

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL
SCIENCES OF UKRAINE

Material Science and Material Technology Department

"APPROVED"
Faculty of Design and Engineering

“_10_”_06_ 2025

CURRICULUM OF ACADEMIC DISCIPLINE

Technology of construction materials

Field of knowledge G Engineering, manufacturing and building industry
Specialty G11 Mechanical engineering (for specializations)
Academic programme Mechanical engineering
Faculty Design and Engineering
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Description of the discipline

The course "Technology of construction Materials" is a comprehensive discipline that contains basic information about methods of obtaining metals from ores, technologies for obtaining blanks, and methods of their physicochemical and mechanical processing in order to give them the specified properties and design parameters necessary in mechanical engineering technology.

Field of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor	
Specialty	G11 Mechanical engineering (for specializations)	
Academic programme	Mechanical engineering	
Characteristics of the discipline		
Type	compulsory	
Total number of hours	180	
Number of ECTS credits	6	
Number of modules	6	
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 hours.	2/6 hours.
Practical classes and seminars	-	
Laboratory classes	15/15 hours.	2/8 hours.
Self-study	60/45 hours.	-/356 hours.
Number of hours per week for full-time students	3/2 hours.	13/14 hours.

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

The work program of the course "Technology of Structural Materials" is designed for students of engineering faculties with mechanical engineering specialties.

The purpose of the discipline is the general technological training of a future specialist in the field of structural materials and their hot and cold processing, as well as acquiring skills in materials science and laying the foundation for studying the disciplines: "Machine Parts", "Lifting and Transport Machinery", "Tractors and Automobiles", "Agricultural and Reclamation Machinery", "Machine Reliability and Repair".

Acquisition of competencies:

Integral competence (IC): The ability to solve complex specialized tasks and solve practical problems in the field of mechanical engineering using 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 competences (GC):

GC5. Ability to generate new ideas (creativity).

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 engineering, to use various types and forms of physical activity for active recreation and leading a healthy lifestyle;

GC14. Ability to make decisions and act in accordance with the principle of non-acceptance of corruption and any other manifestations of dishonesty.

special (professional) competencies of the specialty (SC):

SC6. Ability to assess 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. Ability to carry out commercial and economic activities in the field of mechanical engineering.

Program Learning Outcomes (PLN) :

PLN1. Knowledge and understanding of the principles of technological, fundamental and engineering sciences that underlie mechanical engineering in the relevant industry.

PLN2. Knowledge and understanding of mechanics and mechanical engineering and the prospects for their development.

PH6. Find the necessary scientific and technical information in available sources, in particular, in a foreign language, analyze and evaluate it.

PLN6. Understand appropriate methods and have the skills to design typical assemblies and mechanisms in accordance with the task.

PLN10. Understand the problems of occupational safety and legal aspects of engineering activities in mechanical engineering, skills in predicting the social and environmental consequences of implementing technical tasks.

PLN13. Understand the structure and services of mechanical engineering enterprises.

2. Program and structure of the academic discipline

Names of content modules and topics	Number of hours													
	day uniform							Correspondence form						
	weeks	total	including					total	including					
			l	n	lab	ind	s.r.		l	n	lab	ind	s.r.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
2nd semester														
Module №. 1. Ferrous Metallurgy														
Topic 1. Course objectives and tasks. Methods of obtaining metals from ores.	1	6	2	-	2	-	2	4	2	-	2	-	-	
Topic 2. Metallurgy of blast furnace irons.	2	4	2	-	-	-	2	-	-	-	-	-	-	
Topic 3. Blast furnace products and their use.	3	6	2	-	2	-	2	-	-	-	-	-	-	

