MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
KHARKIV NATIONAL AUTOMOBILE AND ROAD UNIVERSITY

EDUCATIONAL AND PROFESSIONAL PROGRAM

MATERIALS SCIENCE
the name of the OP

second (master's) level of higher education
the name of the level of education

in specialty **132 "MATERIALS SCIENCE"**
code and specialty name

fields of knowledge **13 "MECHANICAL ENGINEERING"**
code and name of the field of knowledge

Qualification: **MASTER OF MATERIALS SCIENCE**
the name of the qualification

APPROVED
SCIENTIFIC ADVICE OF HNADU
protocol No. ../... from "..." ____2023

Chairman of the Academic Council
_____ /Victor BOHOMOLOV/

The educational program will be implemented from September 1, 2023.
order No. ___ of "____"____2023.

Rector
_____ /Victor BOHOMOLOV/

Kharkiv 2023

PREFACE

1. Developed by the project team:

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2. Recommended by the methodological commission of the Faculty of Mechanics

Protocol No. ___ of "___" __.2023.

3. Approved Methodical council

Protocol No. ___ of "___" ____. 2023

Reviewers:

1) Volodymyr Bolshakov, professor of the "Materials Science and Materials Processing" Department of the Dnipro State Academy of Construction and Architecture, Honored Worker of Science and Technology of Ukraine, laureate of the State Prize of Ukraine.

2) Valery Subotina, head of the "Materials Science" department of the National Technical University "Kharkiv Polytechnic Institute".

3) Oleksandr Babachenko, director of the Institute of Ferrous Metallurgy named after Z.I. Nekrasov of the National Academy of Sciences of Ukraine.

1. PROFILE OF THE EDUCATIONAL AND PROFESSIONAL PROGRAM
from the specialty "Materials Science"

1 - General information	
The full name of the higher educational institution and the department responsible for the implementation of the OPP	Kharkiv National Automobile and Road University, department of metal technology and materials science
The degree of higher education and the title of the qualification in the original language	Master's degree Master of Materials Science
The official name of the educational program	Materials science
Type of diploma and scope of the educational program	Master's degree, single, 90 ECTS credits, study period 1 year 4 months.
Availability of accreditation	Accreditation certificate series UD No. 21005756 issued by the Ministry of Education and Science of Ukraine on November 12, 2018. The certificate is valid until July 1, 2023
Cycle / level	NRK of Ukraine - 7th level, FQ-EHEA - second cycle, EQF-LLL - 7th level
Prerequisites	Having a bachelor's degree
Language of teaching	State and/or English language at the applicant's request
The term of validity of the educational program	2 years
Internet address of the permanent placement of the description of the educational program	https://www.khadi_kharkov_ua/education/catalog-osvitnikh-program/132-materialoznavstvo/
2 - The purpose of the educational program	
The purpose of training is to train specialists with higher education and highly qualified personnel who are able to perceive, generate and implement innovative ideas when solving complex tasks and problems related to - development, application, production and testing, prediction of the properties of metallic, non-metallic and composite materials and products based on them, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements; - organization and effective implementation of the educational process in higher educational institutions.	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty)	Branch of knowledge –13 "Mechanical engineering" specialty –132 "Materials Science". **Object:** phenomena and processes related to the formation of the structure and properties of metallic, non-metallic, composite and functional materials, their manufacturing, processing, operation and certification technologies. **Training goals:** training specialists capable of effectively performing professional activities that involve solving complex tasks and problems related to the development, research, application, production, processing and testing of modern materials and products based on them. **Theoretical content of the subject area:** the creation and application of new materials, the influence of production conditions and various factors (temperature, pressure, irradiation, environment, conditions of use, etc.) on their structure, physical, chemical, technological, operational and functional properties, methods of managing the properties of materials.

