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

WAPPROVED

By decision of the Board of the B

«APPROVED»

By decision of the Board of Directors

NJSC «Karaganda University

named after academician E.A. Buketova»

Protocol №5 or « 21 » 06 2024 г.

EDUCATIONAL PROGRAM

Level: Master

Degree: master of science in education program «7M07108 - Nanotechnologies and nanomaterials (by fields of application)»

Karaganda, 2024

APPROVAL SHEET

EDUCATIONAL PROGRAM «7M07108 - Nanotechnologies and nanomaterials (by fields of application)»

«AGREED» Director of ISC «National Center	
Director of 336 whatfoliar Center	
for Expertise and Certification»	
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«AGREED»
Director of «NPO Defectoscopy» LLP

T. Zh. Akylbekov

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2024

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The educational program in the direction of training «7M071 Engineering and engineering» is 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.

Educational program «7M07108 - Nanotechnologies and nanomaterials (by fields of application)»

Content:

№	Passport of the educational program
1	Code and name of the educational program
2	Code and classification of the field of education, areas of training
3	Group of educational programs
4	Volume of loans
5	Form of training
6	Language of instruction
7	Degree awarded
8	Type of EP
9	Level according to the ISCE
10	Level according to the NQF
11	Level according to the IQF
12	Distinctive features of the EP
	Partner University (JEP)
	Partner University (TDEP)
13	The number of the appendix to the license for the direction of training
14	The name of the accreditation body and the validity period of the accreditation EP
15	Purpose of the EP
a)	Qualification characteristics of the graduate
b)	List of graduate positions
c)	Scope and objects of professional activity of the graduate
d)	Types of professional activity of the graduate
16	Functions of the graduate's professional activity
17	Formulation of learning outcomes based on competencies
18	Determination of modules of disciplines in accordance with the results of training
19	Matrix of achievability of learning outcomes
20	Coordination of the planned learning outcomes with the methods of teaching and evaluation within the module
21	Graduate Model

Passport of the educational program

- 1. Code and name of the educational program: 7M071 Engineering and engineering
- **2.** Code and classification of the field of education, training areas: 7M07 Engineering, manufacturing and construction industries, 7M071 Engineering and Engineering work
 - **3. Group of educational programs:** 7M071 Engineering and engineering
 - **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 7M071 Engineering and engineering
 - **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: High-quality training of competitive and competent specialists with a high level of general and professional culture, developed professional language competencies, fundamental knowledge in the field of nanotechnology and nanomaterials, capable of effective professional activity at regional and industry enterprises.
- a) Qualification characteristics of the graduate: The graduate is awarded the degree "Master of science in education program 7M07108 Nanotechnology and nanomaterials".
- **b)** List of graduate positions: The graduate the graduate is awarded the degree "Master of science in education program 7M07108 Nanotechnology and nanomaterials".

c) The scope and objects of professional activity of graduates

The objects of professional activity of masters in the educational program 7M07110801 - Nanotechnology and nanomaterials are:

- theoretical and experimental research,
- mathematical and computer modeling,
- design, construction, production technology, materials, components, electronic devices, devices, installations of vacuum, plasma, solid-state, microwave, optical, micro-and nanoelectronics for various functional purposes.

d) Types of professional activities

- analysis based on modern theoretical concepts
- application of physical phenomena in applied research;
- development of formal models and methods used in the creation of nanoobjects of professional activity;
- perfection of formal models and methods used in the creation of nanoobjects of professional activity;
- development of methods of analysis, synthesis of processes of functioning of nanoobjects of professional activity;
- development of methods for optimization of forecasting the quality of the processes of functioning of nanoobjects of professional activity;
- study of methods of analysis and synthesis of processes of functioning of nano-objects of professional activity;
- research of methods of optimization of forecasting of quality of processes of functioning of nanoobjects of professional activity;

- development of standards and technologies for the production of nanoobjects of professional activity;
- application of means of specification of methods of development of standards and technologies of production of nanoobjects of professional activity.

