Institute _____ **Energy and Mechanical engineering** _____

Department __ **Mechanical engineering** _____

EDUCATIONAL PROGRAM

7M07136 - Additive Manufacturing

the name of educational program

Code and name field of education:
7M07-Engineering, manufacturing and civil engineering
Code and classification direction of personnel training:
7M071-Engineering and engineering trades
Group of educational programs:
M103-Mechanics and metal working
EP purpose: 7
EP type: 7
Period of study: 2 years
Volume of the credits: 120

Almaty 2022

Educational program **7M07136 - Additive Manufacturing**
(the name of educational program)

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

Minutes 13 dated «28» 04 2022.

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

Minutes 7 dated «26» 04 2022.

Educational program 7M07136- Additive Manufacturing code and name of the
(the name of educational program)
educational program developed by the academic committee in the direction «7M071-Engineering and engineering trades»

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	
Issametova M.E.	Candidate of Technical Sciences	Assoc. Professor	Department of Mechanical Engineering	
Smailova G.A.	Candidate of Technical Sciences	Assoc. Professor	Department of Mechanical Engineering	
Employers:				
Azimbekov M. K.		Director	LLP "Zhaken Kalsha"	
Students				
Esmukhambetova D.E.		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
НАО	Некоммерческое акционерное общество
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

Individuality and uniqueness of EP 7M07136 - "Additive Manufacturing" in its focus on modern engineering industries that meet Industry 4.0 standards. Expanding the integration of science and production, creating conditions for the commercialization of intellectual property products and technologies, increasing the competitiveness of personnel and conducting fundamental and applied scientific research at a higher quality level.

EP 7M07136 - "Additive Manufacturing" is focused on learning outcomes that form professional competencies in accordance with the requirements of the labor market.

A master in the field of study "Additive Manufacturing" should be prepared to solve professional problems in accordance with the profile focus of the master's program and the types of professional activities:

research activities:

- analysis of scientific and technical information, domestic and foreign experience in the development and research of digitalization of machine-building production; studying new methods of management theory, artificial intelligence technologies and other scientific areas that make up the theoretical basis for the digitalization of machine-building production, compiling and publishing reviews and abstracts;
- conducting theoretical and experimental research in the field of developing new samples and improving existing digitalization of machine-building production, their modules and subsystems, searching 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;
- carrying out the development of experimental samples of digitalization of machine-building production, their modules and subsystems in order to verify and justify the main theoretical and technical solutions to be included in the terms of reference for the development work;
- organizing and conducting experiments on the existing digitalization of machine-building industries, their subsystems and individual modules in order to determine their effectiveness and determine ways to improve, processing the results of experimental studies 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 development activities:

- preparation of a feasibility study for projects of new digitalization of machine-building production, their individual subsystems and modules;
- calculation and research of digitalization of machine-building production, control, information-sensory and executive subsystems using mathematical

modeling methods, prototyping and testing of existing systems, processing of experimental data using modern information technologies;

- development of special software for solving the problems of designing the 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 in accordance with approved forms;

- organization of the work of small groups of performers participating in research, design work and in conducting experimental research;

- control over the implementation of measures to prevent industrial injuries, occupational diseases, prevent environmental violations in the process of research and operation of digitalization of machine-building production;

assembly and adjustment activities:

- participation in verification, adjustment, adjustment, assessment of the state of equipment and setting up the digitalization of machine-building production for various purposes, including both technical means and software control systems;

- participation in interfacing software and hardware systems with technical objects as part of the digitalization of machine-building production, in testing and commissioning 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 systems;

- preventive control of the technical condition and functional diagnostics of digitalization of machine-building production for various purposes, as well as their individual subsystems;

- drawing up instructions for the operation of digitalization of machine-building production and their hardware and software, development of programs for routine tests;

- 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 production and technological, research and design activities in the field of additive machine-building production

EP tasks:

-formation of knowledge of the basics of additive technologies in the field of mechanical engineering;

- acquisition of theoretical and practical knowledge on the organization, carrying out scientific and experimental, research work in the field of development of innovative additive technologies in mechanical engineering;

- formation of knowledge and skills in the analysis of scientific and technical information, new methods of control theory, scientific areas of additive engineering;

- the formation of knowledge and practical skills for the implementation of 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 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 learning skills in order to carry out further education with a high degree of independence, that is, professional, communication and key competencies are formed that meet employers' requirements.

