Ministry of Education and Science of Ukraine
Sumy National Agrarian University
Faculty of Engineering and Technology
Department of Technical Service and Industrial Mechanical Engineering

Work program (syllabus) of the educational component

OK10 Materials science and forming technologies

(mandatory)

Implemented within the educational program

"Agroengineering"

(name)

in the specialty *H7 Agricultural Engineering*

(code, name)

at the *first (bachelor's)* level of higher education

Sumy – 2026

Developer: _____ *Mykhailo DUMANCHUK, Ph.D., associate professor, associate professor*
(signature) (first name LAST NAME) (academic degree and title, position)

_____ *Vyacheslav TARELNYK, Doctor of Technical Sciences, professor, professor*
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Considered, approved and ratified at the meeting of the Department of Technical Service and Industrial Mechanical Engineering (name of department)	protocol of 15.*06.2026* .№17 Head of the Department _____ *Yevhen KONOPLYANCHENKO*

Agreed:

Guarantor of the educational program _____ Bogdan SARZHANOV
(signature) (first name LAST NAME)

Dean of the faculty
where the educational program is implemented _____ Svitlana KHURSENKO
(signature) (first name LAST NAME)

Review of the work program (attached) provided by: _____ Bohdan SARZHANOV
(signature) (first name LAST NAME)

_____ Yevhen KONOPLYANCHENKO
(signature) (first name LAST NAME)

Methodologist of the Department of Educational Quality,
licensing and accreditation _____ (*Nadiya BARANIK*)
(signature) (first name LAST NAME)

Registered in the electronic database: date: 29.06 2026.

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Information on reviewing the work program (syllabus):

Academic year in which changes are made	Number of the appendix to the work program with a description of the changes	Changes reviewed and approved		
		Date and number of the minutes of the department meeting	Head of the Department	Educational program guarantor

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Name OK	Materials science and forming technologies			
2.	Faculty/department	ITF / technical service and industrial engineering			
3.	Status OK	Mandatory			
4.	Program/Specialty (programs) of which the OK for (to be filled in for mandatory OKs) is a component	For mandatory OKs – the name of the OP is indicated, "Agroengineering"			
5.	The OK can be offered for (filled in for selective OKs)				
6.	NRC level	6			
7.	Semester and duration of study	1 semester, 1-15 weeks			
8.	Number of ECTS credits	5			
9.	The total number of hours and their distribution is 150 hours.	Contact work (classes)			Independent work
		Lectures	Practical / seminar	Laboratory	
		30 / 4	-	30 / 6	90 / 140
10.	Language of instruction	Ukrainian			
11.	Teacher/Educational Component Coordinator	Tarelnyk Vyacheslav Borisovich Dumanchuk Mykhailo Yuriyovych			
11.1	Contact information	Aud. 301m; +38(050)302-62-93; mykhailo.dumanchuk@snau.edu.ua			
12.	General description of the educational component	The discipline “Materials Science and Forming Technologies” studies the structure, properties of structural materials, technological methods of their production, regulation of properties and rational use in machines and structures. It is the basic in the cycle of general technical disciplines and the scientific basis for ensuring the quality of design, operation and repair of production equipment, the basis for studying special disciplines.			
13.	Purpose of the educational component	Studying the discipline allows future specialists to gain theoretical knowledge and practical skills in the use of structural materials, performing proper calculations in the manufacture, operation, and repair of agricultural machinery.			
14.	Prerequisites for studying OK, connection with other educational components of OP	The educational component is the basis for the educational components: OK 14 “Tractors and Automobiles”; OK 15 “Agricultural Machinery”; OK 16 “Mechanics of Materials and Structures”; OK 17 “Machine Parts and Lifting and Transporting Machines”; OK 18 “Theory of Mechanisms and Machines”; OK 19 “Thermodynamics, Heat Engineering and Hydraulics”			
15.	Academic Integrity Policy	The system of requirements that are placed on a higher education applicant when studying the educational component: • students completing assessment stages within the established deadlines; • completion and defense of written and practical work within the established deadlines; • compliance with the Regulations on the procedure for checking academic and scientific texts for uniqueness (https://surl.li/ksidbs) when performing written work; • compliance by applicants with the SNAU code of academic integrity (https://surl.li/yzxgnv). Written works prepared for assessment must be original and completed independently by the higher education applicant. Written works that are completed and submitted after the deadlines without good reason are evaluated with a score lower than the result obtained. Works that are completed with a low level of uniqueness or are a copy of “someone else’s” work will be evaluated with a score of “zero” with subsequent performance of the work according to another original individual task. Re-submission of written works occurs after repeated performance or revision. Copying from			

