



Institute \_\_\_\_\_ Energy and Mechanical engineering \_\_\_\_\_

Department \_\_\_\_\_ Mechanical engineering \_\_\_\_\_

### **EDUCATIONAL PROGRAM**

6B07105- Industrial engineering  
the name of educational program

Code and name field of education:

6B07-Engineering, manufacturing and civil engineering

Code and classification direction of personnel training:

6B071-Engineering and engineering trades

Group of educational programs:

B064-Mechanics and metal working

EP purpose: 6

EP type: 6

Period of study: 4 years

Volume of the credits: 240

**Almaty 2023**

Educational program **6B07105 - Industrial engineering**  
(the name of educational program)

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


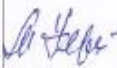


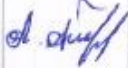
Minutes 5 dated « 24 » November 2022.

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

Minutes 3 dated « 17 » November 2022.

Educational program 6B07105- Industrial engineering  
(the name of educational program)

developed by Academic committee in the direction of "6B071-Engineering and  
engineering"

Full name	Academic degree/ academic title	Position	Workplace	Signature
<b>Chairperson of Academic Committee:</b>				
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	
<b>Teaching staff:</b>				
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	
<b>Employers:</b>				
Dyusembayev I.M.		Chief Engineer	Almaty plant "Electroshield"	
<b>Students</b>				
Akan A.		4th year 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
GED	General education disciplines
EP	Educational program
PD	Profile disciplines
WC	Working curriculum
IWS	Independent work of a student
EMC	Educational and Methodological Council
AC	Academic council

## **1 Description of educational program**

A specialist who develops a virtual prototype of products and technological processes (for example, for remote consulting of personnel, visual demonstration of the product to the customer at the design stage).

The professional activity of graduates of the program is directed to the field of mechanical engineering, additive manufacturing.

The direction of the specialty and specialization program covers engineering and engineering.

The field of professional activity of bachelors includes sections of science and technology containing a set of tools, techniques, methods and methods of human activity aimed at creating competitive engineering products and based on the use of modern methods and means of design, mathematical, physical and computer modeling of technological processes.

Bachelors can perform the following types of professional activities:

- organizational and managerial;
- production and technological;
- design and engineering;
- settlement and design;
- experimental research.

Functions of professional activity of graduates:

- development and design of technological processes for the manufacture of various types of products, equipment, tooling, tools;
- standard control of regulatory and technical documentation;
- solving design, technological, organizational-technical and organizational-economic tasks;
- - maintenance, organization of preventive inspections and routine repairs of production facilities, measurements, tests and control;
- development of design, technological and operational documentation, new technologies, methods of testing equipment and tooling for specific industries;
- analysis of the state of production and assessment of the stability of product quality in order to further develop and improve the efficiency of the enterprise;
- conducting experiments, measurements, observations, implementation of research results and scientific developments.

Graduates are prepared to solve the following types of tasks according to the type of professional activity:

- organizational and managerial: organization of the production process, organization of the work of performers;
- setting goals and forming management tasks related to the implementation of professional functions;
- organization of production maintenance management of the production process taking into account technical, financial and human factors;
- development of management algorithms;
- accounting planning and reporting, development of a business plan of the enterprise, planning to improve production efficiency;

- production and technological: development, implementation and operation of system, resource-saving technologies; development and implementation of technological processes for processing and assembling products;
- automation of machine-building production; creation of continuous in-line production processes, automated complexes, flexible automated productions;
- introduction of highly efficient technological equipment, ensuring environmental friendliness of machine-building production;
- design and engineering: execution of design and graphic works in the design of automation systems, design of highly efficient technological equipment; justification of criteria for evaluating the technical and economic efficiency of the designed systems;
- development of design, design and technological documentation using modern methods of computer-aided design;
- design and design: development of design schemes for the design of equipment systems, tooling and tools;
- execution of calculations for use in design documentation; justification of calculation methods;
- experimental research:

Application of modern experimental methods for the study of processes occurring in machine-building production; research of new directions in the technology of modern mechanical engineering; research of types of processing in mechanical engineering; research of automation objects in the field of mechanical engineering; scientific substantiation of methods for ensuring the quality of manufactured products and increasing labor productivity;

Areas of professional activity

Directions of professional activity of a graduate of this specialty:

- technological processes of machine-building production;
- design and construction of various types of equipment, tooling and tools;
- repair and maintenance of production equipment, tooling and tools;
- experimental research works. The content of professional activity.