16. Functions of the graduate's professional activity

- -analysis of the state and dynamics of engineering nanotechnology;
- -planning, staging and conducting theoretical and experimental research in the field of engineering nanotechnology in order to find principles and ways to improve the objects of professional activity, substantiation of their technical characteristics, determining the conditions of use and operation;
- -participation in the work on the complex solution of innovative problems from the idea, fundamental and applied research to the creation of industrial products and the organization of mass production
- -development of new technological processes of production of experimental and serial samples of products on the basis of complex use of nanomaterials, micro-nanomodules, nanotechnology;
- -participation in the team of performers in the organization and management of the technological cycle of production of experimental and serial products; control over the parameters of nanotechnology processes and the quality of production of products; certification tests of products and nanotechnology equipment.

17. Formulation of learning outcomes based on competencies

Type of competencies	Learning outcome code	Learning outcome
1. Behavioral skills and	ON1	To apply knowledge of traditional and modern problems of history and philosophy of science in scientific
personal qualities: ((Soft skills)		and pedagogical activity in the professional direction.
((Soft Skins)	ON 2	To analyze the modern paradigm of higher education and its content; to identify the features of modern
		didactic concepts in higher education; to demonstrate knowledge in the field of modern educational tech-
		nologies; to choose the optimal and most effective modern educational technologies and forms of organi-
		zation of the educational process in higher education.
	ON 3	Apply the knowledge, techniques and methods of psychology to regulate conflicts in educational organi-
		zations, in professional activities.
	ON 4	Apply basic knowledge in the fields of commercialization of innovations and evaluation of the commer-
		cial potential of innovations in cognitive and professional activities.
	ON 5	Apply foreign languages at a level that allows effective interaction in a professional and scientific
		environment; carry out further training and development of a linguistic personality.
2. Digital competencies:	ON 6	To develop schemes for the organization of scientific research using methods of scientific cognition in the
(Digital skills):		field of innovation in natural science, technical and technological research.
	ON 7	To evaluate the main methods of processing and analysis of measurement information, the current level
		of development of information and measurement technologies and trends in their development; to exper-
		iment with lasers and the simplest laser devices; to develop software and hardware complexes for collect-
		ing, processing and presenting measurement information.
	ON 8	Apply the principles and methods of scientific research to conduct experiments, collect, process scientific
		information, select scientific journals and present research results in the form of an article or report.
	ON 9	To use and develop the theoretical foundations of traditional and new branches of physics and chemistry
		with the involvement of information databases, nanomaterial technologies in solving professional prob-
		lems in the field of nanomaterials and nanotechnology.
	LO 10	To apply the classification of nanostructures and methods of their manufacture, the main patterns of in-
		teraction of optical radiation with nanostructures to study the patterns of formation of spectral characteris-
		tics of nanostructures.

3. Professional competencies:	ON 11	Explain the principles of operation of spintronics devices, apply control methods in various
(Hard-skills)		semiconductor nanostructures.
	ON 12	Apply the regularities of the methodology of science in the field of nanomaterials and nanotechnology to
		solve problems related to the development of new and improvement of existing processes for obtaining
		nanomaterials and nanosystems and forecasting the properties of nanomaterials.
	ON 13	Apply methods of modeling, analysis, evaluation of forecasting and optimization of technological pro-
		cesses and properties of micro- and nanosystems in scientific and pedagogical activities.
	ON 14	Has the skills to select and justify the methods necessary to solve specific problems in chemistry, chemi-
		cal technology, medicine, chemical analysis using nanoobjects and nanotechnology. Independently con-
		ducts a natural science experiment and analysis of its results, using modern technologies to solve funda-
		mental scientific and applied professional tasks. Independently measures the main parameters of laser
		radiation; develops new devices for solving problems of analysis and control of technological chains;
		maintains laser technology.
	ON 15	Analyze the operation of electronics installations and devices, formulate proposals for improving the
		devices of technological equipment.

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

Learning outcome code	Module name	Name of discipline	Volume (ECTS)
LO 1	Philosophical and historical aspects of social	History and philosophy of science	4
LO 2	and humanitarian knowledge	Higher School Pedagogy	4
LO 3		Psychology of management	4
LO 4		Teaching practice	4
LO 5	Professional language	Foreign language (professional)	4
LO 6		Professional foreign terminology of nanotech-	5
		nology and nanoelectronics	
LO 6		Theory and methodology of preparation of a	
		scientific publication in a foreign language	
LO 7	The innovation process the organization of	Commercialization of the results of scientific	5
	scientific research	and technical activities	
LO 7		Advanced technologies in micro and nanoelec-	
		tronics	
LO 8		Innovation in science, technology research	5
LO 8		Functional electronics	
LO 9	Fundamental principles of nanotechnology	Fundamentals basics of nanotechnology	4
LO 10		Nanophotonics (in English)	
			4
LO 11		Basics of spin electronics	4
LO 12	Scientific and experimental foundations of	Methods of contactless diagnostics of nanosys-	4
	nanotechnology	tems and nanoobjects	·
LO 12		Research methods for nanomaterials	
LO 13		Modeling and design of micro and nano systems	4

