

Mining and Metallurgical Institute named after O.A. Baikonurov

Department of "Materials Science, Nanotechnology and Engineering Physics"

EDUCATIONAL PROGRAM 7M07103 "Materials Science and Technology of New Materials"

Code and classification of the field of education: **<u>7M07 ''Engineering, manufacturing and construction industries''</u></u> Code and classification of training directions: <u>7M071 ''Engineering and Engineering Trades''**</u> Group of educational programs: <u>**M101 ''Materials Science and Technology''**</u>

Level based on NQF: 7 Level based on IQF: 7 Study period: 2years Amount of credits: **120**

Almaty 2024

The educational program 7M07103 "Materials Science and Technology of New Materials" was approved at a meeting of the Academic Council of KazNTU named after K.I.Satpayev.

Protocol No. 12, 22.04.2024 was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council. *Protocol No.* 19.04.2024.

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List of abbreviations and designations

Abbreviation		Full name
Ts	—	Teaching staff
EP	_	Educational program
OR	_	Registrar's Office
WC	_	Working Curriculum EP

1. Description of educational program

The main objectives of the educational program are:

- to provide scientific training of undergraduates for their successful solution of scientific and engineering problems of an interdisciplinary nature;

- develop the skills of scientific analysis, staging and conducting scientific research, including as a team member;

- develop skills in the possession and application of scientific research methods, technologies for obtaining and processing materials for a specific purpose;

- to develop ideas about professional and ethical responsibility, the ability to independently study and improve their qualifications during their lifetime for a successful career in scientific, scientific and industrial organizations and educational institutions engaged in solving scientific and technical problems. The program is aimed at the following types of professional activity:

experimental research; design

and analytical; production

and technological; scientific

and pedagogical.

The objects of professional activity of the Master of Technical Sciences are:

employees of national companies, research centers, business structures, public administration of industry and committees on science and technology; teachers in higher educational institutions.

2. Purpose and objectives of educational program

Purpose of EP: The main purpose of the educational program is to provide scientific training for undergraduates to successfully solve scientific and engineering problems of an interdisciplinary nature, to develop the skills of scientific analysis, formulation and conduct of scientific research, to teach the skills of possession and application of scientific research methods, technologies for obtaining and processing materials for a specific purpose.

Tasks of EP:

The objectives of the educational program are consistent with the types of future professional activity and are as follows:

in the field of experimental research activities:

- analysis of the task of research in a given field based on the selection and study of literary and patent sources;

- diagnostics of the state and dynamics of objects of activity (materials, technological processes, equipment in various industries using the necessary tools and methods of analysis);

- study of the structure and properties of technical materials, their improvement and creation of new materials and technological processes for their manufacture;

 $\hfill\square$ construction of mathematical models, computer modeling to solve the problem;

□ carrying out measurements and research in the development of new materials and technologies according to a given methodology with the choice of modern technical means and computer processing of the results; - in the field of design and analytical activities:

- formulation of the objective and objectives of the project (program) with the given criteria, target functions, constraints, building the structure of their relationships, identifying priorities for solving problems;

- development of generalized solutions to problems, analysis of these options, forecasting of consequences, finding compromise solutions in conditions of multi-criteria, uncertainty, planning and implementation of projects;

- development of production equipment projects taking into account mechanical, technological, design, operational, ergonomic, aesthetic and economic parameters;

- the use of information technology to select the necessary materials and equipment in the manufacture of finished products;

in the field of production and technological activities:

 \Box conducting physical and experimental studies using modern methods of measuring and processing the results obtained;

□ introduction of technological processes of production, quality control of

elements and assemblies for various purposes; calculation of production rates, technological standards for material consumption, selection of standard equipment, preliminary assessment of the economic efficiency of the selected materials;

efficient use of materials and equipment, selection and calculation of technological process parameters for the preparation of finished products;
 quality control of materials and technologies;

- in the field of scientific and pedagogical activity:

ensuring high-quality transfer of skills and knowledge and the ability to work with staff during their training.

3. Requirements for evaluating the educational program learning outcomes

Learning outcomes include knowledge, skills and competencies and are defined both for the educational program as a whole and for its individual modules, disciplines or tasks.

The main task at this stage is to select assessment methods and tools for all types of control, with the help of which it is possible to most effectively assess the achievement of planned learning outcomes at the discipline level.

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admission of citizens to the magistracy is established in accordance with the "Standard rules for admission to training in educational organizations implementing educational programs of postgraduate education". The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary to master the relevant master's degree program. The list of necessary prerequisites is determined by the higher educational institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a paid basis.