	Methods, techniques and technologies: forecasting methods, theoretical and experimental methods of materials science research, in particular mathematical and physical modeling, research of the structure, physical, mechanical, functional and technological properties of materials. Technologies of manufacturing, processing, controlling the structure and properties of materials, manufacturing products from them. Modern methods and technologies of organizational, informational, marketing, legal support of production and scientific research. **Tools and equipment:** equipment for the study of chemical and phase composition, structure and fine structure, mechanical, physical, technological and functional properties of materials, mechanical and thermal processing. Specialized software.
Orientation of the educational program	Educational and professional. The educational and professional program focuses on modern scientific achievements in the field of materials science, takes into account the specifics of working with equipment and software for conducting expertise, processing materials, researching the structure and properties of various groups of materials using modern information technologies, features of designing new materials, methods of physical and mathematical modeling when creating new and improving existing materials, their manufacturing and processing technologies.
The main focus of the educational program	Special education in the field of development of new and improvement of existing materials, technologies of their production, selection of materials in order to increase the reliability and operational resource of parts, nodes, equipment of road transport, construction and road , lifting and transport machines , taking into account the technological, ecological and economic needs of the national economy . Keywords: materials science, steels and cast irons, non-ferrous alloys, theory of alloys, heat treatment, surface hardening, coating, composite and non-metallic materials, nanomaterials and nanotechnologies, structural examination, functional materials, system analysis, surface engineering, mathematical modeling.
Features of the program	The components of the educational program were developed as a result of the department's implementation of its scientific developments, including the projects "Development of methods and means of increasing the durability and energy efficiency of engines for armored vehicles based on the convergence of technologies", "Development of intelligent technologies for increasing the durability and energy efficiency of mechatronic systems for armored vehicles". As part of the scientific internship provided by the OP, masters realize their abilities and talents through participation in scientific research and inventive activity, in international conferences and in All-Ukrainian competitions, as well as in the publication of the results of scientific work in professional journals. Professional training of specialists is provided by training in laboratories in the classrooms of the department, where the conditions are close to the conditions of their professional activity, the :laboratory of ion-plasma coating methods, mechanical tests, thermal, metallographic studies, electron-microscopic studies, the educational and training center of the American company HAAS with machines, equipped with CNC. This OP is coordinated with the programs of Lodz Polytechnic University Lodz Polytechnic (Poland), Brandenburg University of Technology (Germany), where students can study under the Erasmus + program (agreement dated February 15, 2023). The possibility of teaching foreign citizens in the Ukrainian language is foreseen.
4 – Eligibility of graduates to employment and further education	
Suitability for employment	Researcher (engineering branch), KP code 2149.1 Researcher (engineering mechanics), KP code 2145.1 Scientific employee (mining, metallurgy), KP code 2147.1 Consultant researcher (mining, metallurgy), KP code 2147.1 Engineer (metallurgy), KP code 2147.2 Technological engineer (metallurgy), KP code 2147.2 Technological engineer (mechanics), KP code 2145.2 Equipment and materials assembly engineer, KP code 2149.2 Engineer for the introduction of new equipment and technology, KP code 2149.2 Research engineer, KP code 2149.2 Technological engineer, KP code 2149.2

	Consultant (in a certain field of engineering), KP code 2149.2 Specialist in non-destructive testing, KP code 2149.2 Crystallograph, code KP 2113.2 Chemist-crystallographer, KP code 2113.2 Welding engineer, KP code 2145.2 Laboratory engineer, KP code 2149.2
Further education	Continuation of education of higher education seekers to obtain the third (educational and scientific) level of higher education, as well as additional qualifications in the adult education system.
5 – Teaching and assessment	
Teaching and learning	Student-centered learning, self-learning, learning through a combination of lectures, laboratory and production practice, solving situational tasks during research work and in production conditions, defense of reports on practical and laboratory work, defense of course work, public defense of qualification work . Theoretical knowledge and practical skills are consolidated and improved during scientific and pedagogical training. The general style is innovative learning at the level of creative search.
Assessment	Current control, semester tests and exams, coursework. Evaluation of written works, oral answers, preparation of presentations and reports on research works and practices. Attestation of applicants in the form of public defense of qualifying work.
6 – Software competencies	
Integral competence	КИ.01 The ability to solve complex tasks and problems in materials science in professional activity and/or in the learning process, which involves conducting research and/or implementing innovations and is characterized by the uncertainty of conditions and requirements.
general competence (QC)	ZK .01 Ability to abstract thinking, analysis and synthesis. ZK .02 Ability to apply knowledge in practical situations. ZK .03 Ability to develop and manage projects. ZK .04 Ability to communicate in a foreign language. ZK .06 Ability to work autonomously. ZK .07 Ability to work and in a team. ZK .08 Ability to work in an international context. ZK .09 Striving to preserve the environment. **Additionally, at the suggestion of stakeholders** ZK.10 The ability to realize one's rights and responsibilities as a member of society, to realize the values of a free democratic society, the rule of law, the rights and freedoms of a person and a citizen in Ukraine. ZK.11 Ability and willingness to form a dignified attitude to the heritage of national culture and production.
Professional competences of the specialty (FC)	Ф K.01 The ability to identify and pose problems in the field of materials science, to make effective decisions to solve them. Ф K.02 Ability to plan and conduct research in the field of materials science in laboratory and industrial conditions at the appropriate level using modern methods and experimental techniques. F K.03 The ability to develop new research methods and techniques, based on knowledge of the methodology of scientific research and the specifics of the problem being solved. F K.04 Ability to evaluate and ensure the quality of the work performed. Ф K.05 Ability to critically analyze and forecast the characteristics of new and existing materials, parameters of the processes of their obtaining and processing and use in products (or in production conditions). F K.06 Ability to understand and use mathematical and numerical methods of modeling properties, phenomena and processes. F K.07 The ability to evaluate the technical and economic effectiveness of research, technological processes and innovative developments, taking into account the uncertainty of conditions and requirements. Ф K.08 The ability to clearly and unambiguously convey one's own knowledge and arguments on matters of materials science, conclusions and related problems to specialists and non-specialists, in particular to students. Ф K.09 The ability to reasonably choose manufacturing technologies, processing, testing of materials and products, for specific operating conditions.

