Institute _____ **Energy and Mechanical engineering** _____

Department __ **Mechanical engineering** _____

EDUCATIONAL PROGRAM

7M07228 - Advanced technologies of materials processing

the name of educational program

Code and name field of education:
7M07-Engineering, manufacturing and civil engineering
Code and classification direction of personnel training:
7M072- Manufacturing and processing
Group of educational programs:
M113 Technology of materials pressure processing
EP purpose: 7
EP type: 7
Period of study: 2 years
Volume of the credits: 120

Almaty 2023

Educational program 7M07228 - Advanced technologies of materials processing manufacturing
(the name of educational program)
was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes 3 dated « 27 » October 2022.

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

Minutes 2 dated « 21 » October 2022.

Educational program 7M07228- Advanced technologies of materials processing
(the name of educational program)
code and name of the educational program developed by the academic committee in the direction «7M072- Manufacturing and processing»

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Nugman E.Z.	Doctor PhD	Head of the Department of "Mechanical Engineering"	NAO KazNRTU named after K.I. Satpayev, Institute of Energy and Mechanical Engineering	
Teaching staff:				
Kerimzhanova M.F.	Candidate of Technical Sciences, Associate Professor	Professor	Department of Mechanical Engineering	
Uderbayeva A.E.	Doctor PhD	Assoc. Professor	Department of Mechanical Engineering	
Employers:				
Azimbekov M. K.		Director	LLP "Zhaken Kalsha"	
Students				
Tolen A.		2nd year Master's student	Department of "Mechanical Engineering"	

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List of abbreviations and designate

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
RWMS	Research work of a master's student
EP	Educational program
PD	Profile disciplines
WC	Working curriculum
IWMS	Independent work of a master's student
EMC	Educational and Methodological Council
AC	Academic council

1 Description of educational program

EP 7M07228 - "Advanced technologies of materials processing" are focused on learning outcomes that form professional competencies in accordance with the requirements of the labor market.

The objects of professional activity of the master in EP 7M07228 - "Advanced technologies of materials processing" are:

-digitalization of machine-building production, including information-sensor, executive and control modules, their mathematical, algorithmic and software, methods and means of their design, modeling, experimental research and design;

- theoretical and experimental studies of digitalization of machine-building production for various purposes.

The Master's degree in EP 7M07228 - " Advanced technologies of materials processing" can perform the following types of work and professional activities.
Types of professional activities for which graduates who have mastered the

Master's degree program are preparing:

- research;
- design and engineering;
- organizational and managerial;
- installation and commissioning;
- service and operational;
- scientific and pedagogical.

A master's degree in the field of training "Advanced materials processing technologies" should be prepared to solve professional tasks in accordance with the profile orientation of the master's program and types of professional activity:

research activities:

- analysis of scientific and technical information, domestic and foreign experience in the field of development and research of digitalization of machine-building production; study of new methods of control theory, artificial intelligence technologies and other scientific areas that make up the theoretical basis of digitalization of machine-building production, compilation and publication of reviews and abstracts;

- carrying out theoretical and experimental research in the field of development of new samples and improvement of existing digitalization of machine-building production, their modules and subsystems, search for new additive technologies;

- conducting patent research accompanying the development of new digitalization of machine-building production, in order to protect intellectual property objects, the results of research and development;

- development of experimental samples of digitalization of machine-building production, their modules and subsystems in order to verify and substantiate the main theoretical and technical solutions to be included in the terms of reference for the implementation of development work;

- organization and conduct of experiments on the existing digitalization of

machine-building production, their subsystems and individual modules in order to determine their effectiveness and identify ways to improve, processing the results of experimental research using modern information technologies;

- preparation of reports, scientific publications and reports at scientific conferences and seminars, participation in the implementation of research and development results into practice;

design and engineering activities:

- preparation of a feasibility study of new digitalization projects of machine-building production, their individual subsystems and modules;
- calculation and research of digitalization of machine-building production, control, information-sensor and executive subsystems using mathematical modeling methods, conducting mock-up and testing of existing systems, processing experimental data using modern information technologies;
- development of special software for solving design problems of digitalization of machine-building production, development of technical specifications and direct participation in the design of additive machines and equipment;

organizational and managerial activities:

- development of organizational and technical documentation (work schedules, instructions, plans, estimates) and established reporting on approved forms;
- organization of the work of small groups of performers involved in research, design work and experimental research;
- control over the implementation of measures for the prevention of occupational injuries, occupational diseases, prevention of environmental violations in the process of research and operation of digitalization of machine-building production;

installation and commissioning activities:

- participation in verification, adjustment, adjustment, assessment of equipment condition and setting up digitalization of machine-building production for various purposes, including both technical means and software control systems;
- participation in the coupling of software and hardware complexes with technical objects as part of the digitalization of machine-building production, in testing and commissioning of prototypes of such systems;

service and operational activities:

- participation in verification, adjustment, adjustment and assessment of the state of digitalization of machine-building production for various purposes, as well as their individual subsystems, in setting up control hardware and software complexes;
- preventive control of the technical condition and functional diagnostics of digitalization of machine-building production for various purposes, as well as their individual subsystems;
- preparation of operating instructions for digitalization of machine-building production and their hardware and software, development of routine testing

programs;

- preparation of applications for equipment and components, preparation of technical documentation for equipment repair;

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.

2 The purpose and objectives of additional educational program

EP purpose:

Training of highly qualified and competitive scientific and pedagogical personnel for design, research, production, technological and management activities in the field of digitalization of materials processing technology by pressure.

EP tasks:

- formation of knowledge of the basics of advanced technologies in the field of materials processing;
- acquisition of theoretical and practical knowledge on the organization, conduct of scientific and experimental research in the field of development of innovative technologies in the field of procurement production;
- formation of knowledge and skills in the analysis of scientific and technical information, new methods of management theory, scientific directions of advanced materials processing technologies;
- formation of knowledge and practical skills of performing scientific and pedagogical activities, the use of computer and distance learning.

3 Requirements for evaluating the learning outcomes of an educational program

As a result of mastering the OP modules, students develop the knowledge, skills and abilities necessary to carry out all types of professional activities in the field of advanced technologies for processing materials by pressure, 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.

The qualification assigned to the graduate is Master of Technical Sciences in EP 7M07228 - " Advanced technologies of materials processing".

4. Passport of the educational program

4.1. General information

№	Название поля	Примечание
1	Code and name field of education	7M07- Engineering, manufacturing and civil engineering
2	Code and classification direction of personnel training	7M072 - Manufacturing and processing
3	Group of educational programs	M113- Technology of materials pressure processing
4	Name of the educational program	7M07228 - "Advanced technologies of materials processing ".
5	Short description of the educational program	The professional activity of graduates of the educational program is aimed at digitalization of procurement production, processing of materials by pressure. In the educational program, students receive professional knowledge on digital design and modeling of new materials, product designs used for the manufacture of blanks, organization, conducting research in the field of materials processing by pressure. He has the skills of designing and developing innovative processes, methods of processing nanomaterials, powder materials, advanced technologies, machinery and equipment.
6	EP purpose	Training of highly qualified and competitive scientific and pedagogical personnel for design, research, production, technological and management activities in the field of digitalization of materials processing technology by pressure.
7	EP type	New EP
8	Level on NQF	7
9	Level on SQF	7
10	EP distinctive features	No
11	List of competencies of the educational program:	- Ability to follow ethical standards in professional activity; - The ability to plan and solve problems of their own professional and personal development. - Ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical tasks; - The ability to design and carry out comprehensive research based on a holistic systematic scientific worldview using knowledge in the field of history and philosophy of science; - Willingness to participate in the work of domestic and international research teams to solve scientific and educational problems in the field of technologies for processing new materials; - Willingness to use modern methods and technologies of scientific communication in the state and foreign languages;
12	Learning outcomes of the educational program:	ON1 Demonstrates the ability to search for new scientific and technical information based on the integration of knowledge in educational and professional fields, the use of a foreign language for business communication.