		various sources of information (including using mobile devices and gadgets) during exams is prohibited. If the fact of copying is detected, the student's work is canceled and the exam is retaken. Re-taking of the exam is carried out with the permission of the dean's office within the specified time limits after re-learning the material from the educational component.
16.	Link to the course in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=145 https://cdn.snau.edu.ua/moodle/course/view.php?id=2050
17.	Keywords	Material, steel, cast iron, properties, processing, forming, casting, plastic deformation, cutting

2. LEARNING OUTCOMES BY EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES

Learning outcomes for OK: *After studying the educational component, the student is expected to be able to…*	**Program learning outcomes that the OK aims to achieve (according to the numbering given in the OP)**			**How is RND assessed?**
	PRN1	PRN13	PRN19	
DRN 1. It is reasonable to choose structural materials for the manufacture of agricultural machinery parts	X	X	X	Execution and defense of laboratory and practical work reports according to the individual version. Written survey (testing) of the assimilation of lecture material. Computer testing.
DRN 2. Determine requirements for the physical and mechanical properties of the material and surface layers of agricultural machinery parts	X	X	X	Execution and defense of laboratory and practical work reports according to the individual version. Written survey (testing) of the assimilation of lecture material. Computer testing.
DRN 3. To prescribe rational methods of surface and volumetric strengthening of parts of agricultural machinery		X	X	Execution and defense of laboratory and practical work reports according to the individual version. Written survey (testing) of the assimilation of lecture material. Computer testing.
DRN 4. Assign rational methods for manufacturing or repairing parts of agricultural machinery			X	Execution and defense of laboratory and practical work reports according to the individual version. Written survey (testing) of the assimilation of lecture material. Computer testing.

PRN 1. Possess humanitarian, natural science and professional knowledge, formulate ideas and concepts for use in professional activities.

PRN 13. Describe the structure and explain the principle of operation of agricultural machinery. Select the working bodies of the machines in accordance with soil and climatic conditions and the characteristics of agricultural materials

PRN 19. Apply strategies and systems for restoring the performance of tractors, combines, cars, agricultural machinery and equipment. Prepare plans and schedules for performing repair and maintenance work. Perform diagnostic, maintenance and repair operations on agricultural machinery

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the overall time budget				Recommended reading
	Classroom work			Independent work	
	Luke	P.z / sem.z	Lab. with.		
Topic 1. Production of ferrous and non-ferrous metals and alloys. Modern metallurgical production. Production of pig iron. Production of steel. Production of non-ferrous metals. Structure of the metallurgical complex. Products of ferrous and non-ferrous metallurgy. Raw materials for the production of metals. Structure and principle of operation of a blast furnace. Material balance of blast furnace smelting. Technical and economic indicators of blast furnace production. The essence of the steel production process. Steelmaking units: structure, principle of operation, advantages and disadvantages. Methods of pouring steel. Equipment for pouring steel. Structure of a steel ingot. Direct recovery of iron from ores, its prospects. Special methods for obtaining high-quality steels. *Laboratory work. Materials for the production of metals and products of metallurgical productionL*	2		2	2	[1], [2], [3], [4], [5], [7], [8], [10], [11], [15], [16], [17], [18], [19]
Topic 2. Crystalline structure of metals. Crystallization. Metals. Classification of metals. Crystal structure of metals. Real structure of metal crystals Types of crystal lattices and their main parameters. Types of bonds in crystalline and amorphous substances. General concepts of defects in the crystal structure of crystals. Polymorphic transformations in metals. Cooling curves of metals with polymorphic transformations. Energy conditions of the crystallization process. Mechanism of the crystallization process. Forms of crystalline formations. Ingot structure. Polymorphism. Thermodynamic foundations of phase transformations of metals. Allotropy of metals, anisotropy in crystals and metals. Crystallization processes in metals and the influence of external factors on their course. Crystalline-dendritic structure of the ingot. *Laboratory work. Crystalline structure of metals and allotropic transformations in them*	2		2	4	[1], [4], [6], [8], [9], [10], [11], [15], [17], [18], [19]
Topic 3. Properties of materials. Classification of properties. Mechanical properties. Deformation. Elastic and plastic deformation. Destruction. Methods for determining mechanical properties. Strength and plasticity. Tension diagram. Destruction. Methods for determining mechanical properties. Metal hardening. Recrystallization. Cold and hot deformation. Hardness. Methods for determining hardness according to Brinell, Rockwell, Vickers, Mohs and microhardness. Structure and principle of operation of Brinell and Rockwell hardness testers. *Laboratory work. Plastic deformation, recrystallization, and mechanical properties of metals* *Laboratory work. Determination of the hardness of metals*	2		4	4	[1], [4], [6], [8], [9], [10], [11], [15], [17], [18], [19]
Topic 4. Theory of alloys. The concept of alloys. The rule of phases. Types, structure, properties of alloys. Thermal method of constructing a phase diagram. The system of alloys "Tin-Zinc". Determination of critical points of the system. Construction of a cooling curve. Gibbs' law. Privilege of phases.	2		2	4	[1], [4], [6], [8], [9], [10], [11], [15], [17], [18], [19]