4. Passport of educational program

4.1. General information

N⁰	Field name	Comments
1	Code and classification of the field of	7M07 "Engineering, manufacturing and construction
	education	industries"
2	Code and classification of training	7M071 "Engineering and engineering trades"
	directions	
3	Educational program group	7M071 "Material Science and Technology"
4	Educational program name	7M07103 "Engineering Physics and Materials Science".
5	Short description of educational program	The main objectives of the educational program are
		to provide scientific training of undergraduates for
		their successful solution of scientific and engineering
		problems of an interdisciplinary nature
	Drawn and CD	
0	Purpose of EP	fundamental and practical training for students to
		rundamental and practical training for students to
		solve scientific and engineering problems in various
		well as to develop students' skills in engineering
		analysis and design
7	Type of EP	New
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	Two - degree EP
11	List of competencies of educational	KK1. Communicativeness
	program	KK2. Basic literacy in
		Natural science disciplines
		KK4 Professional competencies
		KK5. Engineering-computer competencies
		KK6.Engineering-working competencies
		KK7. Socio-economic competences
		KK8. Special-professional competences
12	Learning outcomes of	LO1 to substantiate the choice of experimental methods
	educational program	for studying systems with micro- and nano-sizes;
1		

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		LO2 plan the organization and conduct of an experiment to obtain materials with special physical and chemical properties (porous nanostructures, magnetic nanomaterials, nanobiomaterials); LO 3 Integrate knowledge in professional activities and have the competence to argue their ideas when making decisions in the field of engineering and technology; LO 4 explain the specifics of the functional purpose of equipment in the field of materials science and the possibility of its digitalization; LO 5 apply physical and chemical methods for obtaining nano-objects and their composites for solving applied problems, as well as methods for describing structures, structures, composition, morphologies; LO 6 to study the current trends in advanced materials science for further scientific and pedagogical activities; LO 7 choose the best methods for solving the problems of materials; LO 8 to model and evaluate the forecast of product quality by the parameters of the technological process in order to optimize it in accordance with the type of product obtained;;
12	Education form	Eull time
13	Derived of training	
14	Period of training	2
15	Amount of credits	120 Karalda Daarian
10	Languages of instruction	Kazakn, Kussian
1/	Academic degree awarded	Matural and A
18	Developer(s) and authors	Mulusnev A. Kudaibergenov K
		Smagulov D
		Nazhinkyzy M
		Kemelbekova A.
		Yetish T.
		Abay A.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

N⁰	Discipline name	Short description of discipline	Amou	Generated learning outcomes (codes)							
			ntof credit	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
			S								
1	Foreign language (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies.public discussions; interpret and present the results of scientific research in a foreign language.									
2	History and philosophy of science	The subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.									

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3	Materials science and	The course proposes the master students				
	technologies of modern and	to estimate the results of the research and				
	promising materials	development projects and choose				
		optimal decision in materials science and				
		engineering to introduce novel materials				
		and structures for structural and				
		functional applications for different				
		industries, including electronics and				
		medicine, and technology of surface				
		hardening and coating/ Master students				
		learn how to provide research of				
		physical, chemical, mechanical.				
		technological and functional properties				
		of - ceramic metal and polymer				
		materials of different application				
4	Fundamentals of pedagogical	The course focuses on the approaches of				
	activity	giving classes. Master students learn how				
	detryity	to choose the modern resources and				
		methods of teaching based on the				
		competence oriented sime and outcomes				
		of lessons as well as get the experience of				
		of responses of segmetic of classes and				
		enaboration of scenario of classes and				
		guidelines allowing estimated the				
~	XX' 1 1 1 1	outcomes of the learning.				
Э	Higher school pedagogy	Undergraduates will master the				
		methodological and theoretical				
		foundations of higher school pedagogy,				
		plan and organize the processes of				
		teaching and upbringing, master the				
		communicative technologies of subject-				
		subject interaction between a teacher and				
		a master in the educational process of a				
		university.				
6	Professional training in	The course is focused on the experience				
	English	of learning, analysis and presentation of				

		research results in English, as well as					
		audio- and video-perception of English					
		materials. Master students can translate					
		texts from Russian to English and vice					
		versa, as well as they know the					
		terminology of English in the field of					
		materials science and technologies.					
7	Professional training in	The course is focused on the experience					
	English	of learning, analysis and presentation of					
	C	research results in English, as well as					
		audio- and video-perception of English					
		materials. Master students can translate					
		texts from Russian to English and vice					
		versa, as well as they know the					
		terminology of English in the field of					
		materials science and technologies.					
8	Psychology of	The course gives the conceptions and					
	communication	principals of human relations.					
		interpersonal and group interaction.					
		Students learn the knowledge which help					
		them to build fruitful relations with					
		persons from different groups and social					
		structures, to reveal prejudice and					
		discrimination behavior inside and					
		outside, and to prevent and solve					
		conflicts and overcome communicative					
		barriers in different situations.					
9	Psychology of management	The discipline studies the modern role					
	,	and content of psychological aspects in					
		managerial activity. The improvement of					
		the psychological literacy of the student					
		in the process of implementing					
		professional activities is considered.					
		Self-improvement in the field of					
		psychology and studying the					

