National University of Life and Environmental Sciences of Ukraine
Department of Material Technology and Material Science (MTMS)

"APPROVED"
Dean of Faculty Design and
Engineering Faculty

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 AP Sectoral mechanical engineering

Volodymyr BULGAKOV

CURRICULUM OF ACADEMIC DISCIPLINE
"Material Science"

Field of knowledge 13 " Mechanical engineering "
Speciality 133 "Sectoral mechanical engineering"
Academic program Sectoral mechanical engineering
Faculty of Design and Engineering

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Description of the discipline
"Material Science"

Academic degree, specialty, academic programme		
Academic degree	*Bachelor's*	
Speciality	133 "Sectoral mechanical engineering"	
Academic program	Sectoral mechanical engineering	
Characteristics of the discipline		
Type	Obligatory	
Total number of hours	150	
Number of credits ECTS	5	
Number of thematic modules	-	
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 (course)	2	1/2
Semester	3/4	2/3
Lectures	*30/15* hr.	*2/4* hr.
Practical, seminar classes	-	-
Laboratory classes	*30/15* hr.	*2/6* hr.
Self-study	*30/30* hr.	*-/232* hr.
Individual assignments	- hr.	- hr.
Number of hours per week for full-time students	*4/2* hr.	*13/14* hr.

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

Aim of the discipline is skills of Materials Science and laying the basis for the study subjects: "Machine parts", "Hoisting machinery", "Tractors and cars", "Agricultural and meliorative machines", "The safety and repair of machines."

Objectives of studying the discipline is to study:

- the methods of obtaining metals and alloys;
- the structure, properties and destination of metals and alloys;
- the basic theory of heat treatment of carbon and alloy steels, their technology heat and chemical-heat treatment, as well as specific details and working of agricultural machines;
- the structure, properties and appointment of non-metallic construction materials.

Acquisition of competencies:

- Integral competence (IC):

The ability to solve complex specialized tasks and solve practical problems in the field of mechanical engineering using the theories and methods of modern science based on a systems approach and taking into account the complexity and uncertainty of the operating conditions of technological systems.

General competencies (GC):

GC2. Ability to apply knowledge in practical situations.

GC5. Ability to generate new ideas (creativity).

GC8. The ability to act socially responsibly and consciously.

GC13. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.

Special (professional) competences of the specialty (SC):

SC6. The ability to evaluate the technical and economic efficiency of typical systems and their components based on the application of analytical methods, analysis of analogues and the use of available data.

SC9. The ability to carry out commercial and economic activities in the field of mechanical engineering.

Expected learning outcomes (ELO):

ELO04. Carry out engineering calculations to solve complex problems and practical problems in industrial mechanical engineering.

ELO06. Search for the necessary scientific and technical information in available sources, in particular, in a foreign language, analyze and evaluate it.

ELO09. Choose and apply the necessary equipment, tools and methods.

ELO12. Apply means of technical control to evaluate the parameters of objects and processes in industrial mechanical engineering.

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					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
The module 1. **Metal science**													
Topic 1. The theory of alloys	1-2	8	4	-	4	-	2	22	2	-	-	-	20
Topic 2. Carbon steels and cast irons	3-5	12	6	-	6	-	3	22	-	-	2	-	20
Total for module 1	25		10	-	10	-	5	44	2	-	2	-	40
The module 2. **Bases of heat treatment of metals and alloys**													
Topic 1. The theory of heat treatment	6-8	12	6	-	6	-	2	22	2	-	-	-	20
Topic 2. Technology of heat treatment	9-11	12	6	-	6	-	3	22	-	-	2	-	20
Total for module 2	29		12	-	12	-	5	44	2	-	2	-	40
The module 3. **Alloyed steels and alloys**													
Topic 1. The alloying theory	12-13	8	4	-	4	-	2	22	2	-	-	-	20
Topic 2. Classification of alloy steels, marking and their use in agriculture	14-15	8	4	-	4	-	3	22	-	-	2	-	20
Total for module 3	21		8	-	8	-	5	44	2	-	2	-	40
The module 4. **Steels and alloys with special properties**													
Topic 1. Corrosion	1-2	4	2	-	2	-	2	20	-	-	-	-	20

