of critical temperatures of steels by method of test quenchings	2
13	Determination of carbon steel microstructure in a nonequilibrium state	2
14	Surface hardening steels by high frequency currents	2
15	Chemical heat treatment of steels	2
16	Definition hardenability steels	2
17	Study of microstructure of alloy steels	2
18	Development of technological process of the heat treatment of parts of agricultural machines	2
19	Study of the microstructure of copper alloys	2
20	Study of the microstructure of aluminum alloys	2
21	Study of microstructure babbits	2
22	Composite and bimetallic materials	2
23	Materials with shape memory	1
Total		45

4. Topics for self-study

№	Topic title	Hours
1	Technological properties of materials	3
2	Deformed aluminum alloys strengthened by heat treatment	4
3	Construction mortars and dry mixes	4
4	Asbestos, silicate, gypsum and bituminous products	4
5	Special welding methods	5
6	Features of welding of nickel, titanium, lead, zirconium, tantalum, niobium and molybdenum and trusses of welded structures	5
7	Methods of reducing deformations and the magnetic method of quality control of welds	5
Total		30

5. Tools for assessing expected learning outcomes:

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

6. Teaching methods.

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

7. Assessment methods

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

8. Distribution of points received by students.

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*.

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

To determine a student's rating in the discipline $\mathbf{R_{DIS}}$ (up to 100 points), the received assessment rating $\mathbf{R_A}$ (up to 30 points) is added to the academic performance raiting $\mathbf{R_{AP}}$ (up to 70 points): $\mathbf{R_{DIS} = R_{AP} + R_A}$.

9. Teaching and learning aids

- e-learning course of the discipline «Building material 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. Aftandiliants Y., Stepanechko O., Zazymko O. Material Science: Textbook. Київ, НУБіП України, 2022.- с. 528.
2. Construction materials engineering. Tutorial/Y. Aftandilyants, O. Zazymko, O. Ivanova, K. Lopat'ko //Kyiv: NULES of Ukraine, 2017.-p. 523
3. Афтанділянц Є.Г., Зазимко О.В., Лопатько К.Г. Будівельне матеріалознавство та зварювання в будівництві. Навчальний посібник. К.: НУБіП України, 2018.- с. 523.
4. 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. Сергеєв. – Чернігів : НУ «Чернігівська політехніка», 2021. – 420 с.
5. 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.
6. Афтанділянц Є.Г., Зазимко О. В., Лопатько К.Г. Технологія конструкційних матеріалів і матеріалознавство. Навчальний посібникІ. Металознавство. Київ, НУБіП України. 2020- с.334.
7. Афтанділянц Є.Г., Зазимко О. В., Лопатько К.Г. Технологія конструкційних матеріалів і матеріалознавство. Курс лекцій. Частина ІІ. Металознавство. Київ, НУБіП України. 2020- с.356.
8. 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.
9. Спеціальні види бетонів: характеристика основних складів - https://probud.in.ua/spetsialni-vidi-betoniv-harakteristika-osnovnih-skladiv.html
10. Марки сталей і сплавів: властивості та характеристики https://metinvestholding.com/ua/products/steel-grades
11. Що таке чавун? Характеристики металу, особливості виробництва і застосування https://metinvest-smc.com/ua/articles/chto-takoe-chugun-kharakteristiki-metalla-osobennosti-proizvodstva-i-primeneniya/
12. 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
13. Керамічні матеріали https://www.pharmencyclopedia.com.ua/article/3477/keramichni-materiali
14. Композиційні матеріали https://mozok.click/1786-kompozicyn-materali.html
15. Теплоізоляційні матеріали https://euroterm.com/brand-thermaflex/?gclid=EAIaIQobChMI15zGpYzl8QIVHQCiAx0gKg9iEAAYASAAEgJj1vD_BwE
16. 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/