The content of professional activity includes a set of means, methods and methods of production and technological, design, experimental research, organizational, economic and managerial activities, as well as design and design activities aimed at manufacturing competitive engineering products based on the use of modern design methods.

Requirements for the Bachelor's key competencies.

The bachelor must:

have an idea: about the main equipment, tools, equipment used in mechanical engineering; about calculation and design methods; about modern methods and methods of obtaining blanks; about the development of technological processes; about the current state, trends and prospects for the development of mechanical engineering; about the types of CAD support; about the composition of design tasks; about the sanitary and hygienic basics of labor protection; about the main hazards and harmful conditions; ways of preventing and eliminating accidents; about fixed assets and working capital; about economic efficiency; about modern

forms and methods of organization and management of production;

## **2 The purpose and objectives of additional educational program**

### **EP purpose:**

EP 6B07105- "Industrial Engineering" was developed in accordance with the National Qualification System, coordinated with the Dublin Descriptors and the European Qualification Framework. OP is focused on learning outcomes that form professional competencies in accordance with the requirements of the labor market.

The purpose of the educational program is the professional training of a graduate in the field of design, design and organization of machine-building production, the formation of a technically competent, socially responsible personality; possessing creative thinking, the ability to solve engineering problems, work in a team and having management competencies in the industrial sector.

### **EP tasks:**

- formation of knowledge of modern information technologies;
- acquisition of theoretical and practical knowledge of computer-aided design of machine-building products;
- knowledge of methods and methods of mathematical and 3D modeling;
- acquisition of professional competencies in accordance with the requirements of industry professional standards;
- acquisition of knowledge of the basics of mechanical engineering technology, design of technological processes for the production of machines;
- formation of knowledge about the main trends in the development of mechanical engineering, the introduction of innovative digital technologies.

## **3 Requirements for evaluating the learning outcomes of an educational program**

Description of mandatory standard requirements for graduating from a university and conferring an academic bachelor's degree: mastering at least 240 academic credits of theoretical training and final thesis

## **4 Passport of the educational program**

### **4.1 General information**

<b>№</b>	<b>Название поля</b>	<b>Примечание</b>
1	Code and name field of education	6B07- Engineering, manufacturing and civil engineering
2	Code and classification direction of personnel training	6B071- Engineering and engineering trades
3	Group of educational programs	B064- Mechanics and metal working
4	Name of the educational program	6B07105- Industrial engineering
5	Short description of the educational program	The professional activity of graduates of the program is directed to the field of mechanical engineering, additive

		manufacturing. In the educational program, students will receive professional knowledge of the basics of mechanical engineering technology, machining technology and machine assembly. They will acquire skills in designing machine structures and their parts, technological processes of machine production using modern software products (CAD/CAM/CAE).
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
7	EP type	New
8	Level on NQF	6
9	Level on SQF	6
10	EP distinctive features	-
11	List of competencies of the educational program:	<ul style="list-style-type: none"> <li>- Ability to apply general engineering knowledge, methods of mathematical analysis and modeling in professional activities;</li> <li>- Ability to analyze and evaluate both production and technological processes;</li> <li>- Willingness to use modern information technologies in the modeling of technological processes, mechanical engineering;</li> <li>- Willingness to apply modern calculation methods in the design of parts and assemblies of mechanical engineering products;</li> <li>- Willingness to use low-waste, innovative, additive technologies in mechanical engineering;</li> <li>- Willingness to apply methods of quality control of products and objects in the field of professional activity;</li> </ul>
12	Learning outcomes of the educational program:	<p>ON1- Apply basic knowledge of fundamental disciplines of mathematics, physics, chemistry, digital technologies in the design and preparation of machine-building production.</p> <p>ON2- Apply knowledge of economic laws, occupational safety and health, ecology, rules of moral development, culture of academic integrity at a professional level.</p> <p>ON3- Analyze, synthesize and design elements of machine structures using modern materials and methods for calculating structures for strength, rigidity and stability.</p>