		ON2 Expands and deepens the scientific worldview, focuses on the theories of the historical development of scientific knowledge to develop relevant research directions in professional activities. ON3 Owns the basic provisions and features of the practical psychologist in the field of management activities. ON4 Demonstrates knowledge of advanced materials, methods of their production and application in digital machine-building production. ON5 Analyzes, processes and applies innovative processes, additive technologies and advanced methods of processing materials by pressure. ON6 Demonstrates knowledge of digital and operational management systems, virtual production, lean production management theory.. ON7 Applies sound solutions for the design and application of flexible production systems, ensuring the safety of life, environmental and industrial safety of digital machine-building production. ON8 Applies modern methods of computer modeling of objects and technological processes, methods of computer-aided design of the life cycle of products. ON9 Demonstrates the ability to monitor production, planning and forecasting the development of technologies for processing materials by pressure.
13	Form of training	daytime
14	Period of study	2 years
15	Volume of the credits	120
16	Language of education	russian
17	The awarded academic degree	Master of technical sciences
18	Developer(s) and authors:	The educational program was developed by the academic committee in the direction «7M072-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	ON 9
Cycle of basic disciplines University component												
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. The course ends with a final exam. Undergraduates also need to study independently (MIS).	5	v								
2	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.	3	v		v						
3	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-	3	v	v							

		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.										
4	Higher school pedagogy	The course is intended for undergraduates of the scientific and pedagogical magistracy of all specialties. 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.	3	v	v							
Cycle of basic disciplines Elective component												
5	Equipment and technology of rolling production	The purpose of the discipline is the development of technological processes, the production of all the main types of rolled products – semi-finished products, rails, beams, long and sheet metal, wheel bands. The methods of rolling all types of product, the equipment used and the calibration of rolls necessary to understand the essence of the process are studied. The flow of the material during rolling of the most important types of product is described, for calculating the elements of the technological process	5					**v**				**v**
6	Technologies of pressing and drawing of materials	The purpose of the discipline is to form knowledge and principles in the field of physical foundations and mathematical theory of plastic deformation. The theoretical foundations and practical method of calculating processes in the technology for metal processing by pressure are studied, the methods of	5					**v**				**v**

		experimental determination of the parameters of the stress-strain state using the methods of coordinate dividing grid and current lines under conditions of plane and axisymmetric deformation during pressing and drawing are determined										
7	Mechanical systems in processes of materials by pressure	The purpose of the discipline is to acquire in-depth knowledge of mechanical systems in the processing of materials by pressure. The influence of external and internal factors on the unevenness of deformation of the workpiece material, mechanical deformation schemes under various pressure treatment technologies, factors affecting plasticity, resistance of materials to plastic deformation, methods of analysis and evaluation of plasticity of materials are studied. The processes of destruction of materials and the influence of various factors on the nature of destruction are studied. Modern theoretical, scientific methods for the study of friction processes in the processing of materials by pressure.	5					v				
8	Methodology for the creation and management of a single information space of an industrial enterprise	Flexible production systems and computerized integrated production. Automated product lifecycle management systems. CALS / FPI. Methodology of data representation and exchange. STEP communication standard. The PLIB and MANDATE standards. Technology of data management about products. The tasks and functions of the PDM-system. Integrated logistics support. Integrated information environment of the enterprise.	5					v	v			
9	Mechanical systems in processes of materials by pressure	The purpose of the discipline is to acquire in-depth knowledge of mechanical systems in the processing of materials by pressure. The influence of external and	5					v				