The qualification assigned to the graduate is Master of Technical Sciences in EP 7M07136 - "Additive Manufacturing"

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	7M071- Engineering and engineering trades
3	Group of educational programs	M103- Mechanics and metal working
4	Name of the educational program	7M07136- Additive Manufacturing
5	Short description of the educational program	The professional activity of graduates of the educational program is aimed at mastering, developing and introducing additive technologies into machine-building production. In the educational program, undergraduates will receive professional knowledge of advanced technological processes of additive manufacturing, methods of design and

		production of additive machines and equipment, knowledge of the basics of research activities, design of virtual production, scientific and pedagogical activities. Students will acquire the skills of computer-aided design of the main stages of the product lifecycle, development of business processes, methods of creating and managing a single information space of the enterprise
6	EP purpose	Preparation of demanded, competitive and highly qualified bachelors in mechanical engineering; design, production and operation of machines aimed at their high quality and safety, high economic efficiency for the manufacturer and consumer. The master's program in the scientific and pedagogical direction implements educational programs of postgraduate education for the training of scientific and scientific-pedagogical personnel for universities and scientific organizations with in-depth scientific, pedagogical and research training.
7	EP type	Training of highly qualified and competitive scientific and pedagogical personnel for production and technological, research and design activities in the field of additive machine-building production
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 activities; - Ability to plan and solve problems of own professional and personal development. - The ability to critically analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems; - The ability to design and implement comprehensive research based on a holistic systemic scientific outlook 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; - Willingness to use modern methods and technologies of scientific communication in the state and foreign languages;
12	Learning outcomes of the educational program:	ON1 Develops and improves the intellectual and general cultural level, expands and deepens the scientific worldview, uses new knowledge and skills in practical activities ON2 Applies and observes the rights and duties of a citizen, ethical and legal norms in society and the collective ON3 Demonstrates the ability to search for new scientific and technical information, based on the integration of knowledge in relation to the professional field, the use of a foreign language for business communication ON4 Demonstrates skills and abilities in the organization of research work, in team management,

		in assessing the quality of professional results, in solving problem situations ON5 Shows readiness for research and project work in the field of digital machine-building production, in related fields related to the selection and development of new research methods ON6 Proficient in the principles of innovation management, business activities, quality and risk management in digital engineering ON7 Demonstrates knowledge in the field of universal quality management, principles of modern quality systems, information and communication technologies in the field of educational process management ON8 Demonstrates the ability to analyze, evaluate and synthesize modern innovative technologies, design methods and modeling of digital production processes ON9 Applies advanced methods, materials and technologies for automation of digital production, planning and forecasting of the development of machine-building production. ON10 Demonstrates readiness to use computer and information technologies to solve practical and scientific problems in the field of automation of the life cycle of products, ensuring environmental safety of digital production.
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 "7M071-Engineering and Engineering"

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	ON 10
Cycle of basic disciplines University component													
1	English 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	v							
2	Psychology of management	The purpose of the discipline is to familiarize students with modern ideas about the role and multidimensional content of the psychological component of managerial activity; to increase the psychological culture of the future master for the successful implementation of professional activities and self-improvement. Studies the main stages, trends and trends in the development of Kazakh and foreign management psychology, the composition and structure of management activities. Special attention is paid to the psychological component of the managerial function, the individual characteristics of the manager, the ethical and cultural components of the manager, the basics of interaction.	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-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.	3	v		v							
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 Optional component													
5	Digital Lean Manufacturing	The purpose of the discipline is to form a systematic representation of the concept of lean production, knowledge of theoretical provisions and regulatory documents in the field of quality management. The discipline studies the basic concepts, the history of the Lean management system, lean manufacturing as a model for improving the efficiency of an enterprise; the principles and essence of quality management systems – Kaizen and 6 sigma. The tools of quality management systems are considered; criteria of economic indicators characterizing	5							v			

