Institute _____ **Energy and Mechanical engineering** _____

Department __ **Mechanical engineering** _____

EDUCATIONAL PROGRAM

8D07209 Advanced technologies of materials processing

the name of educational program

Code and name field of education:
8D07-Engineering, manufacturing and civil engineering
Code and classification direction of personnel training:
8D072- Manufacturing and processing
Group of educational programs:
D113- Technology for materials pressure processing
EP purpose: 8
EP type: 8
Period of study: 3 years
Volume of the credits: 180

Almaty 2024

Educational program 8D07209 – Advanced and technologies of
(the name of educational program)
materials processing

was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes 12 dated « 22 » 04 2024.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Minutes 6 dated « 19 » 04 2024.

Educational program 8D07209 – Advanced and technologies of
(the name of educational program)
materials processing
developed by Academic committee in the direction of "8D072-Manufacturing and processing"

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Yelemessov K.	Professor	Director of the Institute of Energy and Mechanical Engineering named after A.Burkitbayev	NAO KazNRTU named after K.I. Satpayev	
Teaching staff:				
Nugman E.Z.	Doctor PhD, Assoc. Prof.	Head of the Department of "Mechanical Engineering"	Institute of Energy and Mechanical Engineering named after A.Burkitbayev	
Uderbayeva A.E.	Doctor PhD	Assoc. Professor	Department of Mechanical Engineering	
Employers:				
Dyussebayev I.M.	Doctor PhD	Chief Engineer	LLP, Almaty plant "Electroshield"	
Students				
Baybatsha A.K.		1st year doctoral student	Department of "Mechanical Engineering"	

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List of abbreviations and designati

ECTS	European Credit Transfer and Accumulation System
BD	Basic disciplines
HEI	Higher education institution
SMSE	State mandatory standard of education
KazNRTU	K. I. Satpayev Kazakh National Research Technical University
MEP	Modular educational program
NJsC	Non-profit joint stock Company
RWDS	Research work of a doctoral student
EP	Educational program
PD	Profile disciplines
WC	Working curriculum
IWDS	Independent work of a doctoral student
EMC	Educational and Methodological Council
AC	Academic council

1 Description of educational program

A doctoral student in the field of training "Advanced technologies of materials processing" should be prepared to solve professional problems in accordance with the profile orientation of the doctoral program and types of professional activities:

design and engineering activities:

- analysis of the state of the scientific and technical problem and determination of the goals and objectives of the design of instrument systems based on the study of world experience;
- making decisions based on the results of calculations on projects and the results of technical and economic and functional cost analysis of the effectiveness of the designed engineering systems;

production and technological activities:

- development of methods for conducting theoretical and experimental research on the analysis, synthesis and optimization of the characteristics of materials used in mechanical engineering;
- solving economic and organizational problems of technological preparation of production of machine systems and the choice of systems to ensure environmental safety of production;

research activities:

- the construction of mathematical models for the analysis and optimization of research objects, the choice of a numerical method for their modeling or the development of a new algorithm for solving the problem;
- development and optimization of field experimental studies of machine systems, taking into account the criteria of their reliability;
- preparation of scientific and technical reports, reviews, publications based on the results of the research carried out;
- application of the results of research activities and the use of intellectual property rights;

organizational and managerial activities:

- finding optimal solutions when creating high-tech products, taking into account the requirements of quality, cost, deadlines, competitiveness, life safety, as well as environmental safety;
- support of a unified information space for enterprise planning and management at all stages of the life cycle of manufactured products;
- development of plans and programs for the organization of innovative activities at the enterprise.
- deep knowledge and understanding of fundamental phenomena in their field of science.

scientific and pedagogical activity:

- participation in the development of programs of academic disciplines and courses based on the study of pedagogical, scientific, technical and scientific-methodical literature, as well as the results of their own professional activities;
- participation in the formulation and modernization of individual laboratory

work and workshops in professional disciplines;

- conducting training sessions with students, participating in the organization and management of their practical and research work;

- application and development of new educational technologies, including computer and distance learning systems. Based on the theoretical and practical knowledge obtained, the doctoral student of technical sciences under the educational program 8D07209 – "Advanced technologies of materials processing" forms professional competencies.

2 The purpose and objectives of additional educational program

EP purpose:

Training of personnel for scientific, scientific-pedagogical, industrial and innovative fields of activity with in-depth scientific, technical and pedagogical training in the field of additive manufacturing, capable of implementing the ideas of "Industry 4.0".

EP tasks:

- training of scientific and pedagogical personnel with practical skills and the ability to perform professional functions in accordance with the market requirements for organizational, managerial, professional competencies;
- training of competitive specialists in the field of advanced technologies of materials processing, new materials used in procurement production;
- training of scientific and pedagogical personnel ready for continuous self-improvement and self-development, mastering new knowledge, skills and abilities in innovative areas in the field of processing technologies of machine-building materials;
- preparation of doctoral students for a successful career in the field of modern technological processes for processing new materials in mechanical engineering, in private, public and state organizations, educational institutions.

