

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE REPUBLIC OF KAZAKHSTAN  
KARAGANDY UNIVERSITY OF THE NAME OF ACADEMICIAN E.A. BUKETOV

«APPROVED»

By decision of the Board  
NJSC «Karaganda University  
named after academician E.A. Buketova»

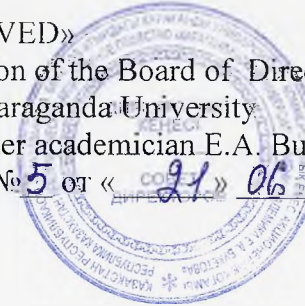
Protocol № 5 от 2024 г.  
prof. Dulatbekov N.O.



«APPROVED»

By decision of the Board of Directors  
NJSC «Karaganda University  
named after academician E.A. Buketova»

Protocol № 5 от «21» 06 2024 г.



EDUCATIONAL PROGRAM

Level: Master

Degree: master of science in education program «7M05303 Physical sciences»

Karaganda,  
2024

# APPROVAL SHEET

## EDUCATIONAL PROGRAM «7M05303 Physical sciences»

«AGREED»

Director of the branch of «Kazteleradio» JSC  
Karaganda ODRT



\_\_\_\_\_ A.K. Zhumabaev

\_\_\_\_\_ 2024 y.

«AGREED»

Director of the Representative Office  
JSC «National Information  
Technologies» in the Karaganda region



\_\_\_\_\_ T.A. Kulbaev

\_\_\_\_\_ «22» 2024 y.

**The educational program «7M05303-Technical Physics» was developed on the basis of:**

- Law of the Republic of Kazakhstan dated July 27, 2007 No. 319-III "On Education";
- Law of the Republic of Kazakhstan dated July 11, 1997 No. 151-I. "About languages in the Republic of Kazakhstan";
- State Mandatory Standards of Higher and Postgraduate Education No. 2 dated July 20, 2022.
- The National Qualifications Framework dated March 16, 2016 by the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations.
- Order of the Ministry of Education and Science of the Republic of Kazakhstan "On approval of the Rules for the organization of the educational process in credit technology" dated April 20, 2011 No. 152 (with amendments and additions dated 07/25/2023 No. 334).
- Classifier of areas of training with higher and postgraduate education dated October 13, 2018 No. 569.

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## Passport of the educational program

**1. Code and name of the educational program:** "7M05303-Technical Physics "

**2. Code and classification of the field of education, training areas:** 7M05Natural sciences, 7M053Physical and chemical sciences

**3. Group of educational programs:** M090-Physics

**4. Volume of credits:** 120 ECTS.

**5. Form of study:** full-time

**6. Language of instruction:** Kazakh, Russian

**7. Degree awarded** Master of Technical Sciences in the educational program 7M05303- Technical Physics

**8. Type of EP:** the current EP is an educational program, according to which training is carried out at the university.

**9. ISCE level** (International Standard Classification of Education) – level 7.

**10. The level of the NQF** (National Qualifications Framework) - level 7.

**11. IQF level** (Industry Qualifications Framework) – level 7.

**12. Distinctive features of EP:** - no

**13. Number of the appendix to the license for the direction of personnel training:** No. 016 KZ 83LAA00018495 dated 07/28/2020.

**14. The name of the accreditation body and the validity period of the accreditation of the EP:** Certificate of international accreditation of educational programs of NAOKO SA-A No. 0174/2 dated December 23, 2019-December 20, 2024.

**15. The purpose of the EP:**The main purpose of the educational program of training masters in the educational program "7M05303 - Technical physics" - the organization of high-quality training of masters as highly qualified and competitive professionals in demand by the domestic education system and motivated to research activities.

**a) Qualification characteristics of the graduate:** the graduate of the master's degree is awarded the degree of Master of Technical Sciences in the educational program "7M05303-Technical Physics".

**b) List of graduate positions:** The sphere of professional activity of graduates of the educational program of Technical physics is the field of science and technology, including research, development, creation and operation of new materials, technologies, devices and devices.