		changes in the activities of machine-building enterprises.											
6	Advanced Materials for Additive Manufacturing	The discipline studies the place and role of additive technologies in the digital economy. Additive technologies using polymer and composite materials.The physical nature and technological possibilities of application in additive technologies of various materials. Methods of obtaining metal powders, nanomaterials and nanopowders for creating machine parts.	5									v	
7	Computer technology analysis and calculation	The purpose of the discipline is to acquire knowledge of modern computer technologies for carrying out calculations and analysis of technical preparation of machine-building production. The processes of computer-aided design are studied; automation of design and technological training; technologies in mechanical engineering; design of technological processes; automation of technological processes; automated programming systems organization of tool production; the current state of the problem of calculating machine tools. Practical calculations are performed on the mechanics of contact interaction and destruction of working surfaces. Engineering methods for calculating complex profile surfaces of machine parts and tools are studied; computational methods for evaluating the performance of friction pairs.	5					v			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	5								v		v

		data management about products. The tasks and functions of the PDM-system. Integrated logistics support. Integrated information environment of the enterprise.											
9	Advanced technologies in mechanical engineering	The purpose of the discipline is to acquire knowledge about the laws of the construction of technological processes, optimization of production costs, computer technological environment and complex automation of production. New processing methods in mechanical engineering, methods of thermomechanical hardening of materials, methods of intensification of cutting processes of materials are considered. Electrophysical and electrochemical methods, methods of finishing and finishing workpieces, new metal alloys and non-metallic materials for the manufacture of machine parts are being studied. High-tech manufacturing of engineering products.	5									v	v
10	Photonics and advanced laser systems and technologies	The purpose of the discipline is to form knowledge in the field of modern laser technologies and photonics used in industrial production. The discipline studies the physics of lasers, laser technologies, methods of modeling laser effects on matter. The principles of functioning and components of laser systems, the metrology of laser radiation are considered; laser technologies of metal processing, methods of laser sintering of powders used in additive manufacturing. The basics of photonics and nanophotonics, laser systems for scientific research are considered.	5									v	
Cycle of major 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	5								v	v	

		processes and technologies in high–tech industries. The course covers industrial revolutions, Industry 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				
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	5									v	v

		computer modeling and design methods in the production of products.											
14	Technological processes of additive manufacturing	The technological process used in the field of additive technologies is characterized by the management of manufacturing parts based on 3D CAD data. A photopolymerization process in a bath in which a pre-deposited photopolymer is selectively irradiated with light. The process of inkjet applying a material in which the production of an object is carried out by applying drops of building material. The process of spraying a binder in which a liquid binder is selectively applied to the powder materials to be bonded. A synthesis process on a substrate in which the surface of a pre-applied layer of powder material is selectively, completely or partially melted by thermal energy. The process of direct supply of energy and material, in which thermal energy is used to connect materials by fusion as they are applied. The process of sheet lamination in which the manufacture of a part is carried out by bonding sheets of material	5								v		
Cycle of major disciplines Selectable Component													
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;	5				v				v		

		software, information, linguistic and technical support of CAD. Computer-aided design of machine parts and assemblies; engineering equipment design.											
16	CAD/CAM/CAE/PLM of Additive Manufacturing	The purpose of the discipline is to acquire knowledge and skills in designing automated and automated production facilities based on information technology. The discipline examines the principles and methodology of building integrated CAD/CAM/CAE/PLM systems of additive manufacturing, the possibilities and prospects of automation of design and technological preparation of production in modern conditions of mechanical engineering. Integrated systems of design and technological preparation of production, engineering calculations in CAE systems, functions and capabilities of basic systems providing implementation of PLM solutions are studied, practical tasks are solved in the SolidWorks program.	5				v				v		
17	Technological methods of improving of the availability and reliability of means of technological support of automated production	The purpose of the discipline is to acquire knowledge in the field of improving the reliability of automated machine–building production. The course examines indicators of reliability of automation tools; qualitative indicators of reliability of technical and software automation tools; the importance of reliability components for equipment, technologies and automation. Functional and numerical reliability indicators, laws of reliability and recoverability of systems; reliability and efficiency of automation systems; reliability of software of automated systems: characteristics and methods of increasing reliability. Diagnostics of	5					v			v		v

		technological systems, types and methods of control of automated systems.											
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 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.	5								v	v	
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	
20	Risk Management in Digital Manufacturing	The purpose of the discipline is to form knowledge of the basics of digital production management, diagnostics and risk modeling. The discipline examines the essence of risks as an economic category, criteria for risk classification.	5						v	v			