	F K.10 Ability to organize and carry out complex tests of materials and products. F K.11 Ability to apply a systematic approach to solving applied problems of manufacturing, processing, operation and disposal of materials and products. F K.12 Ability to develop and implement projects in the field of materials science, as well as related interdisciplinary projects. **Additionally, at the suggestion of stakeholders** FK.13 The ability to carry out scientific research examination of destruction, premature failure of products and the state of structures for the development of methods of increasing the operational resource of parts, nodes, equipment of road transport, construction and road , lifting and transport machines with the aim of rebuilding the economy of Ukraine in the post-war period. FK.14 Ability to apply acquired knowledge in the field of computer modeling and material design of parts for nodes, road transport equipment, road construction, lifting and transport machines, depending on the requirements of the customer and the modern market.
7 – Program learning outcomes (PLP)	
	P PH 1. Understand and apply the principles of system analysis, cause-and-effect relationships between significant factors and scientific and technical solutions in the context of existing theories. П PH 2. Identify, formulate and solve material science problems and tasks. П PH 3. Communicate freely in the national and English languages orally and in writing to discuss professional problems and results of activities in the field of materials science and a wider range of engineering issues, presentation of research results and innovative projects. П PH 4. Apply modern information technologies and specialized software to solve complex problems of materials science. П PH 5. Make effective decisions in new situations or unforeseen conditions, taking into account their possible consequences, evaluate and compare alternatives, evaluate technical, economic, environmental and legal risks. П PH 6. Scientific skills in the field of engineering in order to successfully conduct scientific research both under supervision and independently. П PH 7. Develop and implement projects in the field of materials science and materials science-related interdisciplinary areas, determine goals and required resources, plan work, organize the work of a team of performers, protect intellectual property. П PH 8. Be able to apply methods of protection of intellectual property objects created in the course of professional (scientific and technical) activity. П PH 9. Apply the methods of LCA analysis, eco-audit, sustainable development approaches during the development of new materials and the introduction of new technologies. П PH 10. Skills of presentation of scientific material and arguments for a well-informed audience. П PH 11. Use modern methods for identifying, setting and solving inventive problems in the field of materials science. П PH 12. Formulate and solve scientific and technical problems for development, production, testing, certification, disposal of materials, creation and application of effective technologies for manufacturing products. П PH 13. Plan and perform experimental materials science studies, choose appropriate equipment and methods, carry out statistical processing and statistical analysis of experimental results, justify conclusions. П PH 14. Reasonably assign and monitor quality indicators of materials and products. П PH 15. Design new materials, develop, research and use physical and mathematical models of materials and processes. П PH 16. Ability to effectively use theoretical concepts of management and business administration in practice. П PH 17. Solve applied problems of manufacturing, processing, operation and disposal of materials and products. П PH 18. Collect the necessary information using scientific and technical literature, databases and other sources, analyze and evaluate it. П PH 19. Develop a complex design of new materials and products based on them, taking into account operational properties and conditions of use. **Additionally, at the suggestion of stakeholders**