		<p>ON4- To carry out technical preparation of production, to evaluate the quality of production processes and engineering products.</p> <p>ON5- Develop technical and technological documentation for the design and production of metalworking equipment, tooling and cutting tools.</p> <p>ON6-Apply the principles of interchangeability and rationing of standard connections in machines.</p> <p>ON7- Apply modern engineering materials, technologies and methods of design and production of blanks in mechanical engineering.</p> <p>ON8- Choose effective ways to implement the main technological processes and apply methods of processing machine parts based on additive technologies, automated design systems and production management.</p> <p>ON9- Use process modeling methods, software products and the latest technologies to solve engineering problems in the field of metalworking.</p> <p>ON10- Analyze and apply modern methods of economic regulation and production management, planning and organization of production.</p> <p>ON11- To use the laws of fluid and gas mechanics in the design and operation of technological equipment in the manufacture of machine-building products.</p> <p>ON12- The use of modern technical means and information technologies of machine-building production, advanced equipment, tooling and additive technologies.</p>
13	Form of training	daytime
14	Period of study	4 years
15	Volume of the credits	240
16	Language of education	Kazakh, russian
17	The awarded academic degree	Bachelor of Engineering and technology
18	Developer(s) and authors:	The educational program was developed by the academic committee in the direction "6B071-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	ON2	ON3	ON4	ON5	ON6	ON7	ON8	ON9	ON10	ON11	ON12
Cycle of general education disciplines															
Required component															
1	Foreign language	English is a compulsory subject. According to the results of placement test or IELTS score, students are placed into groups and disciplines. The name of the discipline corresponds to the level of English. When passing from level to level, prerequisites and postrequisites are respected.	10	v											
2	Kazakh (Russian) language	In this course author considers socio-political, socio-cultural spheres of communication and functional styles of the modern kazakh (russian) language. The course covers the specifics of the scientific style to develop and activate professional communication skills and abilities of students. Also it allows students to leavn the basics of scientific style practically and develop the ability of production structural and semantic text analysis.	10	v											
3	History of Kazakhstan	The purpose of the discipline is to provide objective historical knowledge about the main stages of the history of Kazakhstan from ancient times to the present day; introduce students to the problems of the formation and development of statehood and historical and cultural processes; contribute to the formation of humanistic values and patriotic feelings in the student; teach the student to use the acquired historical knowledge in educational, professional and everyday life; evaluate the role of Kazakhstan in world history.	5	v											
4	Philosophy	The purpose of the discipline is to teach students the theoretical foundations of philosophy as a way of knowing and spiritually mastering the world; developing their interest in fundamental knowledge, stimulating the need for philosophical assessments of historical events and facts of reality, assimilating the idea of the unity of the world historical and cultural process while recognizing the diversity of their skills in applying philosophical and general scientific methods in professional activities.	5	v											
5	Module of socio-political knowledge (sociology, political science)	The objectives of the disciplines are to provide students with explanations on the sociological analysis of society, about social communities and personality, factors and patterns of social development, forms of interaction, types and directions of social processes, forms of regulation of social behavior, as well as primary political knowledge that will serve as a theoretical basis for understanding social -political processes, for the formation of political culture, development of a personal position and a clearer	3	v											

		understanding of the extent of one's responsibility; help to master the political, legal, moral, ethical and socio-cultural norms necessary to act in the interests of society, form personal responsibility and achieve personal success.															
6	Module of socio-political knowledge (cultural studies, psychology)	The purpose of the disciplines is to study the real processes of cultural creative activity of people who create material and spiritual values, identify the main trends and patterns of cultural development, changes in cultural eras, methods and styles, their role in the formation of man and the development of society, as well as master psychological knowledge for the effective organization of interpersonal interaction, social adaptation in the field of their professional activities.	5	v													
<b>Cycle of general education disciplines</b> <b>University component</b>																	
7	Information and communication technologies (in English)	The aim of the course is to gain theoretical knowledge in information processing, the latest information technologies, local and global networks, the methods of information protection; Getting the right use of text editor editors and tabulators; creation of base and different categories of applications.	5	v													
<b>Cycle of general education disciplines</b> <b>Optional component</b>																	
8	Fundamentals of anti-corruption culture and law	The course introduces students to the improvement of socio-economic relations of Kazakhstan society, psychological features of corrupt behavior. Special attention is paid to the formation of an anti-corruption culture, legal responsibility for acts of corruption in various spheres. The purpose of studying the discipline «Fundamentals of anti-corruption culture and law» is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in everyday practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.	5	v													
9	Fundamentals of economics and entrepreneurship	Discipline studies the foundations of economics and entrepreneurial activity from the point of view of science and law; features, problematic aspects and development prospects; the theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; The readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, the stages of career, qualities, competencies and responsibility of the entrepreneur, theoretical and practical business planning and economic examination of business ideas, as well as the analysis of the risks of innovative development, the introduction of new technologies and technological solutions.	5	v													
10	Ecology and life safety	The discipline studies the tasks of ecology as a science, environmental terms, the laws of the functioning of natural systems	5	v													