		composition and structure of					
		management activities, both at the local					
		level and abroad. The psychological					
		feature of modern managers is					
		considered.					
10	Modern methods of structural	The course gives master students the					
	analysis in materials science	information about methods, equipment					
	5	and practical skills to determine chemical					
		compositions and structure parameters					
		for materials with the help of scanning					
		and transmission electron microscopy.					
		and phase composition and structure of					
		materials be means of X-Ray analysis.					
11	Technologies of zero-	In the frame of the course master students					
	dimensional nanoobjects	get the practical skill of choosing the					
		optimal technology of synthesizing					
		nanopowders nanoparticles and					
		quantum dots depending on the initial					
		requirements to the properties of zero-					
		dimension objects Master students also					
		learn how to reveal basic features of					
		nanoparticles properties from the bulk					
		materials and get the experience of					
		determining criteria to compare methods					
		for nanonowders nanonarticles and					
		quantum dots synthesis in terms of the					
		final requirements to the target products					
12	Philosophical and	In the framework of the discipline master					
12	methodological problems of	students acquire knowledge about					
	science and technology	criteria norms and standards of scientific					
	service and teenhology	knowledge in professional activity Also					
		master students acquire experience in					
		applying the basic provisions of the					
		theory of argumentation in scientific					
		research, knowledge about the value					
1		research, mionicage acout the value				1	

13 Intellectual property and Purpose; the goal is to train specialists who can effectively manage rights to the results of intellectual activity in the field of science, as well as ensure their legal protection and development results, methods of commercialization of scienctific activity in the context of IP. 14 Materials science and The discipline studies the issues of technologies of advanced smarterials. The course describes new technologies of neutrals from providers and nonpowders of metals, and comporties, manufacture of nanomacture of nanomactures. The technologies for applying coatings and films, superhard materials, and cools from them are described. v 15 Materials research methods The purpose of the discipline is to form the ability to operate with various mothods of studying substances, classify modern methods and tec								
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modern methods of studying substances, classify modern methods and techniques			the ability to operate with various					
classify modern methods and techniques			modern methods of studying substances.					
			classify modern methods and techniques					
for studying the structure and elemental			for studying the structure and elemental					
composition of materials according to			composition of materials according to					

		their purpose and technical					
		characteristics. The discipline is aimed at					
		studying the basic methods and					
		techniques of studying the structure and					
		elemental composition of materials and					
		products based on them. The following					
		methods are considered: transmission					
		electron microscopy, X-ray diffraction					
		analysis, electron microscopic methods,					
		etc.					
16	The scientific basis and	The course content includes the main				v	
	practice of application of	methods of obtaining nanostructures that					
	nano	are used for coating. The course					
		examines the analysis of various					
		nanotechnological processes, which are					
		based on the implementation of local					
		atomic-molecular interactions that form					
		nanoscale systems through self-assembly					
		or self-organization of complex					
		structures on the surface of the material					
17	Modern problems of	The discipline studies the current state of					
1,	materials and process	the science of materials and processes					
	sciences	which allows them to be used in					
	serences	materials science in studying the					
		properties of modern materials as well as					
		the processes of improving the methods					
		of their research and development. This					
		discipling considers theoretical and					
		discipline considers theoretical and					
		experimental nuclear physics,					
		nanomaterials and nanotechnologies,					
		initared methods for studying the					
		structure of polymeric materials,					
10	<u> </u>	advanced composite materials.					
18	Sustainable development	The goal is to develop deep knowledge					
	strategies	and competencies in the development					

		and implementation of sustainable development strategies at various levels. The content covers a wide range of topics, ranging from global environmental challenges such as climate change, biodiversity loss and natural resource depletion, to socio- economic aspects including inequality, health and education.					
19	Structure and properties of carbon nanomaterials	The purpose of the discipline is to form the ability to analyze the morphological 5 diversity of carbon depending on its structure. The discipline is aimed at developing skills in the synthesis of carbon nanostructures. The following questions are considered: structure, nomenclature, synthesis, modification, growth mechanism, morphological features and properties of carbon nanomaterials and their practical application.		v			
20	Technological quality assurance of materials	This discipline studies the concepts of material quality. The course of the 5 discipline also includes the analysis of the reasons for the decline in quality at different stages of the design of the technological process; methods of control (diagnostics) of the state of the material, its defectiveness associated with the violation of technological processes; methods for improving the quality of materials in the technological process of manufacturing parts and structures.	5		v		