LO 13		Computer methods for analyzing the properties	
		of nanoobjects	
LO 14		Research methods and diagnostics of nanoob-	4
		jects and nanosystems	4
LO 14		Methods of teaching nanotechnology in elec-	
		tronics	
LO 15		Nanotechnologies and nanomaterials in electron-	5
		ics	9
LO 15		Nanomaterial technology	
LO16		Measuring systems in nanotechnology	4
LO 16		Electronic measurements in nanotechnology and	
		microelectronics	
LO 17		Laser technology in micro and nanosystem tech-	4
		nology	4
		Laser physics and technology	
LO 17			
LO 18		Methods of teaching special disciplines in higher	4
		education	
LO 18		Methods of teaching nanotechnology in elec-	
		tronics	
LO 19	Research practice	Research work	12
LO 20	Scientific research work	The scientific research work of the undergradu-	24
		ate, including the performance of the master	
		(NIRM)	
LO 21	Final certification	Formalization and defense of the master	8

19. Matrix of achievability of learning outcomes

NN	Name of	Brief description of the	Numbe	Numbe Generated learning results (codes)														
	disciplines	discipline	r of credits	OH 1	OH 2	ОН 3	OH 4	ОН 5	9 HO	ОН 7	8 HO	6 HO	ОН 10	11 HO	OH 12	0Н 13	14 HO	OH 15
	•		Cycle of	basic d	isciplin	ies		•								ı u	<u> </u>	
			Univer	sity con	nponen	t												
D1	History and philos-	The purpose of the discipline - deepening	4															
	ophy of science	the knowledge of philosophy and method-		+														
		ology 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 sci-																
		ence 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 insti-									
		tutional forms of scientific activity.									
D2	Higher school ped-	The pedagogy of higher education is de-	4	+							
52	-	signed to put on a scientific basis both the	•	l '							
	agogy										
		solution of the problem of higher educa-									
		tion for specific specialties, and the devel-									
		opment 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.									
D3		The purpose of the discipline - formation	4	+							
		of undergraduates' systemic ideas about the									
		psychological patterns of managerial activ-									
		ity, theoretical positions and actual prob-									
	Psychology of man-	lems of management psychology, disclo-									
	agement	sure of the specifics of the use of socio-									
		psychological knowledge in the structure									
		of the manager's activities, personal char-									
		acteristics of the head, mastering the skills									
		of analyzing the socio-psychological prin-									
		ciples underlying effective management.									
D 4	Teaching practice	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 doc-									
		toral students in the implementation of the									
		educational process in higher education,									
		including the teaching of special disci-									
		plines, the organization of educational									
		activities of students, scientific and meth-									
		odological work on the subject, obtaining									
		skills and practical teaching skills.									
D5	Foreign language	The purpose of the course: improving the	4		+	+					
	(professional)	level of proficiency of undergraduates in a				-					
	(professional)										
		foreign language to solve social and com-									
		municative tasks. Course content: master-									
		ing the skills of expressing opinions, ar-									
		gumentation of decisions and actions,									
		analysis of socially significant processes									
		and problems; free use of three main com-									
		ponents: the sphere of communication and									
		topics, socio-cultural cognition, linguistics.									
		topics, socio-cuiturai cogintion, iniguistics.									
1											

	Professional foreign terminology of nan- otechnology and nanoelectronics	The purpose of the course: the study of foreign terminology on nanotechnology and nanoelectronics, its specifics, mastering the skills of using foreign terminology on nanotechnology and nanoelectronics in the preparation of reports and publications on the subject of research. Course content: skills of formulating and substantiating a point of view in solving scientific problems, methods of preparing scientific publications using terminology on nanotechnology and nanoelectronics.	5										
	Theory and methodology of preparation of a scientific publication in a foreign language	The purpose of the course: familiarization with the theory, methodology of preparation and skills of writing a scientific publication in a foreign language, mastering the skills of analysis and selection of journals included in the Scopus, Thomson Reuters databases on the subject of research. Course content: methods of writing a scientific article on the profile for submission to journals in a foreign language, including journals included in the Scopus, Thomson Reuters databases. The specifics of the preparation of the article, the compilation of the glossary, the algorithm of writing the publication, the formulation of conclusions.	5										
			Cycle of										
D7	Commercialization	The purpose of the discipline studying the		onent o	f choice	, 1	l ,	<u> </u>	 			I	
D7	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 formula-	5			+	+						