Laboratory work. Construction of a phase diagram by the thermal method					
Topic 5. State diagrams. General requirements for constructing phase diagrams. Experimental methods for constructing diagrams. Analysis of the phase diagram of a two-component system. Rule of segments. Main types of phase diagrams of two-component alloys. Phase diagram for alloys with polymorphic transformations. Main types of phase diagrams of alloys: with eutectics of pure components; with eutectics of solid solutions; with the formation of chemical compounds; with limited and unlimited solubility of components. Relationship between the type of phase diagram of an alloy and the properties of alloys. *Laboratory work. State diagram analysis*	2		2	10	[1], [4], [6], [8], [9], [10], [11], [15], [17], [18]
Topic 6. Iron-carbon alloys. Iron-carbon diagram. Components, Iron-carbon systems. Phases and transformations in the Iron-carbon system. Carbon steels. Cast irons. Steel, chemical composition of steel. Steel part of the Fe-Fe3C phase diagram. Cooling curves and phase transformations of typical steels. Microstructure of steels. Cast iron, chemical composition of cast iron. Iron part of the Fe-Fe3C phase diagram. Cooling curves and phase transformations of typical cast irons. Microstructure of cast irons. Forms of graphite in cast irons. White, gray, malleable and high-strength cast irons. Impurities and their varieties. Classification of steels by purpose, quality, degree of alloying. Principles of marking different groups of materials. Phase transformations in typical alloys. Classification of cast irons. Marking of steels and cast irons. *Laboratory work. Marking of construction materials*	4		2	8	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [15], [16], [17], [18], [19]
Topic 7. Theory of heat treatment. General provisions of heat treatment. Classification of types of heat treatment. Phase transformations during heat treatment. Transformations in steel during its heating and thermodynamic bases of the processes occurring during this. Diagram of isothermal transformation of austenite and kinetics of this transformation. Critical cooling rate. Martensitic transformation and its features. Influence of alloying elements on martensitic transformation. Transformation during continuous cooling. Transformation during tempering of hardened steel and formation of corresponding tempering structures. Irreversible tempering brittleness of steel.	2		0	4	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [13], [16], [17], [18], [19]
Topic 8. Heat treatment practice. Chemical-thermal treatment. Purpose of maintenance modes. Cooling media during maintenance. Technology for performing maintenance operations. Types of heat treatment of steel. Rules for determining the modes of thermal operations. Typical modes of heat treatment of different groups of steels. The influence of heat treatment on the structure of steel. Transformations during heat treatment. Modes of heat treatment operations of annealing, normalizing, hardening and tempering. Choice of heating temperature. The influence of heat treatment and chemical composition on the properties of steel. Basic provisions of chemical-thermal treatment. Types of CTO. Technology for performing CTO operations. Relationship between the "Iron - Carbon" diagram and the structure of the diffusion layer. *Laboratory work.* Research into the effect of heat treatment on steel properties	2		2	5	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [13], [16], [17], [18], [19]