					1	r	
21	High technologies: from research to business	In the frame of the course master students learn how to plan small enterprises aimed at the highly technological products. Master students can reveal the technological problem in the stage of elaboration and application of new materials noting the market requirements and find the best delivers of the equipment, raw materials. They can also form the list of documents needed to start business on the Russia territory taking into account occupational risks of used	3				
		materials and the application of the final products.					
22	Probe methods of diagnostics of the structure and properties of nanomaterials	Master students can investigate the composition and structure of substances, taking into account the specifics of nanoscale materials, using modern equipment and software devices, evaluate the morphology and surface structure of materials, process data obtained using various types scanning probe microscopy, and apply knowledge of the specifics of various techniques to assess the topography of nanostructured materials.	6				
23	Composite materials with desired properties	The purpose of the disciplines is the wide possibilities of research and evaluation of the synthesis of composite materials. The discipline is aimed at developing the skills of masters in creating composite materials, such as electroforming, 3D printing, etc. The main stages that reach the process of creating composite materials are considered; methods for the	5				

		synthesis of fibrous forms of nanomaterials; optimization of technological parameters and characterization of composite materials from the main technological parameters;					
		production of continuous nanoscale					
24	Materials for 3D technology	The discipline studies the methods of obtaining and using composite and powder materials, as well as the presentation of the mechanism and patterns of materials for 3D modeling, their advantages, disadvantages and main areas of application.	5				
25	Multiphase structures and methods for calculating phase diagrams	The discipline studies the creation of new materials with the required level of properties, based on the calculation of phase diagrams. Calculation methods for constructing state diagrams using computer technology and studying the thermodynamic and physical properties of alloys are considered.	5				
26	Modeling of nanomaterials	This course is a professional orientation course for master's degree students in materials. Through this course, students can understand the most basic knowledge of numerical modeling in the process of material processing, master the concept of material modeling and numerical simulation, and have the basic ability of material research test design and numerical simulation	6				
27	Research work in the semester	Selection and study of literature. Preliminary statement of the problem. Search for solution methods, justification	6				

						I		1
		of the chosen method and research						
		technique. Description of the object						
		under study. The choice of the method of						
		solving the problem and its						
		implementation. Planning and						
		conducting preliminary experiments and						
		tests in the field of processing of mineral						
		and man-made raw materials. Processing						
		and analysis of the results of experiments						
		and tests, including using modern						
		computer programs. registration of the						
		results of scientific research in the form						
		of scientific articles, reports, patents.						
		Preparation of the report.						
28	New functional materials	The discipline studies the formation of	5					
		scientific basic knowledge among						
		undergraduates aimed at improving						
		traditional and developing new						
		functional materials and coatings with						
		various properties, such as						
		superhydrophobic, anti-icing, as well as						
		technologies for their production with the						
		required level of quality and properties.						
29	The main directions of	The course systematizes the knowledge	3					
	development of materials	about the history of nanomaterials	_					
	science	research with a global perspective.						
		Master's students analyze current trends						
		in nanotechnology development with						
		respect to the application of metallic,						
		ceramic and polymeric nanomaterials for						
		high-tech industries (nuclear industry,						
		electronics, aerospace engineering,						
		chemical industry, mechanical						
		engineering, laser engineering, security						
		systems, biomedicine) using						

		international and Russian information and publishing resources, activities of leading international scientific organizations, professional and scientific societies in the field of materials science					
		and nanomaterials.					
30	Powder consolidation	In the frame of course master students get	3				
	processes: regularities and	principals of modelling processes of					
	efficiency criteria	pressing powders, learn methods of					
		complex optimization of pressing modes,					
		and choose optimal modes of pressing					
		powders depending on the external					
		energetic impact and target functional					
		characteristics of sintered articles.					
31	Dimensional effects in	In this course master students get the	3				
	nanomaterials	experience of choosing nanomaterials					
		depending on the desirable mechanical					
		and physico-chemical properties, can					
		reveal the relations between materials					
		compositions, structure and mechanical					
		properties, know the features of					
		nanosized state and apply modern					
		methods to analyze mechanical, physical					
20	Tashnalagias	and surface parameters of hanoobjects.	2				
32	reciliologies for	mester students to traditional and unique	3				
	hult nonometerials	master students to traditional and unique					
	burk nanomateriais	A fter completing the course students will					
		be able to produce and analyze some					
		panoceramic materials using bot					
		pressing to produce and analyze					
		nanostructured materials using spark					
		nlasma sintering and to calculate the					
		parameters of some molds for powder					
		compaction.					