D8	Innovation in science, technology and technology research	tion 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. 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.	5					+	+					
			ECIALTY OI	RIENT	ED MO	DULI	ES							
D9	Fundamentals basics of nanotechnology	Purpose: to conduct technological research; to form a holistic view of the professional activity of creating innovations. Tasks: general characteristics of the technical blocks of the innovation process; fundamentals of scientific knowledge and creativity, collection and processing of scientific and technical information. The main concepts related to innovation management;	4					+	+					

		the purpose of innovation activity and the main provisions of a systematic approach to innovation management; the role and tasks of an innovator specialist.													
D10	Nanophotonics (in English)	The purpose of the course is a deeper study of the physical principles of optics of nanoscale systems, familiarization with the development trends in the field of nanophotonics and their application in science and practice. In the course of studying the discipline, the fundamental foundations of the interaction of light with nanoobjects of different nature, experimental methods of nanophthonics, promising directions in this field are considered.	4						+						
D11	Basics of spin electronics	The purpose of the course is to formulate the concept of electron, multi-electron atom and photon spins, to master the methods of controlling them in various semiconductor nanostructures. In the course of studying the discipline, the issues of physics of low-dimensional systems with spinorbit interaction, mathematical models for describing the properties of spin density and methods for controlling them in various semiconductor nanostructures, comparison of techniques for the orientation of charge carrier spins in semiconductors are considered.	4							+					
		SP	ECIALTY ORIEN	NTED E	LECTIVE I	MODULI	ES		ı		I	ı	ı	ı.	
D12	Methods for non- contact diagnostics of nanosystems and nanoobjects	The purpose of the discipline: obtaining theoretical skills and competencies in the field of existing and promising technologies for contactless diagnostics of nanosystems and nanoobjects. The course content includes the study of technologies of optical, atomic force and electron microscopy, X-ray spectroscopy and diffractometry.	4							+	+		+		
	Research methods for nanomaterials	The purpose of the discipline: acquisition of skills in working with nanometer-sized objects and mastering modern physico-chemical research methods. The course discusses methods for studying nanoparticles and nanocomposites: scanning and transmission probe microscopy, optical methods for studying nanostructures.	4									+			

D13	Modeling and design of micro and nano systems	The purpose of the discipline: the formation of undergraduates' skills and abilities to apply modeling methods in order to effectively optimize the properties of materials and components of nano- and microsystem technology. This course discusses methods of formal description of micro- and nanosystems components; methods of calculation and modeling of basic components of micro- and nanosystems, methods of calculation and modeling of basic processes in the manufacture of components of micro- and nanosystems.	4					+				
	Computer methods for analyzing the properties of na- noobjects	The purpose of the discipline: the formation of undergraduates' knowledge of the theoretical foundations of modern computer methods of analysis, analytical techniques and techniques, statistical processing of analysis results. In the course of studying the discipline, the issues of developing skills of practical application of these methods for the analysis of specific technical objects in solving professional problems of nanotechnology and nanoindustry are considered.	4						+			
D 14	Modeling and design of micro and nano systems	The purpose of the discipline: the formation of undergraduates' skills and abilities to apply modeling methods in order to effectively optimize the properties of materials and components of nano- and microsystem technology. This course discusses methods of formal description of micro- and nanosystems components; methods of calculation and modeling of basic components of micro- and nanosystems, methods of calculation and modeling of basic processes in the manufacture of components of micro- and nanosystems.	4							+		
	Methods of teaching nanotechnology in electronics	The purpose is to give an idea about the features of the application of nanotechnology in electronics (including molecular), about the main directions of the development of nanoelectronics and the areas of its use. Tasks: to get acquainted with the historical stages of the origin of nanoelectronics, to determine the role of microelectronics at the present stage. To consider the achievements of nanotechnology in electronics, prospects and trends of its further development.	4								+	