		and aspects of environmental safety in the conditions of labor activity. Monitoring of the environment and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies														
11	Fundamentals of scientific research methods	The purpose of the discipline is to form the skills of organizing and planning scientific research, methods of conducting experimental research, methods of information processing. The discipline introduces students to the goals, objectives and stages of scientific research. The terms and concepts, the methodology of the experiment, mathematical methods of processing research results are considered. The concept of engineering, laboratory and industrial experiment, bench research. The discipline introduces the basics of the theory of solving inventive problems, algorithmic methods of finding technical solutions and their optimization. Highlights the main mathematical methods of optimization, the use of artificial intelligence capabilities to solve optimization problems; issues of search, accumulation and processing of scientific information.	5	v												v
<p style="text-align: center;"><b>Cycle of basic disciplines</b> <b>University component</b></p>																
12	General Chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental laws of chemical thermodynamics and kinetics; quantum mechanical theory of atomic structure and chemical bond. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. The structure of matter and the chemistry of the elements.	4	v												
13	Physics I	Objectives: to study the basic physical phenomena and laws of classical, modern physics; methods of physical research; the relationship of physics with other sciences. The following topics are considered: mechanics, dynamics of rotational motion of a solid body, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, transport phenomena, continuum mechanics, electrostatics, direct current, magnetic field, Maxwell equations.	5	v												
14	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to study elementary functions and solve the simplest geometric, physical and other applied problems. The main focus is on differential and integral calculus. The course sections include the differential calculus of functions of one variable, the derivative and differentials, the study of the behavior of functions, complex numbers, and polynomials. Indefinite integrals, their properties and methods of calculation. Certain integrals and their applications. Improper integrals.	5	v												
15	Physics II	The course studies the laws of physics and their practical application in professional activity. Solving theoretical and experimental-practical educational problems of physics for the formation of the	5	v									v			

		foundations in solving professional problems. Assessment of the degree of accuracy of the results of experimental or theoretical research methods, modeling of physical condition using a computer, study of modern measuring equipment, development of skills for conducting test studies and processing their results, distribution of the physical content of applied tasks of the future specialty.													
16	Mathematics II	The discipline is a continuation of Mathematics 1. The course sections include elements of linear algebra and analytical geometry. The main issues of linear algebra are considered: linear and self-adjoint operators, quadratic forms, linear programming. Differential calculus of a function of several variables and its applications. Multiple integrals. The theory of determinants and matrices, linear systems of equations, as well as elements of vector algebra. The elements of analytical geometry on the plane and in space are included.	5	v								v			
17	Introduction to engineering design	General provisions of the methodology of engineering design. Stages of creating cars. Design procedures. Principles of engineering design. Engineering design methods. Manufacturability of machine designs.	5	v											
18	The theoretical mechanics	Statics: reactions of communications; the theory of the moments; conditions of balance of flat and spatial systems of forces; the centre of grav-ity of a body. Kinematics: kinematics of a point; the elementary movements of a firm body; plane-parallel movement of a firm body; free movement of a firm body; complex movement of a point and a firm body. Dynamics: dynamics of a material point in inertial and not inertial systems of readout; mechanical system and its characteristics; the general theorems of dynam-ics of a material point and system; analytical dynamics; the theory of impact.	5			v			v						
19	Strength of materials	Stretching and compression. Stresses in cross sections and deformations of a straight rod. Mechanical properties of materials under tension and compression. Calculation of strength and stiffness in tension-compression. Geometric characteristics of flat sections. Shear and torsion. Calculation of strength and torsional stiffness. Bend. Normal and tangential bending stresses. Calculation of bending strength. Theory of stressed and deformed states. The limit state hypothesis. Complex resistance. Stability of the equilibrium of deformable systems. Dynamic load.	5			v				v					
20	Electrical and Electronic Engineering	The purpose of the discipline is to acquire theoretical and practical knowledge on the basics of electrical engineering and electronics. The basic laws of the processes occurring in electromagnetic and electronic circuits and methods for determining the electrical quantities characterizing these processes are studied. Methods of calculation of DC electric circuits are studied; analysis and calculation of linear AC circuits; analysis and calculation of magnetic circuits. Electromagnetic devices and electrical machines. Fundamentals of electronics and electrical measurements. The element base of modern electronic devices. Fundamentals of digital and microelectronics, microprocessor tools.	5									v			v