33	The surface structure	The course considers developments in	5			
	engineering	the theory of friction and wear, plasma				
	6 6 6	technologies for surface treatment, ion				
		technology, laser processing, new				
		methods of surface analysis, in				
		particular, developments in the design of				
		nanostructured coatings on the surface of				
		steel.				
34	Innovation in material	The discipline studies trends and	5			
_	science	innovative technologies in the field of				
		materials science. Advanced				
		technologies for designing the structure				
		of materials with desired properties, new				
		technologies for creating modern				
		materials in the field of renewable energy				
		sources, water purification processes,				
		heat and power engineering are				
		considered.				
35	The study of functional	The discipline studies the study of	5			
	materials by electron and	functional materials by probe methods,				
	probe microscopy	the basic physical principles of probe				
		methods for the study of materials. The				
		course covers aspects of the effective and				
		adequate use of various types of electron				
		microscopes, probing methods for				
		studying functional materials, creating a				
		modern element base that will contribute				
		to gaining knowledge about the structure,				
		phase and chemical composition in the				
		practice of solving various problems of				
		materials science and technical physics.				
36	Methodology for materials	The discipline studies the methodology	5			
	selection and technology	of material selection, which affects the				
		quality, reliability and performance of				
		the part. The main material				

		the market of the second					
		characteristics and application features					
		for various equipment and structures are					
		considered, as well as the choice of					
		advanced materials to increase the life					
		cycle and improve the performance of					
		the part.					
37	Methods for obtaining	The discipline considers the main	5				
	functional materials and	methods for obtaining nanosystems and					
	nanostructures	functional materials, the features of					
		physical interactions at the nanoscale,					
		methods for studying and diagnosing					
		nanoobjects and nanosystems, the					
		structure of the main classes of					
		nanomaterials, their properties,					
		production methods, and the most					
		important applications.					
38	Methods for calculating	The discipline studies the fundamentals	5				
	phase transformations and	of the theory of allovs of phase					
	structural analysis of	transformations occurring in materials.					
	materials	the patterns of formation of the phase					
		composition and structure of allows					
		depending on their chemical					
		composition temperature pressure as					
		well as processing modes and theoretical					
		methods for calculating phase equilibria					
		and predicting state diagrams of					
		multicomponent metal systems					
30	Methods of testing the	The course gives the bases and methods	6				
37	performance characteristics	of fast analysis of thermal and corrosive	0				
	of nanomaterials	stability of materials. Students use the					
	or nanomaterials	equipment and can determine					
		electrochemical and thermal properties					
		of materials by means of gravimetry					
		dilatomatic and microscopy Special					
		anatometry and microscopy. Special					