		Development of risk management in practice: stages of the risk management process, methods of risk identification and analysis. The methodology of construction and application of economic and mathematical models of risk analysis and assessment, the basics of risk management in the evaluation activity of a machine-building enterprise using software are studied.											
21	Advanced Additive Manufacturing Ergonomics	The purpose of the discipline is to form knowledge of the basics of digital production management, diagnostics and risk modeling. The discipline examines the essence of risks as an economic category, criteria for risk classification. Development of risk management in practice: stages of the risk management process, methods of risk identification and analysis. The methodology of construction and application of economic and mathematical models of risk analysis and assessment, the basics of risk management in the evaluation activity of a machine-building enterprise using software are studied.	5					v				v	
22	Digital technologies in industrial manufacturing	The purpose of the discipline is to form knowledge in the field of digital technologies in the machine-building complex, about the processes of forming a single information and communication space of the enterprise. Algorithms for computer-aided design of machine components and equipment are studied and developed; mathematical models of machines, drives and systems of technological processes in mechanical engineering; systems of engineering analysis in technological design. As a result, practical skills are acquired in the development and application of computer-	5					v					v

		aided design algorithms, engineering analysis.											
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 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.	5									v	v
24	Cutting theory	The purpose of the discipline is the formation of knowledge on the basics of the theory of metal cutting, practical skills in calculating cutting modes, choosing a model of equipment. Basic concepts and definitions of cutting theory. The physical basis of the theory of cutting. Performance and failure of blade cutting tools. The peculiarity of various methods of machining. Lubricating technology media. Machinability of various materials. The method of increasing the reliability of the right choice of tool material. Heat phenomena during cutting. The theory of abrasive processing. Calculation of cutting modes. Physico-chemical processing methods. Features of the cutting process and cutting conditions in automated production.	5					v				v	5

5. Curriculum of the educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of KazNRTU named after K.Satpayev
_____ M. Begentaev
_____ 2022 y.

CURRICULUM
of Educational Program on enrollment for 2022-2023 academic year

Educational program 7M07136 - "Аддитивное производство"
Group of educational programs M103 - "Mechanics and metalworking"

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			
								1 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											
MSM200	Lean digital manufacturing	BD CCH	5	150	2/0/1	105	E	5			
MSM222	Advanced additive manufacturing materials										
MCH203	Computer technologies of analysis and calculation	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										
ISO241	Advanced technologies in mechanical engineering	BD CCH	5	150	2/0/1	105	E			5	
INO202	Photonics and advanced laser systems and technologies										
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Additive manufacturing module (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			
MSM204	Technological processes of additive manufacturing	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 MSM217	CAE/PLM of machine-building production CAD/CAM/CAE/PLM additive manufacturing	PD, CCH	5	150	2/0/1	105	E			5	
MSM209 ISO246	Digital technologies of machine-building production Flexible production systems and complexes in mechanical engineering	PD, CCH	5	150	2/0/1	105	E		5		
IND209 MCH264	Multipurpose equipment in digital production Technological methods for improving the efficiency and reliability of technological support for automated production	PD, CCH	5	150	2/0/1	105	E		5		
MSM208 IND230	Advanced additive manufacturing ergonomics Risk management in digital production	PD, CCH	5	150	2/0/1	105	E			5	
MSM207 IND229	Occupational health and safety of additive manufacturing Production planning and control	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											
ECA205	Preparation and defense of a master's thesis	FA	12								12
	Total based on UNIVERSITY:							30	30	30	30

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		25	24	49
	Total for theoretical training:	*0*	*45*	*39*	*84*
	RWMS				24
FA	Final attestation	12			12
	TOTAL:	12	45	39	120

Decision of the Academic Council of Kaznitu named after K.Satpayev, Protocol № 13от "28" 04 2022 г.

Decision of the Educational and Methodological Council of Kaznitu named after K.Satpayev, Protocol № 7от "21" 04 2022 г.

Decision of the Academic Council of the Institute E&ME, Protocol № 5от "20" 04 2022 г.

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

E&ME Institute Director _____ K.Velyamov

ME,SC &M Department Head _____ M.Issahmetova

Representative of the Council for EP from Employers _____ I. Dyussebaev