**c) The scope and objects of professional activity of graduates** in this The sphere of professional activity of graduates of the educational program of Technical physics is the field of science and technology, including research, development, creation and operation of new materials, technologies, devices and devices. The objects of professional activity of masters 7M07104- Heat Power Engineering are:

- at scientific and pedagogical preparation – research institutes, scientific centers, research laboratories, design and design bureaus, firms and companies, higher educational institutions, state educational institutions and enterprises of education, and also non-state educational organizations, ministries, public administration bodies of the corresponding profile, the organization of system of education of higher Education institutions and colleges.

- physical processes and phenomena, physical and physical-technological devices, systems and complexes, methods and methods of their research and design.

**d) Types of professional activities**The subjects of professional activity of graduates of the educational program of Technical physics are:

- construction of mathematical models of objects of research and the choice of a numerical method for their modeling, the development of a new or a choice of a ready algorithm for solving problems;

- development of functional and structural schemes, complexes and systems, taking into account the physical principles of their operation, and the establishment of technical requirements;
- development and implementation of technological processes.
- development, creation and operation of devices;
- methods of analysis, forecasting and management of properties of materials, technological processes, technical equipment and operation of production and research facilities of high technologies.

#### **16. Functions of the graduate's professional activity**

Under the guidance of a leading (senior) engineer, a responsible executor or the head of the topic (task), a master's student performs: participates

in learning activities:

- formulation of tasks and plan of scientific research in the field of technical physics on the basis of bibliographic work with the use of modern information technologies;
- implementation of mathematical modeling and optimization of object parameters with the help of developed and available research and design tools, including standard and specialized application software packages;
- implementation of adjustment, adjustment and experimental check of physical devices, systems and complexes;
- design and construction of various types of systems, units and equipment.
- implementation of collection, processing, analysis and systematization of scientific and technical information on research and development topics;
- study of special literature and other scientific and technical information, achievements of domestic and foreign science and technology in the field of technical physics;
- participation in carrying out pilot studies on a given program, preparation of descriptions of experiments, preparation of data for reports, reviews and other documentation;
- participation in the development and development of technological processes in the preparation of new products;
- participation in the organization of quality control of materials and products, their certification.

## 17. Formulation of learning outcomes based on competencies

Type of competencies	Learning result code	Learning result (according to Bloom's taxonomy)
1. Behavioral skills and personal qualities: (Soft skills)	ON 1	Has the ability to use in research activities in the professional direction of knowledge of traditional and modern problems of history and philosophy of science.
	ON 2	Able to choose the best and most effective forms of organization of the educational process in higher education.
	ON 3	He is able to use the basic provisions and methods of psychological science of management in professional activities.
	ON 4	Able to adapt to the specific conditions of the organizations of different organizational and legal forms.
	ON 5	Fluent in foreign languages at a level that allows effective interaction in the professional and scientific environment, transmits the results of research in the form of specific recommendations in terms of technical physics.
2. Digital competencies: (Digital skills):	ON 6	He is able to use in cognitive and professional activities the basic knowledge in the fields of commercialization of innovations and evaluation of the commercial potential of innovations.
	ON 7	Owens the scheme of the organization of scientific research, the practice of using methods of scientific knowledge in the field of innovation in natural science, technical and technological research.
	ON 8	Able to analyze the physical principles of operation, the main characteristics of optoelectronic emitters and photodetectors.
	ON 9	Able to correctly Express physical ideas, quantify and solve physical problems.
	ON 10	Able to explain the principles of operation of spintronics devices, spin transistor device, spin valve and spin emitting diode.
3. Professional competencies: (Hard-skills)	ON 11	He has the skills to work on laser devices and the use of laser technology to solve scientific and applied problems.
	ON 12	Owens techniques for the identification and implementation of new energy-efficient technologies in various sectors of the economy, as well as non-traditional and environmentally friendly energy sources.
	ON 13	It is able to simulate various physical processes using modern programming tools.
	ON 14	Owens the basic principles of construction of structural schemes of telecommunication systems, semiconductor devices for various purposes.
	ON 15	Owens the basic principles of construction of structural schemes of telecommunication systems, semiconductor devices for various purposes.