21	Theory of mechanisms and machine parts	The purpose of the study of the discipline is to gain knowledge of the general methods of studying and designing the schemes of mechanisms necessary for the creation of machines, devices, automatic devices and complexes that meet modern requirements for efficiency, accuracy, reliability and economy. The main task of the discipline is to give knowledge about the kinematic and dynamic characteristics of mechanisms with rigid and elastic links and controlled kinematic chains, about methods for determining the parameters of mechanisms according to the required conditions, methods of vibration protection of a person and a machine, about controlling the movement of mechanisms and machines.	5			v			v						
22	Economics of a machine-building enterprise	The purpose of the discipline is to acquire theoretical knowledge and practical skills of economic assessment of the company's activities. The discipline studies the structure of a machine-building enterprise, fixed and current assets, production capacity of the enterprise, material and technical support of production, personnel, financial resources of production. The issues of forecasting and planning of production, calculation of production costs, production costs, economic efficiency, analysis and evaluation of the economic activity of the enterprise are studied.	5		v							v			
23	Qualimetry	The purpose of studying the discipline is to form students' scientific ideas about the nature and properties of probabilistic processes, random variables, distribution functions and statistical methods, mastering practical skills of working with random variables and methods of their search and evaluation. The subject of probability theory, probability definitions, elements of combinatorics, random variables and the laws of their distribution are considered. The basics of mathematical statistics are studied - samples, types of samples, point and interval estimates.	5	v			v								
24	Basics of interchangeability	The purpose of the discipline is to acquire knowledge and practical skills on the basics of interchangeability, technical measurements, and machine manufacturing accuracy. Students acquire knowledge on accuracy of manufacturing of machines. The basic concepts of interchangeability. Concepts about the sizes, maximum deviations, admissions and landings. Principles of construction of system of admissions and landings. Calculation and a choice of landings. Normalization, methods and means of measurements and the control of rejections of the form, an arrangement, a roughness and a sinuosity of a surface of a detail. Methods and means of measurements and the control of smooth cylindrical connections; carving connections; conic connections and tooth gearings. Substantive provisions of the theory and practice of calculation of dimensional circuits.	6						v						
25	Probabilistic models in industrial engineering	The purpose of the discipline is to acquire theoretical and practical knowledge of the reliability of technical systems (machines). The fundamentals of probability theory and the application of the laws of probability theory to the analysis of technological and technical systems, including in mechanical engineering, in procurement	5	v								v			