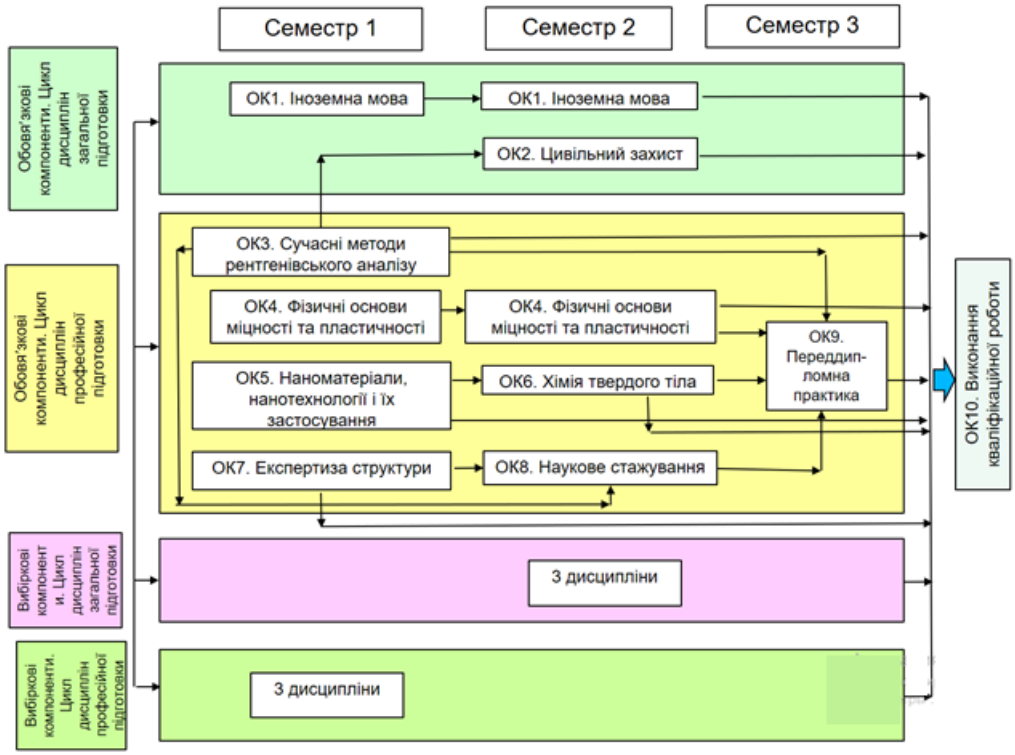
	PRN20. Skills of mastering modern 3D printing techniques for the production of new parts of nodes, automobile transport equipment, road construction, lifting and transport machines depending on the tasks of materials science.
8 – Resource support for program implementation	
Staff support	The main teaching staff of the educational program consists of the teaching staff of the department of metal technology and materials science of the mechanical faculty. In order to improve the professional level in the disciplines taught, all scientific and pedagogical workers constantly improve their qualifications at conferences, symposiums, webinars, undergo internships in various educational institutions, including those outside Ukraine. Also, the teaching staff of other departments of the Mechanical Faculty and the Department of Philosophy and Professional Pedagogical Training are involved in the teaching of individual courses in accordance with their competence and experience.
Material and technical support	The educational process according to the educational program takes place in classrooms and laboratories equipped with audiovisual equipment and the necessary technical means. Training classes are held in 6 laboratories, 2 computer classrooms, the educational and training center of the American company NAA S , equipped with license packages and software . Hardness testers, mechanical testing equipment, metallographic and electron microscopes , the Bulat-3T installation, friction machine, thermal furnaces, hydraulic press, and non-destructive testing devices are used in the educational and scientific work of the educational program .
Informational and educational and methodological support	The educational process is provided with textbooks, study aids, reference, periodical and other educational literature in the library and electronic archive (repository) of the Khnadu (https://dspace.khadi.kharkov.ua/dspace/) ; methodological developments of teachers in the library and in the file archive of the Khnadu (files . khadi . kharkov . ua); distance materials of courses and resource courses created using the Moodle system and posted on the educational website of the Khnadu (https://dl2022.khadi-kh.com/) . Information resources of the university library according to the educational program are formed in accordance with the subject area and modern trends of scientific research in this field. At the same time, students can browse literature using traditional library search tools or use Internet and database access. Access to all library databases is provided on the university's internal network. Methodical material is periodically updated and adapted to the goals of the educational program. ZVO has an official website of Khnadu (www.khadi.kharkov.ua), which contains basic information about its activities (structure, licenses and certificates of accreditation, administrative, financial, educational, scientific, international activities, internal system of ensuring the quality of education, rules reception, contact information).
9 – Academic mobility	
National credit mobility	On the basis of bilateral agreements between Kharkiv National Automobile and Road University and institutions of higher education of Ukraine.
International credit mobility	Academic mobility on the basis of bilateral agreements between the Kharkiv National Automobile and Road University and the Lodz Polytechnic University (Poland), the Brandenburg University of Technology (Germany) and other educational institutions with which bilateral agreements will be concluded.
Education of foreign students of higher education	It is possible to teach foreign students in the Ukrainian language.