3 Requirements for evaluating the learning outcomes of an educational program

As a result of mastering the EP modules, students develop the knowledge, skills and abilities necessary to carry out all types of professional activities in the field of mechanical engineering, develop training skills to carry out further training with a high degree of independence, that is, the formation of professional, communication and key competencies that meet the requirements of employers.

Qualification awarded to the graduate Doctor of Philosophy PhD in EP 8D07209 – "Advanced technologies of materials processing"

4 Passport of the educational program

4.1 General information

№	Field name	Note
1	Code and name field of education	8D07- Engineering, manufacturing and civil engineering
2	Code and classification direction of personnel training	8D072- Manufacturing and processing
3	Group of educational programs	D113- Technology for materials pressure processing
4	Name of the educational program	8D07**209**- Advanced technologies of materials processing
5	Short description of the educational program	The professional activity of the doctoral student is directed in the field of design and development of advanced technological processes of materials processing by pressure, modeling of objects and processes using software packages of automated design, analysis of technical information, research in the field of engineering materials. Doctoral students will gain knowledge of effective methods of solving problems of technology, economics and management; they will acquire the skills and abilities of mathematical, physical and computer modeling of technological processes of materials processing by pressure, conducting research with the search for optimal solutions when creating competitive products.
6	EP purpose	Training of personnel for scientific, scientific-pedagogical, industrial and innovative fields of activity, with in-depth scientific, technical and pedagogical training in the field of additive manufacturing, capable of implementing the ideas of "Industry 4.0".
7	EP type	New EP
8	Level on NQF	8
9	Level on SQF	8
10	EP distinctive features	No
11	List of competencies of the educational program:	- Ability to use new research methods and areas of professional activity; - Willingness to use knowledge of modern problems of science and education in solving problems in the field of advanced materials processing technologies; - The ability to analyze the results of scientific research, apply them in solving specific research tasks in the field of science and education
12	Learning outcomes of the educational program:	ON1 To analyze scientific and technical and popular scientific texts, the results of scientific and experimental research with the preparation of scientific and technical reports, reviews and developments on topical issues of digital machine-building production. ON2 Participate in the formulation of scientific and

		scientific-educational tasks, conducting theoretical and experimental research based on the principles of the organization of scientific research and the choice of research methods in the conditions of digitalization of machine-building production. ON3 Apply innovative business models, business processes, computer technologies in the preparation, design and production of digital factories in scientific research and professional activity. ON4 To make decisions in the field of life cycle management of engineering products based on industrial production modeling, advanced computer-aided design software packages, energy and resource conservation principles. ON5 Synthesize new knowledge and technologies based on the analysis of virtual and augmented reality systems, computer modeling methods in the field of digitalization of machine-building production ON6 To develop projects of modern machine-building production by methods, technologies and systems of industrial automation. ON7 Solve design, engineering, technological, organizational and managerial tasks of machine-building production on the basis of modern optimization methods using targeted software. ON8 Apply advanced methods of digital and additive manufacturing in the design of technological processes for processing materials by pressure.
13	Form of training	daytime
14	Period of study	3 years
15	Volume of the credits	180
16	Language of education	russian
17	The awarded academic degree	Doctorate
18	Developer(s) and authors:	The educational program was developed by the academic committee in the direction «8D072- Manufacturing and processing»

4.2 The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines

№	Name of discipline	Short description of discipline	Number of credits	The formed educational outcomes (codes)							
				ON1	ON 2	ON 3	ON 4	ON 5	ON 6	ON 7	ON 8
Cycle of basic disciplines University component											
1	Academic writing	The course is aimed at developing academic writing skills and writing strategies for doctoral students in the field of engineering and natural sciences. The course focuses on the basics and general principles of academic writing for; writing effective sentences and paragraphs; using tenses in scientific literature, as well as styles and punctuation; writing abstracts, introductions, conclusions, discussions, conclusions, literature and resources used; quoting in the text; preventing plagiarism, and making presentations at a conference.	5	v	v						
2	Research methods	The course contributes to the formation of knowledge about scientific research, methods and methodology of scientific research, methods of collecting and processing scientific data, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in modern science. The discipline examines the structure of technical sciences, the application of general scientific, philosophical and special methods of scientific research in theory and in practice.	5	v		v					
Cycle of basic disciplines Elective component											
3	Digital factory technologies	The course is aimed at developing theoretical knowledge and practical skills in the field of virtual (VR) and augmented (AR) reality technologies. The discipline studies the history of technology development; the scope of Yet Another Reality (Another Reality); market development trends, presentation of analytical materials on the AR/VR market. Gadgets, varieties and features; analysis of	5			v	v				