		internal factors on the unevenness of deformation of the workpiece material, mechanical deformation schemes under various pressure treatment technologies, factors affecting plasticity, resistance of materials to plastic deformation, methods of analysis and evaluation of plasticity of materials are studied. The processes of destruction of materials and the influence of various factors on the nature of destruction are studied. Modern theoretical, scientific methods for the study of friction processes in the processing of materials by pressure.										
10	Technological processes of additive manufacturing	The purpose of the discipline is the formation of knowledge of the basics of digital production in mechanical engineering, the methodology of designing additive technological processes. The discipline studies the history of the development of additive technologies, trends in the development of innovative technologies; the basics of additive manufacturing, the basic principles of additive technologies. The theoretical and technological foundations of the production of products made of polymer and metal materials using additive technologies are considered; the stages of development of technological processes of additive manufacturing are shown and examples of modern equipment for manufacturing products using additive technologies are given.	5					v				v
Cycle of profile disciplines University component												
11	Virtual Factory and Augmented Reality	The goal is to form a knowledge system in the field of new business models, business processes and technologies in high–tech industries. The course covers industrial revolutions, Industry	5						v		v	

		development programs 4.0; modern information technologies and marketing; the creation of factories of the future, their architecture. Digital transformation, principles and management of a digital company. The concept of a virtual factory and the construction of logistics networks for a digital factory. "Digital double", technical and operational data.										
12	Innovative Processes of Digitization for Industrial Manufacturing	The purpose of the discipline is the formation of knowledge in the field of innovation, innovation management, production of digital engineering. The course examines the role of science in innovative development, innovative business; classification and planning of innovations; methods of engineering creativity; theory of solving technical problems; technological approaches and their characteristics. The prospects for the development of high-tech industrial technologies; automation and robotization of machine-building production; digitalization of production are considered	5					v			v	
13	Digital design and modeling	The purpose of the discipline is to acquire knowledge of the basics of computer modeling and computer technologies used in mechanical engineering. The technologies of computer-aided design, rapid prototyping, a complex information model and an integrated information environment used in computer systems supporting the life cycle of mechanical engineering products are considered. Perspective directions of development of computer technologies and industrial systems, virtual engineering are considered. Practical application of computer modeling and design methods in the production of products.	5								v	v

14	Advanced Digital Manufacturing Monitoring	The purpose of the discipline is to acquire knowledge of the basics of technical diagnostics, production control systems at all stages of the product life cycle. The discipline examines the monitoring system of production equipment, systems of the MDC/MDA class (Machine Data Collection/ Machine Data Acquisition). Systems for monitoring the operation of CNC machines: development of programs that provide information about the condition of the machine and production personnel. The issues of optimization of technological processes, control of the efficiency of the use of equipment, tooling and tools are considered.	5									v
Cycle of profile disciplines Component of choice												
15	CAE/PLM for Industrial Manufacturing	The purpose of the discipline is to acquire knowledge and skills of working with CAE/PLM design and engineering analysis systems. The discipline studies the modern concept of CAD construction, the place of CAD in integrated systems of design, production and operation of engineering products. The features of CAE systems for solving problems of design, production and engineering calculations of machine-building products are considered; the effectiveness of CAD application in the development of new machine designs; software, information, linguistic and technical support of CAD. Computer-aided design of machine parts and assemblies; engineering equipment design.	5				v				v	v
16	PLM / PDM processes	The purpose of the discipline is the formation of theoretical knowledge and practical skills in designing machine–building products based on modern software products. The discipline	5						v		v	