## 18. Determination of modules of disciplines in accordance with the results of training

Learning result code	Name of the module	Name of disciplines	Volume (ECTS)
LO 1	Philosophical and historical aspects of social and humanitarian knowledge	History and philosophy of science	4
		Higher School Pedagogy	4
		Psychology of management	4
		Teaching practice	4
LO 2	Professional languages	Foreign language (professional)	4
		Professional foreign terminology in technical physics	5

		Theory and methodology of preparation of a scientific publication in a foreign language	
LO3	The innovation process the organization of scientific research	Commercialization of the results of scientific and technical activities	5
		Advanced technologies in micro and nanoelectronics	
		Innovation in science, technology and technology research	5
		Functional electronics	
LO4	Fundamental principles of modern physics	Physical fundamentals of electronics	4
		Selected chapters of modern physics	4
		Basics of spintronics	4
LO5	Modern problems of technical physics	Introduction to laser technology (in English)	4
		Physics of Nanostructures and Nanoclusters (in English)	
		Energy-saving technologies in power supply	4
		Ecological and energy efficiency of fuel combustion	
		Computer modeling of physical processes using MathCAD (in English)	5
		Automated thermal energy distribution systems	
		Basics of telecommunications(in English)	4
		Development of infocommunication networks and systems(in English)	
		Semiconductors electronics (in English)	4
		Fundamentals of Mechatronics (English)	
		Methods of teaching physical electronics and microelectronics	4
Methods of teaching special disciplines in higher education			
LO6	Research work	Researchpractice	12
	Modernproblemsoftechnicalphysics	The scientific research work of the undergraduate, including the performance of the master	12
LO7	Finalexamination (FE)	Formalization and defense of the master	8

### 19. Matrix of achievability of learning outcomes

NN	Nameofdisciplines	Briefdescriptionofthediscipline	Number ofcredits	Generatedlearningresults (codes)						
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7
Cycle of basicdisciplines University component										



D 1	History and philosophy of science	The purpose of the discipline - deepening the knowledge of philosophy and methodology of science, systematization of knowledge about science as a cognitive activity, study of the features of scientific cognition. The course content includes familiarization with the functions of science in the life of society, the ways of correlation of rational and irrational, logic and intuition, discovery and justification in scientific knowledge, the genesis of institutional forms of scientific activity.	4	+							
D 2	Higherschoolpedagogy	The pedagogy of higher education is designed to put on a scientific basis both the solution of the problem of higher education for specific specialties, and the development by undergraduates in their future professional activities of managing the process of mastering this content. The pedagogy of higher education allows us to scientifically substantiate the requirements for the modern educational process and identify its regularities.	4	+							
D 3	Psychologyofmanagement	The purpose of the discipline - formation of undergraduates' systemic ideas about the psychological patterns of managerial activity, theoretical positions and actual problems of management psychology, disclosure of the specifics of the use of socio-psychological knowledge in the structure of the manager's activities, personal characteristics of the head, mastering the skills of analyzing the socio-psychological principles underlying effective management.	4	+							
D 4	Teachingpractice	The purpose of pedagogical practice is a component of professional preparation for scientific and pedagogical activity in a higher educational institution (university) and is a type of practical activity of doctoral students in the implementation of the educational process in higher education, including the teaching of special disciplines, the organization of educational activities of students, scientific and methodological work on the subject, obtaining skills and practical teaching skills.	4	+							
D 5	Foreignlanguage (professional)	The purpose of the course: improving the level of proficiency of undergraduates in a foreign language to solve social and communicative tasks. Course content: mastering the skills of expressing opinions, argumentation of decisions and actions, analysis of socially significant processes and problems; free use of three main components: the sphere of communication and topics, socio-cultural cognition, linguistics.	4		+						
D 6	Professional foreign terminology in technical physics	The discipline considers modern foreign terminology used in technical physics when reading foreign literature.	5		+						
	Theory and methodology of preparation of a scientific publication in a foreign language										
Cycle of basic disciplines Component of choice											
D 7	Commercialization of the results of scientific and technical activities	The purpose of the discipline - studying the process of commercialization of the results of scientific and intellectual activity, attracting investments, introducing developments into production and their further support. Content of the discipline: legal bases of commercialization of scientific achievements, technologies of commercialization of inventions and innovations, business plan and tender documentation of the commercialization project.	5			+					