		production, are studied. With the help of probabilistic and statistical models, the problems of designing, manufacturing and controlling products are solved. The use of such models in the calculations and research of the accuracy of equipment and technological processes, in the development and selection of statistical methods for quality control of machine-building products.													
26	Construction materials and heat treatments	The purpose of the discipline is to provide theoretical and practical knowledge of the basic properties of structural materials used in mechanical engineering, methods of their heat treatment. The discipline considers: classification of engineering materials, properties and characteristics of materials, methods of studying the structure and composition of materials, the diagram of iron-cementite. The production of cast iron and steel, non-ferrous metal alloys is being studied. The types of heat treatment, modes and recommendations for their use are considered; promising engineering materials.	5			v				v					
27	Metalworking machines	At the study of this discipline students will get general information on the basic types of industrial equipment for making of de-tails, and also taking about bases of plan-ning and exploitation of these types of equipment. Students will know the device of machines, machine-tools and automats. Will master approach of the systems at an analy-sis and synthesis of objects of metal-cutting equipment and will get abilities of kinemat-ics analysis, формообразования etc. Metal-cutting machine-tools. Machine-tools for treatment of bodies of rotation. Machine-tools for treatment of openings. Machine-tools for treatment of prismatic details. Machine-tools for abrasive treat-ment. Metal-cutting machine-tools with CHPU.	5					v							v
28	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.	4							v					v
29	Computer-aided design in mechanical engineering	The purpose of the discipline is to acquire students' knowledge about the automation of existing and projected processes, measures for the effective use and testing programs of automation, on the development of automation, acquisition of skills and abilities of effective use of automated metal - cutting equipment and other automation tools, improvement and design of new technological processes of manufacturing parts.	6								v				v
<p align="center"><b>Cycle of basic disciplines</b> <b>Optional component</b></p>															

30	Hydraulics and hydraulic pneumatic drive	The purpose of the discipline is the formation of knowledge in the field of hydraulics, hydraulic and pneumatic machines for processing, feeding and moving liquids and gases. The discipline deals with the issues of hydrostatics: basic physical properties of liquids and gases; hydrodynamics: motion of liquids and gases, Euler and Bernoulli equations, modeling of hydrodynamic phenomena; hydraulic machines and hydraulic drives. Fundamentals of pneumatic actuators, pneumatic motors, equipment of pneumatic systems. The basics of operation of combined hydraulic pneumatic actuators are studied.	5															v	
31	Mechanics of liquid and gas	The course "Mechanics of liquid and gas" examines the models and physical properties of liquids and gases; the forces acting in the fluid, hydrostatic pressure and its properties; basic equations and laws of equilibrium and motion of liquids and gases; flow regimes and methods for calculating applied problems	5															v	
32	Calculation and design of cutting tools	This discipline must teach students correct-ly to construct and rationally exploit mod-ern metal-cutting instruments. To teach stu-dents correctly to design, and also gro-unded to choose from a set of standard, necessary metal-cutting instruments, com-ing from the set requirements to quality of details and terms of their treatment. Inst-rumental materials. Instruments for treat-ment of openings. Abrasive instruments. Instruments for formation of screw-thread. Instruments for treatment of not ЭВОЛЬ-ВЕНТНЫХ types.	5					v			v								
33	Production of cutting tools	This discipline must teach students correct-ly to construct and rationally exploit mod-ern metal-cutting instruments. To teach stu-dents correctly to design, and also gro-unded to choose from a set of standard, necessary metal-cutting instruments, com-ing from the set requirements to quality of details and terms of their treatment. Inst-rumental materials. Instruments for treat-ment of openings. Abrasive instruments. Instruments for formation of screw-thread. Instruments for treatment of not ЭВОЛЬ-ВЕНТНЫХ types.	5					v			v								
34	Drives of CNC machines	The purpose of the discipline is to acquire theoretical and practical knowledge on the drives of CNC machines, the principles of operation, their regulation and operation. Block diagrams of drives of metal-cutting machines, modular drives of the main movement, methods of regulating drives of machine tools. Main motion drives and feed drives, their	5					v											v



		design, electromechanical and electric drives of CNC machines.																	
35	Operation of machines with program control	The purpose of the discipline is to gain knowledge about the design of CNC machines, the adjustment of machines for processing workpieces, the operation of machines. The discipline studies the classification, basic requirements for CNC equipment; the main parts of CNC machines; adaptations, cutting and measuring tools for CNC machines; tool binding; adjustment of the machine for processing parts; workplace of the operator of the CNC machine; the design of individual components of the CNC machine.	5					v			v								
36	Dynamics of mechanical machining	Basics of feasibility study when choosing a method for producing blanks. Basic concepts about blanks and their characteristics. Methods for producing castings. Production of forged, stamped blanks. Features the formation of cast parts. Design and production of cast billets. Features of the formation of cast parts. Quality control of castings. Ways to fix casting defects. Design and manufacture of blanks by pressure treatment. General characteristics of metal forming processes. Getting blanks in special ways.	5							v	v								
37	Designing of blank production	The purpose of studying the discipline is to acquire students' knowledge and skills in choosing a method for obtaining blanks that provides low-waste and non-waste technology, methods of designing and manufacturing blanks. Methods of obtaining blanks, design and development of technological processes for their production, schemes of work of procurement equipment. Design and production of workpieces by methods of processing materials by pressure, welding methods. Various casting methods. The current state of procurement production, new promising ways of obtaining blanks.	5					v		v									
<p style="text-align: center;"><b>Cycle of profile disciplines</b> <b>University component</b></p>																			
38	Processes of machine-building production	The purpose of the discipline is to acquire knowledge of technological methods for obtaining and processing blanks and machine parts. The discipline studies the general characteristics of metals and alloys used in mechanical engineering, the technological foundations of metallurgical production, the technology of metal processing by pressure, the technology of foundry production, the technology of welding production. The technology of production of blanks and machine parts from non-metallic materials is considered; features of welding of various metals and alloys.	5					v		v									v