Topic 4. Steel metallurgy.	4	4	2	-	-	-	2	-	-	-	-	-	-
Topic 5. The influence of the method of steel production on its quality. Steel deoxidation processes.	5	6	2	-	2	-	2	-	-	-	-	-	-
Topic 6. Steel production in electric furnaces. Special methods for obtaining high-quality steels.	6	4	2	-	-	-	2	-	-	-	-	-	-
Topic 7. Steel casting. Structure of steel ingots.	7	6	2	-	2	-	2	-	-	-	-	-	-
Total by module 1	36		14	-	8	-	14	4	2	-	2	-	-
Module №. 2. Nonferrous metallurgy technology													
Topic 1. Nonferrous metallurgy. Copper. The essence of the process of obtaining copper from ores.	8	4	2	-	-	-	2	-	-	-	-	-	-
Topic 2. Obtaining and refining raw copper. Marking and use of copper in technology.	9	6	2	-	2	-	2	-	-	-	-	-	-
Topic 3. Aluminum. Electrolysis of alumina, aluminum refining.	10	4	2	-	-	-	2	-	-	-	-	-	-
Topic 4. Titanium-magnesium metallurgy. Production of refractory metals. Production of nickel.	11	6	2	-	2	-	2	-	-	-	-	-	-
Together by content module 2	20		8	-	4	-	8	-	-	-	-	-	-
Module №. 3. Fundamentals of powder metallurgy													
Topic 1. Introduction to powder metallurgy	12		4	2	-	-	-	2	-	-	-	-	-
Topic 2. Methods of obtaining powder products	13		11	4	-	3	-	4	-	-	-	-	-

Topic 3. Classification, labeling of powders and their application in mechanical engineering.	14-15	4	2	-	-	-	2	-	-	-	-	-	-
Total by module 3	19		8	-	3	-	8	-	-	-	-	-	-
Module №. 4. Foundry production													
Topic 1. Introduction. Methods of making castings and types of casting molds.	1	4	2		2			54	2		2		50
Topic 2. Casting, knocking out molds and cores, cleaning and cutting off castings.	2	6	3		3			52			2		50
Topic 3. Special methods of manufacturing castings. Technological features of manufacturing castings from various alloys	3	4	2		2			50					50
Total modulo 4	14		7		7			156	2		4		150
3rd semester													
Module №. 5. Pressure treatment of metals and ALLOYS													
Topic 1. Physical and technological foundations of metal deformation. Methods of increasing the plasticity of metals and alloys	4	4	2		2			54	2		2		50
Topic 2. Classification of pressure processing methods.	5	4	2		2			50					50
Total modulo 5	8		4		4			54	2	-	2	-	50
Module №. 6. Welding production technology													
Topic 1. Theoretical foundations of welding. Chemical-metallurgical and physical phenomena in the welding zone and their influence on the structure of the surrounding zone. Classification of	6	6	2		2		2		2				50

welding types.													
Topic 2. Electric arc and gas welding.	7-8	7	2		2		3			2			
Total modulo 6	13		4		4		5		2		2	116	
Total hours	180		45		30		105	374	8	-	10	-	356

3. Lecture topics

No.	Topic title	Q-ty, hours
1	Course objectives and tasks: Methods of extracting metals from ores.	2
2	Metallurgy of blast furnace irons.	2
3	Blast furnace products and their uses.	2
4	Steel metallurgy.	2
5	Steel casting. Structure of steel ingots.	2
6	Nonferrous metallurgy. Copper. The essence of the process of obtaining copper from ores.	2
7	Aluminum. Electrolysis of alumina, refining of aluminum.	2
8	Titanium-magnesium metallurgy. Production of refractory metals. Production of nickel.	2
9	Introduction to powder metallurgy.	2
10	Methods of obtaining powder products	4
11	Classification, labeling of powders and their application in mechanical engineering.	2
12	Introduction. Methods of making castings and types of casting molds.	2
13	Pouring, knocking out molds and cores, cleaning and cutting off castings.	2
14	Special methods of manufacturing castings. Technological features of manufacturing castings from various alloys	2
15	Physico-technological foundations of metal deformation. Methods for increasing the plasticity of metals and alloys	2
16	Classification of pressure processing methods.	2
17	Theoretical foundations of welding. Chemical-metallurgical and physical phenomena in the welding zone and their influence on the structure of the surrounding zone. Classification of welding types.	2
18	Electric arc and gas welding.	2