		existing devices for demonstrating realities; platforms and software; features of projects with augmented and virtual reality technologies.										
4	Sustainability Science	Objective: to develop a deep understanding among doctoral students of the interactions between natural and social systems, as well as to develop skills for identifying and developing strategies for sustainable development that promote long-term human well-being and environmental preservation. Content: complex interconnections between ecosystems and societies, as well as an in-depth analysis of sustainability issues at local, national, and international levels.	5			v		v			
5	Intellectual property and the global market	Purpose: the goal is to train specialists in the field of intellectual property law who can analyze and predict trends in its development in the global market, develop strategies for the protection and commercialization of intellectual property. Contents: global aspects of intellectual property and its role in international trade and economics, analysis of international agreements and conventions, IP management strategies, cases of protection and violation of intellectual property rights in various jurisdictions.	5	v	v						
Cycle of profile disciplines Component of choice												
6	Design optimization analysis of technologies and technological systems	The purpose of the discipline is to form knowledge on the practice of applying methods of rational redistribution of limited resources in models of system functioning. The methods of changing the properties of the system in order to increase its functionality, known as optimization methods, mathematical methods for solving optimization problems, are considered. As a result of studying the discipline, doctoral students will master the mathematical apparatus of modeling technological systems and processes; methods of modeling technological systems, calculating optimal parameters of processes and technological systems; They will acquire skills in applying optimization methods in the design of material, technical, operational and organizational constraints.	5				v	v		v	
7	Advanced Systems of Manufacturing	The course is aimed at the formation of knowledge about the state, problems and prospects of the effective organization of technological processes in the branches of the material sphere.The discipline studies modern production technologies: metallurgical, machine-building, transport, information. The types of technologies and their impact on the life cycle are considered; automation of the technological process in mechanical engineering; fundamentals of	5			v				v	v

		technology and the construction of a lean production process; methodology of the theory of constraints.									
8	Advanced 3D Nanoprinting Technology	The course is aimed at the formation of knowledge of nanotechnology and nanomaterials, nanoindustry. The discipline examines the history of the development of nanotechnology, the properties and structure of nanomaterials, the classification of dispersed systems, methods for obtaining nanoscale materials. The structure and properties of carbon nanotubes, nanocomposite materials, and methods for producing nanopowders are considered. 3D printing technologies, analysis of the application of 3D printing in the field of industrial industry, 3D nanoprinting technologies are studied.	5						v		v
9	Smart Manufacturing	The course is aimed at developing knowledge of the theory and technologies of the industrial Internet of Things, practical skills and competencies necessary for conducting research of the projected production. The architecture of the industrial Internet of Things, modern wireless sensor networks, machine-to-machine communications, standards and protocols for data transmission in the Internet of Things, cloud technologies for data collection, visualization and analytics are considered. The practical part of the course is devoted to the team development of a project in which the entire set of industrial Internet of Things technologies is implemented.	5			v				v	v
8	Digital Manufacturing	The course is aimed at developing knowledge about digital production methods, modern approaches and methods of digital production in the field of high technologies, skills in using modern digital production tools, creating and scaling innovative projects and products. The features of digital production, additive technologies, advanced methods and methods of processing materials by pressure, digital production software are studied. The use of digital production technologies in industry. International Fab Lab network. Principles and functioning. Typical composition of Fab Lab equipment.	5								v

5 Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kaznu named after K.Satpayev
M.M. Begentaev
"21" 04 2024 y.

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

Educational program 8D07209 - "Advanced materials processing technologies"
Group of Educational programs D113 - "Technology of materials processing by pressure"

Form of study: full-time **Duration of study: 3 year** **Academic degree: Doctor of Philosophy (PhD)**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters					
								I course		2 course			
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Technical training module (university component)													
MET322	Methods of scientific research	BD UC	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	5	150	0/0/3	105	E	5					
Component of choice													
MSM308	Digital factory technologies	BD, CCH	5	150	2/0/1	105	E	5					
MNG350	Sustainability Science												
MNG349	Intellectual property and the global market												
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of scientific and industrial training (component of choice)													
MSM309	Design optimization analysis of technologies and technological systems	PD, CCH	5	150	2/0/1	105	E	5					
IND311	Advanced production systems												
MSM303	Advanced 3D nanoprinting technologies	PD, CCH	5	150	2/0/1	105	E	5					
IND313	Development of advanced control systems												
M-3. Practice-oriented module													
AAP350	Pedagogical practice	BD UC	10						10				
AAP355	Research practice	PD UC	10							10			
M-4. Experimental research module													
AAP336	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	5					5					
AAP347	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	40						20	20			
AAP356	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	60								30	30	
AAP348	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	18										18
M-5. Module of final attestation													
ECA303	Writing and defending a doctoral dissertation	FA	12										12
	Total based on UNIVERSITY:							30	30	30	30	30	30
								60		60		60	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines		20	5	25
PD	Cycle of profile disciplines		10	10	20
	Total for theoretical training:	*0*	*30*	*15*	*45*
	RWDS				*123*
FA	Final attestation	12			12
	TOTAL:	12	30	15	180

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol №12 от "22" 04 2024 y.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol №6 от "19" 04 2024 y.

Decision of the Academic Council of the Institute E&ME. Protocol № 4 от "18" 04 2024 y.

Board Member -Vice-Rector for Academic Affairs R.Uskenbaeva
E&ME Institute Director K.Yelemessov
ME Department Head E.Nugman
Representative of the Council for EP from Employers M.Azimbekov