	attention is given to the study of sintering							
	ceramic and composite materials							
Nanomatorials	The purpose of mostering the discipline	5						
nanotachnologias in industry	is the formation of theoretical and	5						
nanotechnologies in muusuy	is the formation of theoretical and							
	practical knowledge about the basic							
	physical and chemical processes in							
	nanostructured materials, the properties							
	of functional nanomaterials and the use							
	of nanotechnologies and nanomaterials							
	in industry. The discipline is aimed at							
	studying the synthesis of low-							
	dimensional systems in powder							
	metallurgy and the creation of functional							
	nanomaterials based on them used in							
	industry. Their classification, methods							
	and technologies for obtaining							
	nanomaterials, structural features and							
	properties, as well as the study of the							
	formation of nanostructures are							
	considered.							
Nanomaterials and the	The goal of the course gives the	6						
environment: application and	information about sources, fate and							
risk assessment	toxicity of engineered micro- and							
	nanoparticles released into atmosphere,							
	hydrosphere, lithosphere, and biosphere.							
	Master students can use diffraction,							
	spectroscopic and microscopic methods							
	to learn physical, physico-chemical and							
	biological properties of nanoparticles, as							
	well as they know the environmental							
	impact of nanoparticles, forecast the fate							
	of airborne nanoparticles in human body.							
	and choose the personal protective							
	equipment.							
	Nanomaterials and nanotechnologies in industry Nanomaterials and nanotechnologies in industry Nanomaterials and the environment: application and risk assessment assessment	attention is given to the study of sintering ceramic and composite materials.Nanomaterialsand The purpose of mastering the discipline is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low- dimensional systems in powder metallurgy and the creation of functional nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered.Nanomaterials and technologiesand technologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation about sources, fate and toxicity of engineered micro- and nanoparticles released into atmosphere, hydrosphere, lithosphere, and biosphere. Master students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, s well as they know the environmental impact of nanoparticles in human body, and choose the personal protective equipment.	attention is given to the study of sintering ceramic and composite materials. Nanomaterials and The purpose of mastering the discipline 5 is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low- dimensional systems in powder metallurgy and the creation of functional nanomaterials based on them used in industry. Their classification, methods and technologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the Nanomaterials and technologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the Nanomaterials and the Nanomaterials and the nanoparticles released into atmosphere, hydrosphere, lithosphere, and biosphere. Master students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, as well as they know the environmental impact of nanoparticles, forecast the fate of airborne nanoparticles, in human body, and choose the personal protective equipment.	attention is given to the study of sintering ceramic and composite materials. Nanomaterials and The purpose of mastering the discipline 5 is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low- dimensional systems in powder metallurgy and the creation of functional nanomaterials based on them used in industry. Their classification, methods and technologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the The goal of the course gives the 6 environment: application and risk assessment 6 information about sources, fate and toxicity of engineered micro- and nanoparticles released into atmosphere, hydrosphere, lithosphere, and biosphere. Master students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, as well as they know the environmental impact of nanoparticles, forecast the fate of airborne nanoparticles in human body, and choose the personal protective equipment.	Nanomaterials and The purpose of mastering the discipline 5 nanotechnologies in industry is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low-dimensional systems in powder metallurgy and the creation of functional nanomaterials have the used of nanotechnologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the The goal of the course gives the 6 environment: application and information about sources, fate and nanoparticles released into atmosphere, hydrosphere, lithosphere, and biosphere. Master students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, as well as the gring and industry and industry in the course gives the formation of nanostructures are considered.	attention is given to the study of sintering ceramic and composite materials. Nanomaterials and The purpose of mastering the discipline 5 nanotechnologies in industry is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low-dimensional systems in powder metallurgy and the creation of functional nanomaterials based on them used in industry. Their classification, methods and technologies for obtaining nanomaterials based on them used in industry. Their classification, methods and technologies for obtaining nanomaterials, survcural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the The goal of the course gives the 6 environment: application and information about sources, fate and toxicity of engineered micro- and nanoparticles released into atmosphere. Master students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, fate and toxicity of nanoparticles, fate and biological properties of nanoparticles, as well as they know the environmental impact of nanoparticles, forecast the fate of airborne nanoparticles in human body, and choose the personal protective equipment.	attention is given to the study of sintering ceramic and composite materials. Nanomaterials and The purpose of mastering the discipline 5 is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. The discipline is aimed at studying the synthesis of low- dimensional systems in powder metallurgy and the creation of functional nanomaterials based on them used in industry. Their classification, methods and technologies for obtaining nanomaterials, structural features and properties, as well as the study of the formation of nanostructures are considered. Nanomaterials and the The goal of the course gives the 6 environment: application and information about sources, fate and risk assessment Nanet students can use diffraction, spectroscopic and microscopic methods to learn physical, physico-chemical and biological properties of nanoparticles, released to learn physical, physico-chemical and biological properties of nanoparticles, as well as they know the environmental impact of nanoparticles, fore cast the fate of airborne nanoparticles in human body, and choose the personal protective equipment.	attention is given to the study of sintering ceramic and composite materials. Nanomaterials and The purpose of mastering the discipline 5 is the formation of theoretical and practical knowledge about the basic physical and chemical processes in nanostructured materials, the properties of functional nanomaterials and the use of nanotechnologies and nanomaterials in industry. 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42	Advanced materials	The discipline studies advanced 5
.2	processing technologies	materials processing technologies used
	processing teennologies	in modern production Processes such as
		thermomechanical and thermochemical
		processing are considered and the
		processes of surface treatment of metals
		for protection against wear and corresion
		of metals are studied
12	Destruction and reliability	The discipline studies the issues of 5
45	Destruction and reliability	destruction of motorials associated with
	assessment of materials	destruction of materials associated with
		the formation of crack propagation
		conditions (type of stressed and
		deformed state of the initial material,
		structural innomogeneity in the crack
		zone, dislocation mechanism of crack
		initiation and propagation), which
		contributes to the formation of the basic
		concepts of the theory of reliability and
		durability of materials, taking into
		account their specifics. Within the
		framework of the course, the basic
		concepts of the theory of reliability are
		studied, the fundamental provisions of
		the method of limit states are given, and
		the nature of the calculated coefficients is
		shown with the position of the theory of
		probability and the theory of reliability.
44	Modern technologies of	Through the study of the course, students 6
	surface hardening	can master the enhanced mechanism of
		enhancers in composite materials,
		understand the structure, organization
		and performance characteristics of
		different properties of enhanced body
		materials, master the surface treatment