39	Labour safety	The purpose of the discipline is to form knowledge of legislative acts and norms aimed at ensuring occupational safety. In the discipline, students study legal and regulatory documents on labor protection (LP), occupational hygiene and industrial sanitation. Dangerous and harmful production factors, safety measures during installation and operation of technological equipment, emergency situations and elimination of their consequences are considered. In the discipline, they study the basics of LP management, rationing, methods of assessing and forecasting LP, methods of monitoring and auditing LP.	5		v										
40	Technology of mechanical engineering	The purpose of the discipline is to form knowledge and skills in the design of technological processes for assembling machines and manufacturing machine parts. The discipline deals with the basics of mechanical engineering technology: terminology, theory of manufacturing accuracy, basing theory, calculation of allowances, processing modes, equipment selection. The basics of designing typical technological processes for manufacturing parts of classes are studied: shafts and axles, body parts, discs (gears), bushings, levers and brackets, fasteners.	5				v				v				
41	Computer-aided design systems of machine structures	The purpose of the course is to familiarize students with various automatic design systems and acquire the necessary knowledge and skills to develop various technical documentation and perform calculations using a personal computer. The task of the discipline: to give the necessary knowledge on various kinds of automatic design systems of technical and design documentation, to teach how to use the knowledge gained.	4									v			v
<b>Cycle of profile disciplines</b>															
<b>Optional component</b>															
42	Design of machining on CNC machines	The purpose of the discipline is theoretical and practical knowledge on the design of technological processes for processing workpieces on CNC machines. The discipline studies the issues of classification, the structure of CNC machines, the development of control programs. Design of processing technology on turning, grinding, milling, combined CNC machines. Features of designing technological processes in the conditions of flexible automated production, programming automation systems.	5					v				v			
43	Development of control programs	The purpose of the discipline is theoretical and practical knowledge on the development of control programs for processing on CNC machines. The issues of preparation for the development of control programs, technological documentation, calculation of elements of the trajectory of the cutting tool, recording, control and editing of the control program are considered. The basic principles of automation of the process of preparation of control programs. The study of the automated workplace of a programmer technologist, a CNC machine operator. Various software products of SolidWorks, Autodesk are considered.	5					v				v			