Topic 9. Metal processing by pressure. Physical and mechanical foundations of metal processing by pressure. The influence of plastic deformation on the properties of metals. Methods of metal processing by pressure Rolling production. The importance of metal processing by pressure in agricultural engineering and repair production. Theoretical foundations of metal processing by pressure (elastic and plastic deformation, the phenomenon of riveting, recrystallization, cold and hot metal processing by pressure). Structure formation in the process of metal and alloy processing by pressure. Forging. Basic provisions of forging. Technological operations of forging. Equipment for forging. Design of forging. The essence of the forging method. Basic forging operations. Purpose of allowances and overhangs. Determination of technical and economic indicators of the forging process. Technological process of forging. Stamping. Basic principles of stamping. Hot volumetric stamping. Cold stamping. Methods of manufacturing machine-building profiles. Temperature range of steel pressure treatment. Heating methods and heating furnaces, their structure and operation. *Laboratory work.* Forging design	2		4	8	[2], [3], [4], [5], [7], [8], [10], [15], [16], [17], [18], [19]
Topic 10. Fundamentals of foundry production. General information. Properties of casting alloys. Molding and core mixtures. Melting of alloys. The essence of the casting method. Designing a casting. Choosing the plane of separation of the model and the casting mold. Purpose of allowances, overhangs and forming slopes. Core and core marks. Designing a casting model. Designing a casting mold. Technology of manufacturing a casting mold. Technology of manufacturing cores. Technology of manufacturing castings. Furnaces for melting metals and their alloys. Technology of melting in melting units. Technology of pouring into casting molds. Special methods of manufacturing castings. Designing a casting. Casting defects and technical control. Quality control of cast products and main types of casting defects. Features of the technology of obtaining castings from cast iron, steel and non-ferrous alloys. Safety precautions when working in foundries. *Laboratory work.* Casting manufacturing technology	2		2	6	[2], [3], [4], [5], [7], [8], [10], [15], [16], [17], [18], [19]
Topic 11. Fundamentals of welding production. General information. Fusion welding. Pressure welding. Application of wear-resistant and heat-resistant coatings. The essence of the welding method. Welding safety precautions. The structure of the weld. Equipment for electric arc welding of metals. Welding electrodes. Purpose of welding modes. Types of electric welding. Electrodes, their classification and marking. External characteristics of welding transformers, their types. Manual electric arc welding, electric arc and its characteristics. Automatic and semi-automatic welding. Welding technology of various metals and alloys. Soldering of metals and alloys. Quality control of welding and brazing joints. Processability of welding joints. Electrocontact welding. Special welding methods (electroslag, in a protective gas environment, ultrasonic, plasma, electron beam, underwater, friction and explosion). Physical essence of the soldering process. Soldering materials. Soldering methods. Soldering technology with soft and hard solders.	2		2	5	[2], [3], [4], [5], [7], [8], [10], [12], [15], [17]

Laboratory work. Study of electric arc welding equipment					
Topic 13. Metalworking processing of materials. General definitions. Main types of metalworking work. Tools and technical equipment used in metalworking operations. Safety precautions when performing metalworking operations. Technology for performing metalworking operations	2		0	8	[2], [3], [4], [5], [7], [8], [10], [15], [16], [17]
Topic 14. Metal cutting. Physical and mechanical basics of metal cutting. Tool materials. Metal cutting tools. Problems of increasing the wear resistance of metal cutting tools. Strengthening metal cutting tools. Structure of a lathe. Types of turning. Turning tools. Performing basic turning operations. Basic information about metal cutting machines. Processing of workpieces on lathes. Processing of workpieces on drilling machines. Processing of workpieces on milling machines. Purpose of cutting modes. Structure of a drilling machine. Types of drilling. Cutting tools. Performing basic drilling operations. Structure of a milling machine. Types of milling. Cutting tools. Performing basic milling operations. Methods of finishing the surface of workpieces. Grinding. Polishing. Honing. Grinding group machines. Classification of machine tools. Abrasive tool and its characteristics, marking and intended use. *Laboratory work. Study of the design and adjustment of a screw-cutting lathe* *Laboratory work. Study of the design and adjustment of milling and boring machines*	2		4	12	[2], [3], [4], [5], [7], [8], [10], [14], [15], [16], [17]
Topic 15. Technological process and its structural elements. Concept and definition. Elements of the technological process (processing route, operation, settings, position, work stroke, machining allowance, base, transition, passage, etc.). Structure of the technological process for manufacturing parts. Technological documentation Requirements for compiling a technological process. Production and technological process. Concept of designing typical technological processes for machining parts of different classes (shafts, bushings, discs, levers, gears). Machine tools and auxiliary tools. *Laboratory work.* Design of the machining process	2		2	10	[2], [3], [4], [5], [7], [8], [10], [14], [15], [16], [17]
Total	30		30	90	