		examines PDM (Product Data Management) and PLM (Product Lifecycle Management) systems that provide product lifecycle management: marketing research, design of the production facility, planning and development of the production process, technical support and maintenance, disposal and recycling. Practical application of the programs SOLIDWORKS, Compass 3D, Inventor for the formation of the composition of the product using 3D models.										
17	Gas and Plasma Atomization	The purpose of the discipline is to acquire knowledge of methods for obtaining metal powders for additive manufacturing. The discipline examines metal powders based on nickel and cobalt, iron, titanium, aluminum and other metals, technical features of powders; foreign standards for materials for additive technologies ISO, NIST, ASTM (USA). Are being studied atomization methods (gas, vacuum, centrifugal), devices and processes for producing metal powders. The method of plasma processing, the device and the principle of operation of the plasma torch, the advantages of the method, the prospects of methods for obtaining metal powders for the manufacture of products by additive technologies are considered.	5					v		v		
18	Flexdle production systems and complexes in mechanical engineering	The purpose of the discipline is to acquire theoretical and practical knowledge on the development and operation of flexible production modules in mechanical engineering. The discipline examines the essence of flexible production automation, source data and product range, the structure of flexible production modules, the sequence of module	5							v	v	

		development. The main structural elements of flexible automated production (GAP): automatic transport system, tool support and automatic control systems, production management systems; planning of the GAP, technical and economic assessment of the GAP project.										
19	Multipurpose equipment in digital manufacturing	The purpose of the discipline is to acquire knowledge and practical skills in the use of multipurpose equipment in automated production. The design and technological features of CNC machining machines are considered; principles of development of control programs and analysis of machine software; means of technological equipment. The development and implementation of 3D printers are considered; features of their maintenance, diagnostics and operation. The study of the software of CNC equipment, programming features, issues of debugging and editing programs, the advantages of multipurpose equipment in digital production.	5							v	v	
20	Nanomaterials for processes of processing	The purpose of the discipline is to form knowledge of the problems of creation, research and application of metallic nanomaterials, properties of nanomaterials and methods of their production. The discipline examines the physical foundations of nanotechnology, methods for studying nanostructures and properties; the use of nanomaterials in mechanical engineering. The principles and methods of obtaining functional nanomaterials are studied: carbon, semiconductor, photonic crystals, films of surfactants. Types and methods of obtaining structural nanomaterials (metals, ceramics, composite materials), properties of structural nanomaterials.	5				v					

21	Operating Systems for Additive Manufacturing	The purpose of the discipline is the formation of professional competencies in the design and development of additive manufacturing technologies. The discipline is based on the study of the methodology of designing additive technological machines and complexes, requirements for additive technological equipment, the manufacturability of equipment. The construction of computer 3D objects based on tomographic data, methods of non-contact formometry and photogrammetry, methods of computer modeling are considered. Are being studied technical means and software of modern additive manufacturing; selection of printing parameters and its optimization.	5					v	v			
22	Technological fundamentals of powder metalurgy	The purpose of the discipline is to form knowledge of the mechanism and laws of creating composite and powder materials, mastering engineering skills in building technological processes for obtaining powder materials. The discipline studies the essence of powder metallurgy, prospects and main directions of development. The physical and technological properties of powders, methods of their determination, mechanical and physico-chemical methods of obtaining powders, methods of choosing a method for obtaining powder are considered. Theoretical foundations of powder forming, theory and technology of sintering.	5				v	v				
23	Occupational Health and Safety for Additive Manufacturing	The purpose of the discipline is to acquire knowledge on ensuring the safety of life in additive manufacturing. The discipline is based on the study of normative and technical documents on labor protection, work safety in areas equipped with	5							v		

		additive equipment. The main categories of work in additive manufacturing are considered: material extrusion, powder layer melting, photopolymerization in a bath, material jet processing, binder jet processing, sheet lamination. Classification of hazards arising during the operation of additive machines and equipment. Safety and security measures for work on additive equipment.										
24	Digital Systems of Industrial Manufacturing	The purpose of the discipline is to acquire knowledge of the design of digital machine-building industries, methods and means of construction based on information and production technologies. The discipline examines the concept of information support for the life cycle of products, the principles of building automated production, the methodology of end-to-end automated design of mechanical engineering products. As a result, students will be able to develop highly efficient technological processes and equipment using modern computer-aided design systems, create new technical solutions in the field of mechanical engineering technology, equipment and tools.	5						v		v	
25	Pipe production technologies	The purpose of the discipline is to master the technology of production of different types of pipes. The production of pipes is being studied, starting from seamless pipes on aggregates with automatic, continuous, pilgrim, three-roll rolling mill, on an aggregate with a rack-and-pinion mill for continuous non-stop rolling of pipes to the production of seamless and cold-formed pipes on batch mills. The main technologies of quality and finishing of pipes are described at the modern scientific level	4					**v**				**v**