2. LIST OF COMPONENTS OF THE EDUCATIONAL AND PROFESSIONAL PROGRAM AND THEIR LOGICAL SEQUENCE

2.1 List of OPP components

Code n/a	Components of the educational and professional program (disciplines, projects / works, practice, qualification work)	Number of credits	Final control form
1	2	3	4
1. Mandatory OP components			
1.1. Cycle components of general training			
OK1	Foreign Language	3.0	Exam
OK2	Civil Protection	3.0	Test
1.1.2. Components of professional training			
OK3	Modern methods of X-ray analysis	4.0	Exam
OK4	Physical foundations of strength and plasticity	7.0	Exam
OK5	Nanomaterials, nanotechnologies and their applications	7.0	Exam
OK6	Solid state chemistry	4.0	Exam
OK7	Examination of the structure	3.0	Exam
OK8	Research internship	3.0	Test
OK9	Pre-diploma practice	3.0	Test
OK10	Performance of qualification work	27.0	Public protection
	The total amount of mandatory components	**66.0**	
2. Selective OP components			
2.1. Cycle components of general training			
VK	Elective discipline 1	4.0	Test
	Elective discipline 2	4.0	Test
	Elective discipline 3	4.0	Test
2.2. Disciplines of professional training			
VK	Elective discipline 4	4.0	Test
	Elective discipline 5	4.0	Test
	Elective discipline 6	4.0	Test
	The total amount of sample components	**24.0**	
	GENERAL SCOPE OF THE EDUCATIONAL AND PROFESSIONAL PROGRAM	**90**	

3. STRUCTURAL AND LOGICAL SCHEME OP



4. FORM OF CERTIFICATE OF THE ACQUIRENT OF HIGHER EDUCATION

Forms of attestation of applicants of higher education	Certification of higher education applicants is carried out in the form of a public defense of the qualification work.
Requirements for qualifying work	The qualification work involves solving a complex problem of materials science using experimental methods of materials science research, mathematical and/or computer modeling. The master's qualification work must not contain academic plagiarism, fabrication, or falsification. The qualification work must be made public by placing it in the repository of the Kharkiv National Automobile and Road University. Publication of qualification works containing information with limited access shall be carried out in accordance with the requirements of current legislation.

5. MATRIX OF CORRESPONDENCE OF SOFTWARE COMPETENCES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

Marks of program competencies and educational components	OK 1	OK 2	OK 3	OK 4	OK 5	OK 6	OK 7	OK 8	OK 9	OK 10
ZK .01						+	+			
ZK .02		+		+	+				+	+
ZK .03			+					+		
ZK .04	+			+	+					
ZK .06										+
ZK .07			+					+		
ZK .08	+									+
ZK .09		+						+	+	
ZK .10			+			+				
ZK .11	+						+			
FC.01				+	+	+		+		
FC.02		+	+				+		+	
FC.03						+	+			
FC.04		+						+		
FC.05			+			+				
FC.06			+		+					
FC.07				+					+	+
FC.08								+		
FC.09			+						+	+
FC.10					+		+		+	
FC.11				+					+	+
FC.12				+	+			+		+
FC. 13			+	+			+			
FC. 14					+	+				