4. Topics of laboratory classes

No. salary	Topic name	Number hours
2nd semester		
1	Study of blast furnace production starting materials	2
2	Blast furnace products	2
3	Study of the features of the use of non-ferrous metal alloys	2

	in various operating conditions	
4	Determination of properties of metal powders	2
5	Powder metallurgy products and their applications	2
6	Determining the properties of molding materials	1
7	Design of the technological process for manufacturing castings	4
Total for 2 semesters		15
3rd semester		
1	The effect of cold plastic deformation on the properties and structure of steel	2
2	Studying the effects of sintering and recrystallization	2
3	Design of the technological process for manufacturing steel forgings	4
	Features of obtaining and using bent profiles	2
5	Construction of the characteristics of an electric welding transformer	2
6	Determination of modes and technological coefficients in electric arc welding	2
8	Methods of researching weld defects and methods of its control	1

5. Topics for independent work

No. of the company	Topic name	Number of hours
1	What are the industrial methods of extracting metals from ores? Their disadvantages and advantages.	5
2	Technologies for producing machine-building cast irons	10
3	Describe the technologies of special casting methods	10
4	Main technological characteristics of casting alloys	10
5	Alloys subject to pressure treatment and	10
6	Obtaining blanks by pressure processing methods	10
7	Advantages and disadvantages of methods of obtaining blanks by casting and pressure processing	15
8	Features of electron beam welding	10
9	Advantages and disadvantages of welding methods with consumable and non-consumable electrodes	10
10	Features of welding in different environments	10

6. Methods and means of diagnosing learning outcomes:

- exam;
- test
- module tests;
- defense of laboratory and independent works;
- test work.

7. Teaching methods:

- verbal method (lecture, interview);
- practical method (laboratory, educational mechanical and technological practice);
- visual method (illustrations and demonstrations);
- work with educational and methodological literature (note-taking, theses, annotations);
- video method (remote, multimedia, web-based);
- independent work (completion of tasks);
- individual research work of higher education students.

8. Assessment methods:

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. Ferrous Metallurgy		
Lecture 1	PH1, PH2, PH6, PH8, PH10, PH13	-
Laboratory work 1.	Know the methods of obtaining and enriching the raw materials necessary for smelting ferrous metals.	10
Independent work 1		20
Lecture 2	Be able to distinguish the starting materials of metallurgical production	-
Independent work 2		20
Lecture 3		-
Laboratory work 2 .		30
Lecture 4		-
Lecture 5		-
Modular test 1.		
Total by module 1		100
Module 2. Nonferrous metallurgy technology		
Lecture 6	PH1, PH2, PH6, PH8, PH10, PH13	-
Independent work 3	Know the methods of obtaining and enriching the raw materials necessary for smelting non-ferrous alloys.	25
Lecture 7		-
Lecture 8	Be able to distinguish the areas of use of non-ferrous metal alloys	-
Laboratory work 3.		20
Independent work 4		25
Modular test 2.		30
Total by module 2		100
Module No. 3. Fundamentals of powder metallurgy		
Lecture 9	PH1, PH2, PH6, PH8, PH10, PH13	-
Laboratory work 4.	Know the methods of obtaining metal powders	35
Lecture 10		-
Laboratory work 5.	Be able to apply technological processes for sintering powder metallurgy products	35
Lecture 11		-
Modular test 3.		30
Total by module 3		100

Module No. 4. Foundry production		
Lecture 12	PH1, PH2, PH6, PH8, PH10, PH13	-
Laboratory work 6.	Know the methods of obtaining blanks by casting methods	20
Independent work 5		20
Lecture 13	Be able to apply technological processes of foundry technologies	-
Laboratory work 7.		20
Lecture 14		-
Independent work 6		10
Modular test work 4.		30
Total modulo 4		100
Educational work		70
Test		30
Total per semester		100
Module No. 5. Pressure treatment of metals and ALLOYS		
Lecture 15	PH1, PH2, PH6, PH8, PH10, PH13	-
Laboratory work 8.	Know the methods of obtaining blanks using pressure processing methods	10
Laboratory work 9.		10
Independent work 7	Be able to apply technological processes of metal pressure processing technologies	20
Lecture 16		-
Laboratory work 10		10
Laboratory work 11		10
Independent work 8		10
Modular test work 5.		30
Total modulo 5		100
Module NO. 6. Welding production technology		
Lecture 17	PH1, PH2, PH6, PH8, PH10, PH13	-
Laboratory work 12	Know how to weld metals and alloys	10
Laboratory work 13		10
Independent work 9	Be able to apply welding modes in accordance with production requirements	20
Lecture 18		-
Laboratory work 14		10
Independent work 10		20
Modular test 6.		30
Total modulo 6		100
Educational work		70
Exam		30
Total per course		100