4. TEACHING AND LEARNING METHODS

DRN	**Teaching methods**(work that will be carried out by the teacher during classroom lessons, consultations)	**Number of hours**	**Teaching methods**(what types of learning activities should the student perform independently)	Number of hours
DRN 1.	Showing examples of solving production problems using an interactive method during lectures and practical classes	12	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	10
DRN 2.	Showing examples of solving production problems using an interactive method during lectures and practical classes	16	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	16
DRN 3.	Showing examples of solving production problems using an interactive method during lectures and practical classes	20	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	22
DRN 4.	Showing examples of solving production problems using an interactive method during lectures and practical classes	26	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	28

5. EVALUATION BY EDUCATIONAL COMPONENT

5.1. Diagnostic assessment (indicated as needed)

5.2. Summative assessment

5.2.1. To assess the expected learning outcomes, there are

No.	Summative assessment methods	Points / Weight in the overall score	Date of compilation
1.	Execution and defense of laboratory and graphic works	*40 points / 40%*	1-15 weeks
2.	Computer-based testing - multiple choice test	*15 points / 15%*	Week 7
3.	Student independent work: completion of individual tasks	*15 points / 15%*	Week 15
4.	Exam	*30 points / 30%*	Week 16-17

5.2.2. Evaluation criteria

Component	***Unsatisfactorily***	***Satisfactorily***	***Good***	***Perfectly***
Performing and defending laboratory work	*<24 points*	*24-30*	*30-35 points*	*36-40 points*
	Task requirements not met	*Most requirements are met, but some components are missing or insufficiently disclosed*	*All task requirements have been met, but there are minor comments regarding the design.*	*All task requirements have been met, and your own solution to the task has been proposed.*
Computer-based certification - multiple choice test	*<9 points*	*9-10*	*11-13 points*	*>13 points*
	Fewer than 9 out of 15 correct answers	*9 or 10 out of 15 correct answers*	*Correct answers 11 or 14 out of 15*	*Correct answers 15 out of 15*
Student independent work: completion of individual tasks	*<9 points*	*9-10*	*11-13 points*	*>13 points*
	Task requirements not met	*Most requirements are met, but some components are missing or insufficiently disclosed*	*All task requirements have been met, but there are minor comments regarding the design.*	*All task requirements have been met, and your own solution to the task has been proposed.*
Exam	*<18 points*	*18-22*	*23-26 points*	*>26 points*
	Task requirements not met	*Most requirements are met, but some components are missing or insufficiently disclosed*	*All task requirements have been met, but there are minor comments regarding the design.*	*All task requirements have been met, and your own solution to the task has been proposed.*

5.3. Formative assessment:

To assess current progress in learning and understand areas for further improvement,

No.	**Elements of formative assessment**	**Date**
1	*Correctly completed tasks during classes with feedback from the teacher*	Within 1-15 weeks
2	*Verbal feedback from the teacher while working on assignments during classes.*	Within 1-15 weeks

6. LEARNING RESOURCES (LITERATURE)

Main sources

1. Buzylo V.I. Materials Science: teaching aids / V.I. Buzylo, V.P. Serdyuk, A.V. Yavorsky, O.A. Gaidai / Ministry of Education and Science of Ukraine, National Technical University "Dnipro Polytechnic" – Dnipro: NTU "DP", 2021. – 243 p.
2. Pogrebna N.E., Kutsova V.Z., Kotova T.V. Methods of strengthening metals: Textbook. – Dnipro: NMetAU, 2021. - 89 p.
3. Antonova G. V., Vershkov O. O., Matsulevych O. E. Materials Science. Technology of Structural Materials. Part I. "Materials Science": Textbook. – Zaporizhzhia: Tavria State Agrotechnological University, 2024.