26	Tribology in pressure treatment	The purpose of the discipline is to acquire theoretical foundations for determining the forces of external friction in various processes of metal processing by pressure. Methods for determining the coefficient of friction in plastic deformation processes are studied. The issues of the theory of lubricating action, the range of effective technological lubricants, methods of their production, as well as lubrication systems and their operating conditions are considered. Described methods of testing lubricants and their technical and economic indicators	4					**v**				**v**

5. Curriculum of the educational program

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
«1» 12 2023 y.

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

Educational program 7M07228 - "Advanced materials processing technologies"
Group of educational programs M113 - "Technology of materials processing by pressure"

Form of study: full-time **Duration of study: 2 year** **Academic degree: Master of technical sciences**

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
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Engineering training module (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	5			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E		3		
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E	3			
component of choice											
MSM227	Rolling production equipment and technologies	BD CCH	5	150	2/0/1	105	E	5			
MSM228	Pressing and drawing technologies										
MSM220	Technological processes of additive manufacturing	BD CCH	5	150	2/0/1	105	E	5			
MCH206	Methodology of creation and management of a single information space of an industrial enterprise										
MCH278	Mechanochemical pressure treatments	BD CCH	5	150	2/0/1	105	E			5	
MCH270	Mechanical systems in the process of pressure treatment										
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. The module of digitalization of materials processing by pressure (university component, component of choice)											
MSM201	Virtual factory and Augmented reality production	PD UC	5	150	2/0/1	105	E	5			
MSM218	Digital design and modeling	PD UC	5	150	2/0/1	105	E	5			
MSM202	Advanced digital production monitoring	PD UC	5	150	2/0/1	105	E		5		
MSM206	Innovative processes of digitalization of machine-building production	PD UC	5	150	2/0/1	105	E			5	
MSM210 MCH244	CAE/PLM of machine-building production PLM/PDM processes	PD CCH	5	150	2/0/1	105	E			5	
IND209 ISO246	Multipurpose equipment in digital production Flexible production systems and complexes in mechanical engineering	PD CCH	5	150	2/0/1	105	E		5		
MCH284 MCH279	Technological bases of powder Nanomaterials for pressure treatment	PD CCH	5	150	2/0/1	105	E		5		
MSM211 MSM216	Digital systems of machine-building production Additive Manufacturing operating	PD CCH	5	150	2/0/1	105	E			5	
MSM229 MSM230	Pipe production technologies Tribology in pressure treatment	PD CCH	4	120	2/0/1	75	E			4	
MSM207 MSM214	Occupational health and safety of additive manufacturing Gas and plasma atomization	PD CCH	5	150	2/0/1	105	E			5	

M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD, CCH	4								4
M-4. Experimental research 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
M-5. Module of final attestation											
ECA212	Preparation and defense of a master's thesis	FA	8								8
	Total based on UNIVERSITY:							30	30	34	26
								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	15	35
PD	Cycle of profile disciplines		24	29	53
	Total for theoretical training:	**0**	**44**	**44**	**88**
	RWMS				*24*
FA	Final attestation	8			8
	TOTAL:	**8**	**44**	**44**	**120**

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol № 3 от "17" 10 2022 y.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol № 2 от "14" 10 2022y.

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

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

E&ME Institute Director _____ **K.Yelchiyessov**

ME Department Head _____ **E.Nugman**

Representative of the Council for EP from Employers _____ **I. Dyusebaev**