D15	Nanotechnologies and nanomaterials in electronics	The purpose of the course is to study the main classes of nanotechnologies and nanomaterials used in the manufacture of electronics devices. The course covers the basics of nanotechnology and nanomaterials in electronics; the peculiarities of the influence of nanomaterials on the properties of metals, methods of studying nanomaterials and nanostructures, methods of forming nanomaterials.	5							+	
	Nanomaterial technology	The purpose of the course: mastering by undergraduates of the basic technologies for obtaining nanomaterials for experimental research. The course discusses the issues of electron microscopy, the principles of scanning tunneling, atomic force microscope, methods for obtaining thin films and heterostructures by molecular beam epitaxy and nanophotolithography, ion-track technology.	5							+	
D16	Measuring systems in nanotechnology	The purpose of the discipline: the formation of undergraduates' skills of verification and calibration of measuring instruments, skills of working with measuring systems in nanotechnology. The course content includes the study of methods of verification, calibration of measuring instruments, methods of measuring parameters and characteristics of objects and products of nanotechnology and nanoindustry.	4								+
	Electronic meas- urements in nano- technology and microelectronics	The purpose of the discipline: the formation of undergraduates' skills in using technical means to measure and control the main parameters of technological processes, properties of materials and products. The course content includes consideration of modern electronic and measuring devices used in scientific research, methods of testing and testing of devices and systems of microelectronics and nanotechnology.	4								+
D17	Laser technology in micro and nanosystem technology	The content of the course includes consideration of modern electronic and measuring instruments used in scientific research, methods of testing and testing devices and systems of microelectronics and nanotechnologies. The content of the course includes consideration of modern electronic and measuring instruments used in scientific research, methods of testing and testing devices and systems of microelectronics									

		and nanotechnologies.									
	Laser physics and technology	The purpose of the course: the formation of undergraduates' ideas about the physics of laser operation, the properties of laser radiation, the skills of using lasers in science, technology, and production. The course discusses ideas about the principles of operation, the design of lasers, the properties of laser radiation, types of lasers, pulsed modes of their operation, introduces the most common laser systems, issues of interaction of laser radiation with matter and areas of application of lasers.									
D18	Methods of teaching nanotechnology in electronics	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 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	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 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.	4								
D 19	Research practice	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	Research work of a master's student, including internship and completion of a master's thesis (RWMS)	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	24							+	

		the duration of the master's degree and in the form of a scientific seminar.									
defer	paration and ense of a mas- thesis		8								+

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

Learning result	The result of the training (according to Bloom's taxonomy)	Teaching methods	Assessment methods
code			
ON1	To apply knowledge of traditional and modern	Interactive lecture, case-methods, round table,	Colloquium, testing
	problems of the history and philosophy of science in	analysis of publications, demonstration of speech	
	scientific and pedagogical activities in the		
	professional field. Interactive lecture, case		
	methods, round table, analysis of publications,		
	demonstration of speech, Colloquium, testing.		
ON2	To analyze the modern paradigm of higher education	Interactive lecture, experimental works intended	Project preparation
	and its content; to identify the features of modern di-	for scientific research	
	dactic concepts in higher education; to demonstrate		
	knowledge in the field of modern educational tech-		
	nologies; to choose the optimal and most effective		
	modern educational technologies and forms of organ-		
	ization of the educational process in higher education.		
ON3	Apply knowledge, techniques and methods of psy-	Interactive lecture, experimental works intended for scientific research	Written work
	chology to conflict management in educational organ-	for scientific research	
	izations and in professional activities.		
ON4	Apply basic knowledge in the fields of commerciali-	The round table	Portfolio
	zation of innovations and assessment of the commer-		
	cial potential of innovations in cognitive and profes-		
	sional activities.		
ON5	To apply foreign languages at a level that allows	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	Written work
	effective interaction in a professional and scientific	scientific incrature, presentation of reports	
	environment; to carry out further education and		
0)//	development of a linguistic personality.		The si
ON6	To develop schemes for the organization of scientific	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	Testing
	research using methods of scientific cognition in the	scientific incrution, presentation of reports	
	field of innovation in natural science, technical and		
ONE	technological research.	Analysis of the conducted assessment and the	Depart properties
ON7	To evaluate the main methods of processing and ana-	Analysis of the conducted experiments, analysis of scientific literature, presentation of reports	Report, presentation
	lyzing measurement information, the current level of	of selectione metatate, presentation of reports	