4. Borak K. V., Kulykivskyi V. L. Materials science and technology of structural materials. Part 1. Theoretical foundations of materials science: textbook. – Zhytomyr: Polesie National University, 2024. – 101 p.
5. Antonova G. V., Vershkov O. O., Chaplinsky A. P. Materials Science. Technology of Structural Materials. Part II. Technology of Structural Materials. Zaporizhzhia: TSATU, 2024. – 242 p.
6. Shilina O. P. Technology of structural materials. Part 1. Structural materials: properties, classification, production: textbook. 2nd ed., revised and supplemented. – Vinnytsia: VNTU, 2025. – 97 p.
7. Shilina, O. P. Technology of structural materials. Part two. Procurement production: a textbook [Electronic resource] – [Ed. 2nd, revised and supplemented]. – Vinnytsia: VNTU, 2025. – 154 p.
8. Perez N. Materials Science: Theory and Engineering. Cham: Springer Nature, 2024. 917 p.
9. Voisey KT The Engineer's Guide to Materials: An Applications-Focused Introduction to Materials Science. Cham: Springer Nature, 2024.
10. Huda, Z. (2022). Materials in Engineering. In: Mechanical Behavior of Materials. Mechanical Engineering Series. Springer, Cham.https://doi.org/10.1007/978-3-030-84927-6_5
11. Salama, E., Shokry, H., Elkady, M. (2025). Introduction to Engineering Materials. In: Shaker, K., Nawab, Y. (eds) Engineering Materials. Springer, Cham.https://doi.org/10.1007/978-3-031-72263-9_1
12. Singh, DK (2024). Introduction to Materials and Their Properties. In: Fundamentals of Manufacturing Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-99-8767-2_1

Additional sources

13. Materials science and technology of materials (in diagrams and tasks) [Text]: teaching aid. / T. P. Govorun, O. P. Gaponova, S. V. Marchenko. — Sumy: SumDU, 2020. — 163 p.
14. Technology of structural materials [Text]: textbook / S. V. Marchenko, O. P. Gaponova, T. P. Govorun, N. A. Kharchenko. — Sumy: SumDU, 2016. — 146 p.
15. Technology of structural materials [Text]: textbook. / P. I. Litovchenko, L. P. Ivanova. – Kh.: NA NGU, 2016. – 306 p.
16. Aftandilyants E.G., Zazimko O.V., Lopatko K.G. Materials Science: textbook – Helvetica Publishing House – 2020 – 612 p. ISBN: 978-966-2393-67-5
17. Steinbach I., Salama H. Lectures on Phase Field. Cham: Springer Nature, 2023.
18. Construction Materials Technology and Materials Science: A Textbook for Higher Educational Institutions of III-IV Levels of Accreditation / Edited by A.S. Opalchuk. – Nizhyn: LLC “Publishing House “Aspect-Polygraph”, 2011. –792 p.
19. Litovchenko P.I. Technology of structural materials. Textbook. / P.I. Litovchenko, L.P. Ivanova. – Kh.: NANGU, 2016. – 306 p.
20. Lyubych O. Y., Radzievsky V. M., Budnyk A. F. Equipment and technology of welding production: textbook. Sumy: Sumy State University, 2013. 228 p.
21. Metal-cutting tools: a textbook / S. V. Shvets. – Sumy: Sumy State University, 2019. – 272 p.
22. Metal and welding technology. Modular course: textbook / A. M. Vlasenko. – Vinnytsia: VNTU, 2013. – 250 p.
23. Aftandilyants E.G., Zazimko O.V., Lopatko K.G. Materials Science: Textbook. K.: Higher Education, 2012.- p. 548.
24. Materials science and technology of structural materials. Laboratory practical: a manual for higher educational institutions of III-IV levels of accreditation / Authors: Opalchuk A.S., Kotrechko O.O., Rogovsky L.L., Semenovsky O.E., Rogovsky I.L. – NUBiP. – 2015 – 426 p.