		meaning of mailing antiquery and the					
		process of various enhancer materials					
		and understand their applications.					
45	Technologies for the	In the frame of the course students learn	6				
	production of powder	the classification and labelling composite					
	composite materials	powder materials and fields of their					
		application as well as their get the skills					
		to determine dispersion composition by					
		different methods, morphology, density,					
		etc. They synthesize powders and articles					
		depending on their application and target					
		properties including economical					
		viewpoint.					
46	Functional problems of	The content of the course includes the					
	materials science	formation of in-depth theoretical					
		knowledge in the field of materials					
		science, ideas about modern topical					
		problems and methods for solving them,					
		as well as the ability to independently set					
		tasks for solving functional problems and					
		ways to solve them by studying the					
		characteristics, properties and structure					
		of materials.					

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV



CURRICULUM of Educational Program on enrollment for 2024-2025 academic year

Educational program 7M07103 - "Materials science and technology of new materials" Group of educational programs M101 - "Materials science and technology of new materials"

Dissiplic	Name of disciplines	Cycle	Total amount in	Total hours	Classroom amount	SIS (including	Form of control	Allocatio	on of face-to- courses an	face training bass d semesters
Code			credits		lec/lab/pr	TSIS) in		Ico	urse	2 course
						hours		1 semester	2 semester	3semester 4 s
	la series and s	N	1-1. Modul	e of basi	training (up	iversity com	ponent)			La constanta da fil
NG213	Finglish (professional)	BDUC	3	150	0/0/3	105	E	3		
UM214	Management Psychology	BD UC	3	90	1/0/1	60	E	3		
UIM212	History and philosophy of science	BD UC	3	90	1/0/1	60	Е		3	
UM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E		3	
		N	I - 2. Modu	le of app	lied problem	s of material	s science			
HY712	Technological quality assurance of materials				2/0/1					
4NG781	Intellectual property and research	BD, CCH	5	150	2/0/1	105	Е		5	
HY278	Modern problems of materials and process sciences				1/0/2					
PHY7U	Materials science and technologies of advanced materials	BD CCH	5	150	2/0/1	105	F			
	The scientific basis and practice of	SD, CCH		150	1.00.00	100				
HY280	application of nano				1/0/2				-	
HY725	Materials research methods				2/0/1					
4NG782	Sustainable development strategies	BD, CCH	5	150	2/0/1	105	E	5		
PHY724	Structure and properties of carbon nanomaterials				2/0/1					
PHY719	Multiphase structures and methods for calculating phase diagrams	PD, UC	5	150	2/0/1	105	E			5
'H Y 720	Destruction and reliability assessment of materials				2/0/1					
PHY274	Methods for calculating phase transformations and structural analysis of materials	PD, CCH	5	150	2/1/0,	105	E			5
			M-3 4	dyanced	Materials S	ciance Modu	1.			
	Composite materials with desired	ap Lic		100	2 mail	Licite Modu			5	
HY /25	properties	PD, UC	,	150	2/0/1	105	E			
HY714	New functional materials	PD, UC	5	150	2/0/1	105	E		5	
HY716	Materials for 3D technology	PD, UC	5	150	2/0/1	105	E	5		
	Eurotional problems of metarials			M-4. Na	norechnology	module				
HY717	science				2/0/1					
H¥260	Methods for obtaining functional materials and nanostructures	PD, CCH	5	150	1/0/2	105	Е	5		
HY722	Advanced materials processing technologies				2/0/1					
HY261	The study of functional materials by electron and probe microscopy	PD, CCH	5	150	1/0/2	105	E			5
HY721	The surface structure engineering				2/0/1					
HY726	Nanomaterials and	PO, CCH	2	150	2/0/1	105	E			5
20070	Inanotechnologies in industry				Den .	-				
				M-5	. R&D mod	ule				
HY718	Methodology for materials				2/0/1					
HY276	Innovation in material science	BD, CCH	5	150	2/0/1	105	E			5

