Institute of Energy and Mechanical Engineering
Department of "Technological machines and equipment"

EDUCATIONAL PROGRAM
8D07110 - "Digital Engineering of Machines and Equipment"

Code and classification of the field of education	8D07 – «Engineering, manufacturing and civil engineering»
Code and classification of training directions	8D071 – «Engineering and engineering trades»
Group of educational programs	D103 – «Mechanics and metal working»
Level based on NQF	Level 8 – Postgraduate education (programs leading to the academic degree of Doctor of Philosophy (PhD) and doctors in the profile and/or practical experience)
Level based on IQF	Level 8 – Knowledge at the most advanced level in the field of science and professional activity
Study period	3 years
Amount of credits	180

Almaty 2023

Educational program 8D07110 – "Digital Engineering of Machines and Equipment" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes # 3 dated « 24 » 10 2022.

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

Minutes # 2 dated « 21 » 10 2022.

Educational program 8D07110 – "Digital Engineering of Machines and Equipment" was developed by Academic committee based on direction «Engineering and engineering trades»

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Yelemessov Kassym	Candidate of Technical Sciences, Associate Professor	Director of the Institute of Energy and Mechanical Engineering	KazNRTU named after K.I. Satbayev	
Teachingstaff:				
Eskulov Serik	Candidate of Technical Sciences, Associate Professor	Head of the department "Technological machines and equipment"	KazNRTU named after K.I. Satbayev	
Myrzakhmetov Beibit	Candidate of Technical Sciences, Associate Professor	Professor	KazNRTU named after K.I. Satbayev	
Bortebayev Saiyn	Candidate of Technical Sciences, Associate Professor	Associate Professor	KazNRTU named after K.I. Satbayev	
Employers:				
Kanatbayev Maksat	Master MBA	CEO	JSC "Almaty plant of heavy engineering"	
Students				
Mashatayeva Gulzada		2rd year doctoral student	KazNRTU named after K.I. Satbayev	

Table of contents

List of abbreviations and designations

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATBAYEV» – NCJS KazNRTU named after K. I. Satbayev;
SOSE – State obligatory standard of education of the Republic of Kazakhstan;
EP - educational program;
SRO - independent work of a student (student, undergraduate, doctoral student);
SROP - independent work of a student with a teacher (independent work of a student (undergraduate, doctoral student) with a teacher);
RUP - working curriculum;
QED - catalog of elective disciplines;
VK - university component;
KV - component of choice;
NQF - National Qualifications Framework

1. Description of educational program

The Ph.D. educational program has a scientific and pedagogical orientation and involves fundamental educational, methodological and research training and in-depth study of disciplines in relevant areas of science for the system of higher and postgraduate education and the scientific field.

The educational program for the preparation of a doctor in profile assumes fundamental educational, methodological and research training and an in-depth study of disciplines in relevant areas of science for the sectors of the national economy and the social sphere: education, medicine, law, arts, economics, business administration and in the field of national security and military affairs.

Doctoral educational programs in terms of vocational training are developed on the basis of studying the experience of foreign universities and research centers that implement accredited training programs for PhD doctors or doctors in the profile.

The content of the educational program of specialized doctoral studies is established by the university itself.

The main criterion of completion of the educational process for the preparation of PhDs (PhDs) is a mastering of at least 180 academic credits by a doctoral student, including all types of educational and scientific activities.

The term of study in doctoral studies is determined by the amount of mastered academic credits. When mastering a set amount of academic credits and achieving the expected learning outcomes for a Ph.D. degree or in profile, the doctoral education program is considered fully mastered.

Training in doctoral studies is carried out on the basis of master's educational programs in two areas:

1) scientific and pedagogical with a study period of at least three years;

2) specialized with a study period of at least three years.

2. Purpose and objectives of educational program

Purpose of EP:

The goal of the educational program "Digital Engineering of Machines and Equipment" is to train personnel for the system of higher, postgraduate education and the research sector with advanced scientific and pedagogical training.

2 Types of employment

Graduates of this SP can conduct the following professional activities:

- pedagogical;
- research;
- organizational and managerial;
- production and technology.

3 Objects of professional activity

The objects of professional activity of the OP are:

- institutions of higher and postgraduate education;

- research and design organizations;
- enterprises of the mining and metallurgical and oil and gas industry;
- enterprises for the manufacture and production of technological equipment and the organization for the maintenance of technological machines.