	Advanced technologies in micro and nanoelectronics	The purpose of the discipline: to study the theoretical foundations of various types of micro- and nanoelectronics devices, to develop skills in applying the principles of micro- and nanoelectronics to automate process control. Tasks: to use micro- and nanoelectronics methods that allow solving specific practical tasks; skills in interpreting physical ideas, their quantitative formulation and solving physical problems; knowledge of the theoretical foundations of micro- and nanoelectronics, analysis of various dependencies, principles of functioning of micro- and nanoelectronics devices.				+				
D 8	Innovation in science, technology and technology research	The purpose of the discipline - mastering the methodology of substantiating technical solutions in innovation management, promoting innovative products to the market, determining the main directions of effective scientific, technical and production activities of the organization in the areas of development, implementation and commercialization of innovations. The content of the course is aimed at studying the role of innovations and innovative technology markets in the development of the world economy, studying the features of innovation activity in certain groups of countries.	5			+				
	Functional electronics	The purpose of the course: the formation of a new physical worldview among undergraduates, but not circuit-based methods of processing and storing information to understand the further development of microelectronics. In the course of studying the discipline, the basics of electronics are considered, including the device and the principle of operation of electronic components; non-circuitry methods of processing and storing information; methods and means of automated modeling and design of electronic circuits.				+				
SPECIALTY ORIENTED MODULES										
D 9	Physical fundamentals of electronics	Basic concepts, basic physical processes in optoelectronic devices and devices.	4				6			
D 10	Selected chapters of modern physics	The basic principles and laws of physics and their mathematical expression, the basic physical phenomena, methods of their observation and experimental research are considered.	4				+			
D 11	Basics of spintronics	Formulates the concepts of electron spins, multi-electron atom and photon. Considers the magnetism of the traditional (the transition metals of the iron group) and new materials (signalisierung manganese elemental semiconductors, compounds $And(III)In(Y)$ , nanosized particles).	4				+			
SPECIALTY ORIENTED ELECTIVE MODULES										
D 12	Introduction to laser technology (in English)	Laser designs, basic parameters of laser radiation, new devices for solving specific problems of analysis and control of technological chains are considered.	4					+		
	Physics of Nanostructures and Nanoclusters (in English)	The purpose of the course is to gain knowledge in the field of the physical foundations of photonics and optoinformatics nanotechnology, practical use of nanostructures, condensed matter physics. This course outlines a range of issues that form the basis of modern physical models applicable to the description of such nanostructures as semiconductor quantum wells, quantum filaments, quantum dots, carbon nanotubes, graphene and metal nanoparticles. The						+		

		description of the main physical effects and phenomena characteristic of systems with reduced dimension is given.								
D 13	Energy-saving technologies in power supply	The legislation of the Republic of Kazakhstan on energy saving, the main directions of the state policy and the basic principles in the field of energy saving, the basics of energy saving.	4						+	
	Ecological and energy efficiency of fuel combustion	Objectives of the course and expected results: formation of knowledge, skills and abilities on energy saving in the fuel and energy complex, industries, transport, agro-industrial complex, public utilities and the use of unconventional renewable energy sources. Summary of the course: acquaintance with the general problems of energy saving at the present stage, in the future with the state policy of the Republic of Kazakhstan on energy conservation and the introduction of non-traditional energy sources; mastering the method of marginal energy saving.							+	
D 14	Computer modeling of physical processes using MathCAD (in English)	Physical processes using modern programming tools, theoretical foundations of numerical methods for solving differential equations.	4						+	
	Automated thermal energy distribution systems	The purpose of the discipline is to study the general principles of the functioning of the automated control system of thermal power plants; to teach to make and justify specific technical decisions when choosing the structure of the control systems of thermal facilities, the structure of the automated control system and the automated control system.							+	
D 15	Basics of telecommunications(in English)	Basic principles of construction of structural schemes of telecommunication systems, features of multi-channel systems, digital networks with the integration of services and intelligent networks.	4						+	
	Development of info communication networks and systems(in English)								+	
D 16	Semiconductors electronics (in English)	Principles of operation of the most important semiconductor devices, physical processes occurring in electrical transitions,models of semiconductor devices for various purposes.	4						+	
	Fundamentals of Mechatronics (English)								+	
D 17	Physical methods of non-destructive testing	Technological control of processes as well as management, determination of structural and mechanical characteristics of masses, measurement and measurement is the methodology of experimental technology.	4						+	
	Physics of rheological fluids	Control and management of technological processes, measurement methodology and instrumentation to determine the structural and mechanical properties of the masses.							+	
D 18	Methods of teaching physical electronics and microelectronics	The training is conducted in order to form knowledge about the means, methods and forms of teaching special disciplines and to acquire by undergraduates the necessary practical skills in organizing the educational process for the study of disciplines of a special cycle, preparing methodological support for the educational process of training specialists.	4						+	
	Methods of teaching special disciplines in higher education	It is studied in order to form knowledge about the totality of means, methods and forms of teaching special disciplines and the acquisition by undergraduates							+	