	E	-		M-6. Pr	actice-oriente	d module			_		
AAP273 AAP269	Pedagogical practice Research practice	PD. UC	8						8		100
			M-	7. Exper	rimental rese	arch module					
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	5							5	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	14								14
			N	M-8. Mo	dule of final :	attestation					
CA212	Preparation and defense of a master's thesis	FA	8								8
	Total based on UNIVERSITY:							23	3 3	7 3	30
	Educational pro (gram "Pro Course of s	oduction of tudy 22.04.	product 01 - "M:	s from nanos aterials scien	tructured ma ce and techno	iterials and dogy of ma	additive te terials''	chnologies'		
	Name of disciplines	Cycle	Total	Total	Classroom	SIS	Form of	Allocati	on of face-to-	face trainin	g based un
Discipline code	Name of disciplines	Cycle	Total amount in	Total hours	Classroom amount	SIS (including	Form of control	Allocati	on of face-to-	face trainin	ig based on course
Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in	Form of control	Allocati L c 1 semester	on of face-to- ourse 2 semester	face trainin 2 3semester	course 4 secondary
Discipline code	Name of disciplines	Cycle	Total amount in credits MI,6	Total hours MI Block	Classroom amount lec/lab/pr k 1. Disciplines //Ib общенаучи	SIS (including TSIS) in (modules)	Form of control	Allocati E c 1 semester	on of face-to- ourse 2 semester	face trainin 2 3semester	ng based un course 4 seconder
biscipline code	Name of disciplines Philosophical and methodological problems of science and technology	Cycle BD UC	Total amount in credits MI,6	Total hours MI Block MI Moay 108	Classroom amount lec/lab/pr к l. Disciplines ль общенаучн 1/0/1	SIS (including TSIS) in (modules) ых ансциплан 76	Form of control	Allocati Ec I semester	on of face-to- ourse 2 semester 3	face trainin 2 3semester	ig based on course 4 secondor
Discipline code PHY728 PHY729	Name of disciplines Philosophical and methodological problems of science and technology. Professional training in English	Cycle BD UC BD UC	Total amount in credits MI,6 3 6	Total hours MI Block MI Moay 108 216	Classroom amount lec/lab/pr k 1. Disciplines //Ib offueHayver 1/0/1 0/0/4	SIS (including TSIS) in (modules) bix aucuuntuu 76 152	Form of control Exam Test	Allocati Le I semester	on of face-to- ourse 2 semester 3 3	face trainin 2. 3semester	ig hased on course 4 secondor
Piscipline code PHY728 PHY729	Name of disciplines Philosophical and methodological problems of spicone and technology Phofessional training in English Materials science and helenologies	Cycle BD UC BD UC	Total amount in credits 3 6 MI.BM	Total hours MI Block MI Moay 108 216 2 Module	Classroom amount lec/lab/pr k 1. Disciplines 7/16 of general prof	SIS (including TSIS) in (modules) htt ancumnan 76 152 essional discipt	Form of control Exam Test ines	Allocati Ec 1 semester	2 semester 3 3	face trainin 2. 3semester	eg based on course 4 secretor
Discipline code PHY728 PHY729 PHY730	Name of disciplines Philosophical and methodological problems of acience and technology. Pholosocoal training in English Materials science and technologies materials Materials from search from technologies	Cycle BD UC BD UC BD UC	Total amount in credits 3 6 M1.BM2 6	Total hours MI Block MI Moay 108 216 2 Module 216	Classroom amount lec/lab/pr k I. Disciplines //Ib of uenayyuu 1/0/1 0/0/4 of general prof 1/1/1	SIS (including TSIS) in (modules) bits auctionant 76 152 essional discipt 152	Form of control Exam Test Exam	Allocati I c I semester	2 semester 3 6	face trainin 2 3semester	ig based on course 4 second or
Piscipline code PHY728 PHY729 PHY730 PHY731	Name of disciplines Philosophical and methodological problems of science and technology. Professional training in English Materials science and technologies of modern and promising materials High technologies: from research to busines. Provder compliant processes	Cycle BD UC BD UC BD UC PD, UC	Total amount in credits MI.6 3 6 MI.BM2 6 3	Total hours MI Block MI Moay 108 216 2 Module 216 108	Classroom amount lec/lab/pr k I. Disciplines //tb ofgeneral prof 1/0/1 0/0/4 of general prof 1/1/1	SIS (including TSIS) in (modules) stx aucustants 76 152 essional discipt 152 60	Form of control Exam Test Exam Exam Exam	Allocati I c 1 semester	an of face-to- ourse 2 semester 3 3 6 3	face trainin 2: 3semester	ig based on course 4 secretion
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PHY748	Pedagogical practice	BDUC	3	108		-	-		2		-
PHY749	Research work in the semester	PD, UC	18	648				6	6	6	
	Research work (obtaining primary			M2	Block 2. Prac	tices			_		
PHY750	skills of research work)	PD, UC	6	216						6	
PHY751 PHY752	Research work	PD, UC	9	324							
	Conservation Practice	PD, 00	15	M3 Block	3. State final c	ertification					1
PHY753	Master's final qualifying work (performance, preparation for the defense procedure and defense of the final qualifying work)	FA	9	324							6
								25	29	33	- 20
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