Tasks of EP:

to deepen the system knowledge of doctoral students, allowing them to give a critical assessment of the problems studied and discussed in the framework of modern production;
- develop skills in analyzing the designs of technological machines and equipment based on the use of modern digital technologies;
- to deepen the skills to work with modern foreign and domestic scientific literature and to give their own assessment of the events in the creation of machines and equipment;
- to expand the fluency in English necessary for writing scientific articles, reading foreign scientific literature, continuing education in foreign educational institutions, participating in international conferences and negotiations with foreign partners;
- to develop the ability to contribute to the development of the latest trends in the digitalization of technological machines and equipment through original scientific research.

3. Requirements for evaluating the educational program learning outcomes

1) have an idea:
- about the main stages of development and the change of paradigms in the evolution of science;
- about the subject, world outlook and methodological specificity of natural (social, humanitarian, economic) sciences;
- about scientific schools of the corresponding branch of knowledge, their theoretical and practical developments;
- about scientific concepts of world and Kazakhstan science in the relevant field;
- about the mechanism of implementation of scientific developments in practical activities;
- about the norms of interaction in the scientific community;
- on the pedagogical and scientific ethics of a research scientist;

2) know and understand:
- current trends, trends and patterns of development of domestic science in the context of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of world and Kazakhstan science in the relevant field;
- (recognize and accept) the social responsibility of science and education;
- perfectly foreign language for scientific communication and international cooperation;

3) be able to:
- organize, plan and implement the research process;

- analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;
- analyze and process information from various sources;
- conduct an independent scientific study, characterized by academic integrity, on the basis of modern theories and methods of analysis;
- generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- choose and effectively use modern research methodology;
- plan and forecast their further professional development;

4) have skills:

- critical analysis, evaluation and comparison of various scientific theories and ideas;
- analytical and experimental research activities;
- planning and forecasting research results;
- oratory and public speaking at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordinating and implementing research processes;
- a systematic understanding of the field of study and demonstrate the quality and effectiveness of selected scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership and team management;
- responsible and creative attitude to scientific and scientific-pedagogical activity;
- carrying out patent search and experience in transferring scientific information using modern information and innovative technologies;
- protection of intellectual property rights to scientific discoveries and developments;
- free communication in a foreign language;

5) be competent:

- in the field of scientific and educational activities in the context of rapid updating and growth of information flows;
- in carrying out theoretical and experimental research;
- in the formulation and solution of theoretical and applied problems in scientific research;
- in carrying out professional and comprehensive analysis of problems in the relevant field;
- in matters of interpersonal communication and human resource management;
- in matters of university training specialists;
- in the examination of scientific projects and research;
- in ensuring continuous professional growth.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 – «Engineering, manufacturing and civil engineering»
2	Code and classification of training directions	8D071 – «Engineering and engineering trades»
3	Educational program group	D103 – «Mechanics and metal working»
4	Educational program name	Digital Engineering of Machines and Equipment
5	Short description of educational program	The educational program for the preparation of a Doctor of Philosophy (PhD) has a scientific and pedagogical orientation and assumes fundamental educational, methodological and research training and in-depth study of disciplines in the relevant fields of sciences for the system of higher and postgraduate education and the scientific sphere
6	Purpose of EP	The purpose of the educational program is to train personnel for the system of higher, postgraduate education and the research sector with in-depth scientific and pedagogical training.
7	Type of EP	updated
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	no
11	List of competencies of educational program	Communication skills Professional competencies; Research competencies; Information and communication competencies Management competencies; Creative competencies Special professional competencies
12	Learning outcomes of educational program	ON1: He has the skills of patent search and experience in the transfer of scientific information using modern information and innovative technologies, protection of intellectual property rights to scientific discoveries and developments; ON2: Able to organize, plan and implement the research process, analyze, evaluate and compare different theoretical concepts in the field of research and draw conclusions ON3: Knows and understands the current trends, trends and patterns of development of domestic science in the context of globalization and is fluent in a foreign language for scientific communication and international cooperation ON4: It is capable to apply modern methods of monitoring and diagnostics, to form diagnostic decisions on the basis of digitalization of control of parameters of operation of technological machines ON5: It is able to effectively operate and carry out

		service work of technological machines with the use of digital technologies, remotely control machines and equipment with the help of digital sensors and microprocessors
13	Education form	full-time
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	Doctor of PhD
18	Developer(s) and authors	1. Director of the Institute of Energy and Mechanical Engineering, Yelemessov Kassym 2. Head of the department "Technological machines and equipment", Eskulov Serik 3. Professor, Myrzakhmetov Beibit 4. Associate Professor, Bortebayev Saiyn 5. Master MBA, Kanatbayev Maksat 6. Teacher, Tagauova Raikhan