		ates of the necessary practical skills in organizing the educational process for the study of disciplines of a special cycle, preparing methodological support for the educational process of training specialists.									
D 19	Resear chpractice	Research practices are organized in accordance with the profile of the master's program and include the formation of the required competencies of undergraduates. When checking, there is an individual educational trajectory, the topic of the master's dissertation, as well as the type of professional activity chosen by the magician. The practice includes the implementation of a list of tasks by a master student on the profile of his future activity. It requires the study, collection, processing and systematization of materials for writing magic.	12							+	
D 20	The scientific research work of the undergraduate, including the performance of the master	The main purpose of the research work (RWMS) is the study by undergraduates of the current state of the scientific and practical problem on the topic of the master's thesis. Research work for the preparation of a master's thesis was carried out simultaneously with the educational process during the duration of the master's degree and in the form of a scientific seminar.	24							+	
D 21	Formalization and defense of the master	The purpose of the problem investigated in the work should be in demand and relevant. The ways to solve it and the methods used are innovative and previously unexplored. A master's student should rely on new inventions in her work and have suggestions for solving the problem.	8								+

## 20. Coordination of the planned learning outcomes with the methods of teaching and evaluation within the module

Learning results	Planned learning results for the module	Teaching methods	Assessment methods
LR 1	Able to use knowledge of traditional and modern problems of the history and philosophy of science in research activities in the professional direction. Has the basic concepts and categories of the philosophy of science for setting and solving urgent problems in his own field of scientific research. Substantiates the modern paradigm of higher education, its content.	Interactive lecture, case-methods, round table, analysis of publications, demonstration of speech	Colloquium, testing
LR 2	Fluent in foreign languages at a level that allows effective interaction in a professional and scientific environment; he has skills that allow him to carry out further training and development of a linguistic personality with a high degree of self-activity and self-regulation. To know foreign terminology in thermal power engineering. Applies knowledge of foreign terminology in thermal power engineering at a professional level when reading foreign literature.	Interactive lecture, experimental works intended for scientific research	Project preparation
LR3	Able to use basic knowledge in the fields of commercialization of innovations and evaluation of the commercial potential of innovations in cognitive and professional activities. Has basic theoretical knowledge about the organization of innovation activities, basic theoretical knowledge about the use of information technology in innovation risk management.	Interactive lecture, experimental works intended for scientific research	Written work
LR4	Know the main traditional and non-traditional renewable energy sources; the energy potential of renewable energy sources; principles and methods of practical use of renewable energy sources. Provision of technical solutions aimed at the rational use of unconventional and renewable energy sources;	Round table	Portfolio

LR5	Knows the basic theoretical provisions, principles, terms, concepts, processes, methods, technologies, tools, operations of scientific activity; understands the methods of planning and organizing scientific research; has the methodology of scientific design, creativity, the general scheme of organizing scientific research, the practice of using methods of scientific knowledge in the field of innovation in natural sciences. Scientific, technical and technological research.	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	Written work
LR6	To set and solve innovative tasks for the application of modern methods of non-destructive testing using system analysis and modeling of control processes. Apply in-depth knowledge in the field of non-destructive testing of products and welded joints. Know different types of heat exchange and methods of their calculation; be able to calculate different types of heat exchange and the thermal state of various components and parts;	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	Testing
LR7	Know the basic principles of heat and mass transfer and methods of mathematical modeling of heat and mass transfer processes and installations, the main sources of scientific and technical information about new developments in the field of heat and mass transfer; be able to independently analyze the processes of heat and mass transfer and make optimal decisions in the design and operation of heat and mass exchange equipment;	Analysis of conducted experiments, analysis of scientific literature, presentation of reports	Report, presentation
LR8	Know the procedures for setting and solving scientific problems; applies standards and regulations for the registration of research results, for the preparation of scientific reports, publications for seminars and conferences; applies procedures for searching global networks for information on scientific developments, opportunities for scientific contacts, applications for scientific grants of various levels.	Monitoring of the implementation by doctoral students of an individual research plan (publication of scientific results, preparation of a dissertation).	Report, presentation
LR9	Demonstrates the procedures for testing the results of scientific research, preparation of publications on the results of scientific research; possess a way of presenting scientific materials and forming a manuscript of scientific work, registration of a master's thesis.	Analysis of the results of the intermediate and final certification of the research work of PhD students. Organization and monitoring of the defense of doctoral dissertations.	Protection