and heat resistant steels and magnetic alloys.													
Topic 2. Amorphous, bimetallic and composite materials and materials with shape memory	3-5	4	2	-	2	-	3	20	-	-	-	-	20
Total for module 4	13		4	-	4	-	5	40	-	-	-	-	40
The module 5. **Non-ferrous metals and alloys**													
Topic 1. Copper, aluminum, titanium, magnesium and their alloys	6-8	8	4	-	4	-	2	20	-	-	-	-	20
Topic 2. Zinc, lead. Solders. Antifriction alloys	9-11	6	3	-	3	-	3	20	-	-	2	-	20
Total for module 5	19		7	-	7	-	5	40	-	-	2	-	40
The module 6. Nonmetallic construction materials													
Topic 1. Polymers and plastics. Rubber. Glue materials. Inorganic glass.	12-13	4	2	-	2	-	2	16	-	-	-	-	16
Topic 2. Paints and insulating materials. Wood.	14-15	4	2	-	2	-	2	16	-	-	-	-	16
Total for module 6	12		4	-	4	-	4	40	-	-	-	-	40
Total hours	119		45	-	45	-	29	246	6	-	8	-	232

3. Topics of laboratory classes

№	Topic title	Hours
3 semester		
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

4 semester		
1	Definition hardenability steels	2
2	Study of microstructure of alloy steels	2
3	Development of technological process of the heat treatment of parts of agricultural machines	2
4	Study of the microstructure of copper alloys	2
5	Study of the microstructure of aluminum alloys	2
6	Study of microstructure babbits	2
7	Composite and bimetallic materials	2
8	Materials with shape memory	1

4. Topics for self-study

№	Topic title	Number of hours
1	Ferrous metals	2
2	Non-ferrous metals	3
3	Defects of the crystal structure	2
4	Mechanical properties	3
5	Anisotropy and isotropy	2
6	The classification of carbon steels	3
7	Ordinary plain carbon steels	2
8	Quality plain carbon steels	3
9	High quality carbon steels	2
10	Composition and destination of USA carbon steels	3
11	Microstructural analysis	2
12	Poldi hardness	2

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;
   - self-study.

7. Assessment methods

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

8. Distribution points that receive 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 «Material Science» (https://nubip.edu.ua/sites/default/files/u374/2_z_eng_robocha_programa_materialoznavstvo_2023_0.pdf)
- 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. Афтанділянц Є.Г., Зазимко О.В., Лопатько К.Г. Матеріалознавство: Підручник (Гриф надано Міністерством освіти і науки, молоді та спорту України, лист №1/11-18055 від 20 листопада 2012 р.). Херсон, Видавець Грінь Д.С., 2013.- с 612.
3. Практикум з матеріалознавства. Навчальний посібник. (гриф МОН (лист № 1/11-4472 від 27.02.2013 р.))/ Котречко О. О. Зазимко, К.Г. Лопатько, Є.Г. Афтанділянц, Гнилоскуренко В. В.// Херсон: Олді Плюс, 2013.-с. 500.
4. 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.
5. Попович В., Голубець В., Технологія конструкційних матеріалів і матеріалознавство: Навчальний посібник для вищих навчальних закладів: У 2-х кн. Книга II. – Суми: ВТД «Університетська книга», 2002. – 260 с.
6. Афтанділянц Є.Г., Зазимко О. В., Лопатько К.Г., Технологія конструкційних матеріалів і матеріалознавство. Курс лекцій. Частина 1. Металургія. Київ, НАУ, 2005.- с.115.
7. Хільчевський В.В. та ін., Матеріалознавство і технологія конструкційних матеріалів, К: Либідь, 2002, 326с.
8. Бялік О.М., Металознавство, К: Політехніка, 2002, 383с.
9. Матеріалознавство і технологія металів. http://univer.nuczu.edu.ua/tmp_metod/924/MZTM_KONSP_LEK.pdf
10. Особливості хіміко-термічної обробки металів і сплавів. https://fizmat.7mile.net/materialoznavstvo/3_4_2-himiko-termichna-obrobka.html

11. Класифікація та обладнання нагрівальних печей. https://fizmat.7mile.net/materialoznavstvo/3_3_5-nagrivalni-pechi.html 4. Термічна обробка виробів із сталі. https://www.youtube.com/watch?v=8UvkV92z2fI
12. Термічна обробка і структури. https://www.youtube.com/watch?v=7mpAt7h317c