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

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)				
				ON1	ON2	ON3	ON4	ON5
Cycle of basic disciplines University component								
1	Research methods	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	v		
2	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		v
Cycle of basic disciplines Component of choice								
3	Innovative methods for processing experimental results	he course program includes the study of methods for planning experiments, determining their number to obtain reliable results. Acquired skills in the use of the Box Wilson steep ascent method. The possibilities of programs for static processing of the results of laboratory and production experiments are being studied. Methods of constructing graphs and empirical formulas are mastered with obtaining characteristics of	5		v	v		

		reliability, closeness of connection, coefficient of variation and other indicators						
4	Methods of search and analysis of scientific and technical information	When studying a course, students will be familiarized with methods of searching, systematizing, processing and analyzing large masses of scientific and technical information using modern application programs and information systems, methods of processing and analyzing archive materials on paper and digitizing them for subsequent use of information systems	5	v		v		
Cycle of profile disciplines Component of choice								
5	Management in planning the repair and maintenance of machines	The course program includes the study of the organization, planning and management of the repair and service economy of industrial enterprises in the mining, metallurgical and oil and gas clusters: the study of the design of repair enterprises; optimization of the costs of material and labor resources in critical conditions, the use of network technologies in the organization of maintenance and repair of machines; analysis and study of the experience of organizing repairs in industrialized countries	5			v	v	v
6	Methods and tools for diagnosing the technical condition of machines and mechanisms	The program of the course includes the study of the issues of using technical diagnostics to maintain machines in working condition; methods for predicting their resource based on the results of technical diagnostics using modern tools and calculation programs, studying modern instrumental methods and tools for diagnostics, digitalization of control parameters, establishing the technical condition and monitoring machines and mechanisms	5				v	v
7	Digitization of operational and service processes	The course program includes the study of the issues of digital technology in science and education - in the search, processing and analysis of large arrays of scientific and technical information using special computer programs; in the application of digital technologies and software in modeling and research of technological objects; when modeling and creating new types of equipment; in teaching practice in the presentation of educational materials and assessment of	5			v	v	

		residual knowledge						
8	Innovative technology and technology in science and production	The course program includes issues related to new methods for predicting engineering structures with reference to promising technologies. Innovative methods for assessing the quality of equipment and methods for selecting operational parameters are being mastered. Particular attention is paid to the digitalization of these processes, promising techniques for monitoring parameters and decision-making methods. Studies international experience in the field of technology and technology improvement	5				v	v

5. Curriculum of educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazntu named after K.Satpayev
M.M. Begentaev
«01» 12 2023 y.

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 8D07110 - "Digital Engineering of Machines and Equipment"
Group of educational programs D103 - "Mechanics and metal working"

Form of study: full-time **Duration of study: 3 year** **Academic degree: 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					
								1 course		2 course		3 course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
MET322	Scientific research methods	BD UC	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	5	150	0/0/3	105	E	5					
Experimental research module													
Component of choice													
TEC302	Innovative methods for processing experimental results	BD CCH	5	150	2/0/1	105	E	5					
TEC303	Methods of search and analysis of scientific and technical information		5	150	2/0/1	105	E						
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (component of choice)													
Module of innovative technologies and equipment													
TEC315	Management in planning the	PD, CCH	5	150	2/0/1	105	E	5					
TEC316	Methods and tools for diagnosing the technical condition of machines and mechanisms		5	150	2/0/1	105	E						
TEC317	Digitization of operational and service processes	PD, CCH	5	150	2/0/1	105	E	5					
TEC314	Innovative technology and technology in science and production		5	150	2/0/1	105	E						
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 Kazntu named after K.Satpayev. Protocol № 3 от "14" 10 2022y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 2от "11" 10 2022y.

Decision of the Academic Council of the Institute E&ME . Protocol № 2от "11" 10 2022y.

Vice-Rector for Academic Affairs _____ B.A.Zhautikov

Director of Institute of E&ME _____ K.K. Yelemessov

Head of department TM&T _____ S.A. Bortebayev

Specialty Council representative from employers _____ M.A. Kanatbayev

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of mastering the additional educational programs (Minor)