## 21. The graduate model of the educational program

Attributes:

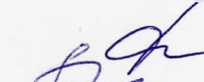
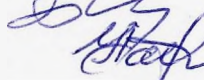
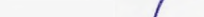
- deep professional knowledge in their field of study;
- interest in mastering trends in education and science;
- ability to collaborate in the professional community;
- independence in the search for opportunities for professional and personal development;
- sociability;
- tolerance and good manners;
- academic integrity;
- willingness to participate in solving state tasks and strategies of Kazakhstan.

Types of competencies	Description of competencies
1. Behavioral skills and personal qualities (Soft skills)	Able to use knowledge of traditional and modern problems of the history and philosophy of science in research activities in the professional direction. Has the basic concepts and categories of the philosophy of science for setting and solving urgent problems in his own field of scientific research. Fluent in foreign languages at a level that allows effective interaction in a professional and scientific environment; has the skills to carry out with a high degree of independence and self-regulation further training and development of a linguistic personality. He is able to use basic knowledge in the fields of commercialization of innovations and evaluation of the commercial potential of innovations in cognitive and professional activities.

2. Digital competencies (Digital skills):	Know the main traditional and non-traditional renewable energy sources; the energy potential of renewable energy sources; principles and methods of practical use of renewable energy sources. Providing technical solutions aimed at the rational use of unconventional and renewable energy sources; know the basic theoretical provisions, principles, terms, concepts, processes, methods, technologies, tools, operations of scientific activity; understands the methods of planning and organizing scientific research; possesses the methodology of scientific conception, creativity, the general scheme of the organization of scientific research, the practice of using methods of scientific cognition in the field of innovation in natural science, technical and technological research. To master the methods and techniques of analog, physical and mathematical modeling; development of skills and abilities: mathematical modeling of processes.
3. Professional competencies (Hard skills)	To set and solve innovative tasks for the application of modern methods of non-destructive testing using system analysis and modeling of control processes. Apply in-depth knowledge in the field of non-destructive testing of products and welded joints. To know different types of heat exchange and methods of their calculation; to know the basic principles of heat and mass transfer and methods of mathematical modeling of heat and mass transfer processes and installations, the main sources of scientific and technical information about new developments in the field of heat and mass transfer; independently set and solve problems of thermohydraulic processes and perform numerical calculations; develop computer models of thermohydraulic processes. Know the procedures for setting and solving scientific problems; applies standards and regulations for the design of research results, for the preparation of scientific reports, publications for seminars and conferences; demonstrates procedures for testing the results of scientific research, preparation of publications based on the results of scientific research; possess the method of presentation of scientific materials and the formation of the manuscript of scientific work, the design of a master's thesis.

### Developers:

Head of the Department of Radiophysics and Electronics, PhD  
Associate Professor, Candidate of Technical Sciences  
Assistant Professor, Candidate Chemical Science

 G.K. Alpysova  
 L.V. Chirkova  
 A.S. Utegenova

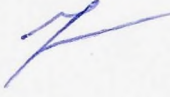
### Notes.

The educational program was reviewed by the faculty council from 25.04.24 Protocol no. 9

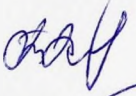
The educational program was reviewed at the meeting of the Academic Council from 29.04.24 Protocol no. 5

The educational program was reviewed and approved at the meeting of the University Board from 24.05.24 Protocol no. 8

**Board Member-Vice-Rector for Academic Affairs**

 M.M. Umurkulova

**Director of the Academic Work Department**

 T.M. Khasenova

**Dean of the Faculty of Physics and Technology**

 A.K. Zeinidenov