	development of information and measurement tech- nologies and trends in their development; to experi- ment with lasers and the simplest laser devices; to develop software and hardware complexes for collect- ing, processing and presenting measurement infor- mation.		
ON8	Apply the principles and methods of scientific research to conduct experiments, collect and process scientific information, select scientific journals and present research results in the form of an article or report.	Monitoring the implementation of an individual research plan by doctoral students (publication of scientific results, preparation of a dissertation).	Report, presentation
ON9	To use and develop the theoretical foundations of tra- ditional and new branches of physics and chemistry with the involvement of information databases, na- nomaterial technologies in solving professional prob- lems in the field of nanomaterials and nanotechnolo- gy.	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.	Testing
ON10	To apply the classification of nanostructures and methods of their manufacture, the basic patterns of interaction of optical radiation with nanostructures to study the patterns of formation of spectral characteristics of nanostructures.	Interactive lecture, case-methods, round table, analysis of publications, demonstration of speech	Colloquium, testing
ON11	To explain the principles of operation of spintronics devices, to apply control methods in various semiconductor nanostructures.	Interactive lecture, experimental works intended for scientific research	Project preparation
ON12	Apply the regularities of the methodology of science in the field of nanomaterials and nanotechnology to solve problems related to the development of new and improvement of existing processes for obtaining nanomaterials and nanosystems and forecasting the properties of nanomaterials.	Interactive lecture, experimental works intended for scientific research	Written work
ON13	Apply methods of modeling, analysis, evaluation of forecasting and optimization of technological processes and properties of micro- and nanosystems in scientific and pedagogical activities.	The round table	Portfolio
ON14	To choose methods for solving specific problems in chemical technology, medicine, chemical analysis using nanoobjects and nanotechnology, to assess the potential opportunities and risks of using nanoobjects.	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	Written work
ON15	Analyze the operation of electronic installations and devices, formulate proposals for improving the devices of technological equipment.	Interactive lecture, discussion, analysis of scientific literature, presentation of reports	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
Behavioral skills and personal qualities (Soft skills)	To apply knowledge of traditional and modern problems of history and philosophy of science in scientific and pedagogical activity in the professional direction. To analyze the modern paradigm of higher education and its content; to identify the features of modern didactic concepts in higher education; to demonstrate knowledge in the field of modern educational technologies; to choose the optimal and most effective modern educational technologies and forms of organization of the educational process in higher education. Apply the knowledge, techniques and methods of psychology to regulate conflicts in educational organizations, in professional activities. Apply basic knowledge in the fields of commercialization of innovations and evaluation of the commercial potential of innovations in cognitive and professional activities. Apply foreign languages at a level that allows effective interaction in a professional and scientific environment; carry out further training and development of a linguistic personality.
2. Digital competencies (Digital skills):	To develop schemes for the organization of scientific research using methods of scientific cognition in the field of innovation in natural science, technical and technological research. To evaluate the main methods of processing and analysis of measurement information, the current level of development of information and measurement technologies and trends in their development; to experiment with lasers and the simplest laser devices; to develop software and hardware complexes for collecting, processing and presenting measurement information. Apply the principles and methods of scientific research to conduct experiments, collect, process scientific information, select scientific journals and present research results in the form of an article or report. To use and develop the theoretical foundations of traditional and new branches of physics and chemistry with the involvement of information databases, nanomaterial technologies in solving professional problems in the field of nanomaterials and nanotechnology. To apply the classification of nanostructures and methods of their manufacture, the main patterns of interaction of optical radiation with nanostructures to study the patterns of formation of spectral characteristics of nanostructures.

Developers:

Head of the Department of Radiophysics and Electronics, PhD Professor, Candidate of Physical and Mathematical Sciences Associate Professor, PhD

A.K. Zeimidenov

-G.K. Alpysova

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The educational program was reviewed at the meeting of the Academic Council from 29, 04, 24 Protocol no. 5 Protocol no. 9 The educational program was reviewed by the faculty council from 25.04.24

The educational program was reviewed and approved at the meeting of the University Board from 24.24 Protocol no. 2

Board Member-Vice-Rector for Academic Affairs

Director of the Academic Work Department

Dean of the Faculty of Physics and Technology

M.M.Umurkulova

T.M. Khasenova

A.K. Zeinidenov