8.2. Scale for assessing knowledge of a higher education applicant

Higher education applicant rating, points	Assessment according to the national system (exams/credits)
90-100	perfectly
74-89	good
60-73	satisfactorily
0-59	unsatisfactorily

8.3. Evaluation Policy

<i>Deadline and resubmission policy:</i>	The student must Submit assignments within the deadlines set by the instructor. Assignments submitted after the deadlines without good reason will be given a lower grade. Modules can be retaken with the instructor's permission if there are good reasons (for example, sick leave).
<i>Academic Integrity Policy:</i>	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct text references to the literature used.
<i>Visitation Policy:</i>	The student is required to attend all classes every day according to the established schedule, not be late, and have an appropriate appearance. For objective reasons (for example, illness, international internship), training may take place individually (online, in agreement with the dean of the faculty).

9. Educational and methodological provision

- Electronic training course in the discipline " Technology of construction materials <https://elearn.nubip.edu.ua/course/view.php?id=1174>
- Lecture notes and presentations;
- Textbooks, study guides, workshops;
- Methodological guidelines for performing laboratory work;
- Stands, posters;
- End-to-end internship program

10. Recommended sources of information

1. Технологія конструкційних матеріалів та матеріалознавство: Начальний посібник/ С.М. Уманський, Б.В. Лебедев, П.І. Осадчук, С.С. Житков; Одеса:ТЕК, 2020. – 180 с.
2. Матеріалознавство і технологія конструкційних матеріалів : лабораторний практикум : начальний посібник / О. Є. Семеновський, І. Л. Роговський. - К. : , 2019. - 597 с. - ISBN 978-617-640-202-2
<http://dspace.nubip.edu.ua/handle/123456789/6500>
3. Матеріалознавство та технологія матеріалів (у схемах і завданнях): навч. посіб. / Тетяна Павлівна Говорун, Оксана Петрівна Гапонова, Станіслав Вікторович Марченко ; Сум. держ. ун-т. – Суми : Сум. держ. ун-т, 2020. – 162 с.
4. Кюрчев С.В., Колодій О. С., Сушко О. В., Ковальов О. О., Верхоланцева В. О. Матеріалознавство та технологія конструкційних матеріалів розділ “Обробка матеріалів різанням”. Посібник-практикум для виконання лабораторних робіт.ТОВ “Видавничий будинок ММД”, 2021, 112с.
5. Опальчук А.С., Афтандіянц 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.

6. Сологуб М.А., Рожнецький І.О., Некоз О.І., Горпенюк М.А., Прейс Г.О., Технологія конструкційних матеріалів; за ред. Сологуба М.А. – 2-ге вид., перероб. і допов. – К.:Вища шк., 2002. – 374 с.
7. 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.
8. Афтандіянц Є.Г., Зазимко О. В., Лопатько К.Г., Іванова О. В. Технологія конструкційних матеріалів. Навчальний посібник в 2-х книгах. Книга 1. – К.:НУБіП України, 2016. – 511 с.
9. Афтандіянц Є.Г., Зазимко О. В., Лопатько К.Г., Технологія конструкційних матеріалів і матеріалознавство. Курс лекцій. Частина 1. Металургія. Київ, НАУ, 2005.- с.115.
10. Хільчевський В.В. та ін., Матеріалознавство і технологія конструкційних матеріалів, К: Либідь, 2002, 326с.
11. Бялік О.М., Металознавство, К: Політехніка, 2002, 383с.
12. Виробництво чавуну - <https://www.youtube.com/watch?v=WCJSdp6lhZo>
13. Виробництво чавуну і сталі - <https://www.youtube.com/watch?v=uzwnfQ6krV8>
14. Виробництво сталі - <https://www.youtube.com/watch?v=tYTazquHXfY>
15. Порошкова металургія: <https://www.youtube.com/watch?v=LnALTU4BEgQ>
16. Виробництво міді: <https://www.youtube.com/watch?v=M2hvjv6FS67g>
17. Виробництво алюмінію: <https://www.youtube.com/watch?v=JBso28su0G4>