6. MATRIX OF ENSURING PROGRAM LEARNING OUTCOMES BY EDUCATIONAL PROGRAM COMPONENTS

Marks of program learning outcomes and educational components	OK 1	OK 2	OK 3	OK 4	OK 5	OK 6	OK 7	OK 8	OK 9	OK 10
P RN 1					+		+			
P RN 2				+		+			+	
P RN 3	+							+		+
P RN 4	+		+						+	+
P RN 5		+							+	
P RN 6			+					+		+
P RN 7				+		+			+	
P RN 8				+				+		
P RN 9					+	+				
P RN 10								+		+
P RN 11			+							+
P RN 12		+		+	+		+		+	
P RN 13			+				+	+		+
P RN 14				+	+		+			
P RN 15			+						+	+
P RN 16				+				+		
P RN 17				+						+
P RN 18	+					+	+	+		+
P RN 19					+			+		+
P RN 20				+					+	

7. COMPLIANCE MATRIX OF PROGRAM RESULTS EDUCATION (PRN) AND COMPETENCES

	ZK01	ZK02	ZK03	ZK04	ZK 06	ZK 07	ZK 08	ZK 09	ZK 10	ZK 11	FK01	FK02	FK03	FK04	FK05	FK06	FK07	FK08	FK09	FC10	FC11	FC12	FC13	FC14
PRN 1	+								+	+			+										+	
PRN 2		+									+													+
PRN 3	+			+		+				+														
PRN 4		+								+		+		+										+
PRN 5	+						+	+							+		+							
PRN 6		+			+												+						+	
PRN 7			+		+	+																+		
PRN 8						+																		
PRN 9							+		+															+
PRN 10																		+						+
PRN 11	+									+	+				+									
PRN 12							+								+				+	+	+		+	
PRN 13												+			+	+		+		+			+	+
PRN 14												+		+						+				+
PRN 15		+							+			+			+	+					+		+	
PRN 16		+			+												+					+		
PRN 17		+						+																+
PRN 18															+					+	+			
PRN 19	+	+									+	+		+	+							+		+
PRN 20	+				+			+			+	+		+			+		+	+	+	+	+	

LITERATURE

1. On higher education: Law of Ukraine dated 01.07.14 No. 1556-VII. Update date: 07/24/2020. URL: https://zakon.rada.gov.ua/laws/show/2145-19#Text .

2. Law of Ukraine dated September 5, 2017 "On Education". Date of update: 06/24/2020. URL: https://zakon.rada.gov.ua/laws/show/2145-19#Text .

3. Resolution of the Cabinet of Ministers of Ukraine dated April 29, 2015 No. 266 "On approval of the list of fields of knowledge and specialties for which higher education applicants are trained." Date of update: 11.02.2017. URL: https://zakon.rada.gov.ua/laws/show/266-2015-%D0%BF#Text .

4. Resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015 No. 1187 "On approval of the Licensing conditions for conducting educational activities of educational institutions." Date of update: 04.05.2020. URL: https://zakon.rada.gov.ua/laws/show/1187-2015-%D0%BF/page#Text .

5. Resolution of the Cabinet of Ministers of Ukraine dated November 23, 2011 No. 1341 "On Approval of the National Framework of Qualifications". Update date: 07/02/2020. URL: https://zakon.rada.gov.ua/laws/show/1341-2011-%D0%BF#Text . (date of application: 21.03.2021).

6. National classifier of Ukraine: "Classifier of professions" DK 003:2010DK 003:2010. URL: http://www.dk003.com .

7. Standards and recommendations for quality assurance in the European Higher Education Area (ESG). URL: https://www.britishcouncil.org.ua/sites/default/files/standards-and-guidelines_for_qa_in_the_ehea_2015.pdf .

8. Development of educational programs. Guidelines. URL: http://ibhb.chnu.edu.ua/uploads/files/metodrada/Rozroblennya_osv_program.pdf .

9. EQF-LLL – European Qualifications Framework for Lifelong Learning. URL: http://ecompetences.eu/wp-content/uploads/2013/11/EQF_broch_2008_en.pdf .

10. QF-EHEA – Qualification Framework of the European Higher Education Area. URL: https://www.aec-music.eu/userfiles/File/Framework_for_Qualifications_of_European_HE_Area.pdf .

11. Standard of higher education in specialty 132 "Materials science" branch of knowledge 13 "Mechanical engineering" for the second (master's) level of higher education. Approved by the Order of the Ministry of Education and Science of Ukraine dated November 17, 2020 No. 1423.