44	3D modeling and 3D printing	The core of the discipline is the formation of knowledge and practical skills of 3D modeling and manufacturing of parts on 3D printers. The discipline studies modern information technologies, gives knowledge of spatial, three-dimensional thinking and practical skills of working with 3D printing. Modeling with the help of modern software products SolidWorks, APM, etc. Additive manufacturing technologies of machines and their parts are being studied. The essence of additive technologies, methods of 3D printing of parts from various materials. 3D printing technologies.	4									v			v
45	Process modeling in mechanical engineering	The purpose of the discipline is to acquire knowledge and skills in the field of creating and applying mathematical models of technological processes. The structure, classification, mathematical description of the regularities of technological processes, probabilistic and statistical models of technological processes, models of selection and adoption of technological decisions, modeling of the processes of machining workpieces and machine assembly are considered. Modeling of power calculations of structures – elements of automated engineering analysis (SAE), the finite element method in engineering.	4									v			
46	Automation of technological processes in mechanical engineering	The purpose of the discipline is the formation of competencies necessary for the performance of production, technological and design activities related to the automation of machine-building production. The issues of automation of production at all stages of the product life cycle are considered. Methods and means of automating the design and production of machines: CAD, CNC machines, aggregate machines, industrial robots, creation and analysis of flexible production sites. The basic principles of creating flexible production modules based on CNC machines.	6									v			v
47	Robotization of machine-building production	The purpose of the discipline is to prepare a future specialist for design and technological activities in the conditions of production automation based on industrial robots. The basics of automation and robotization of mechanical engineering, the structure and technological capabilities of robots are studied. Classification of robots, principles of operation of gripping devices, features of robots used in machine assembly operations. The main technical parameters of robots, cyclograms of work in flexible production models.	6								v	v			
48	Organization and planning of machine-building production	The purpose of the discipline is the formation of practical skills in the design of production sites and workshops. The main stages of designing mechanical assembly shops with calculation of the main technological and production parameters, classification of mechanical shops and their composition, lifting and transport equipment of the shop and warehousing are considered. The structure of workshops, the layout of the main and auxiliary production sites. Calculations of the quantity and productivity of equipment, the capacity of production and technological equipment.	6									v	v		
49	Production design	The purpose of the discipline is to prepare the student to solve problems related to the design of workshops, the ability to find and choose progressive design and technological solutions. The	6								v			v	

		composition of the machine-building plant. Determination of the quantity and loading of equipment. Selection of the type and calculation of heating devices. Calculation of the number of workers. Determination of the areas of departments within the workshop. The layout of the main and auxiliary sections, the transport system of the workshop. Design methods. Classification and structure of the main workshops. Construction design. Automation of design of workshops of machine-building plants													
50	Design and calculation of technological equipment	Students acquire theoretical knowledge and practical skills of designing of the industrial equipment applied at processing of details of cars. Role and value of industrial equipment in mechanical engineering development. Classification of adaptations: on a special-purpose designation, a technological sign, specialisation and mechanisation degree. Basic elements of designs. Special adaptations. Designing and calculation of adaptations. Calculation and a choice of drives for adaptations.	5					v			v				
51	Progressive methods of surface treatment	The purpose of the discipline is to acquire knowledge of modern methods of surface treatment of workpieces in machine-building production. The discipline considers technologies of procurement production - laser and waterjet cutting of metal; new structural materials - processing of metal-carbon fiber packages. Electrophysical and electrochemical methods of surface treatment of workpieces. Innovative technologies are considered - additive manufacturing, manufacturing of parts on 3D printers. Finishing and strengthening methods of processing parts.	5								v				v
52	CAM(Solidworks, Inventor)	The purpose of teaching the discipline is to form the skills of the profession as a constructor using the Solid Works program. The purpose of the discipline is to form students' basic concepts of modeling(structure, classification,application of models, requirements for models), to introduce students to the theoretical foundations and ways of optimization of modeling processes in Mechanical Engineering, processing and obtaining information from various sources, to analyze the structure of the model, to know its application ,to know the methods of constructing models, to use modern applied programs in the design of machine mechanisms and nodes.Machines, drives, and systems being studied, development of physical and mathematical models of phenomena and objects	5								v	v			
53	Additive Manufacturing	The concept of additive manufacturing. The history of the emergence and development of additive technologies. 3D modeling as the basis of additive technologies. Type of print FDM. Type of print SLA. Type of printing DLP. Print Type SLS / SLM. Type of printing 3DP. Type of printing LOM. Types of printing MJM, EBM. Optimization of additive manufacturing. Preparation of 3D models for printing. Engineering calculations in additive manufacturing. Accounting for the characteristics of materials in additive manufacturing. The concept of slicers. Variations and correlation of print parameters. Defects and their classification. Post processing. Mechanical processing of	5												v

		products. Heat treatment. Chemical treatment. Optimization of the print taking into account post-processing.														
54	Theory and practice of project management	The purpose of mastering the discipline is to expand and deepen knowledge about modern project management technology and study the principles of using project management in practical tasks. Mastering the discipline involves an introduction to the problems of project management and the study of project management methodology, familiarization with the tools and methods of project management at all stages of the project life cycle, starting with initialization project, planning its work, organizing their use and control, and ending with completion.	5					v			v		v			
55	Capstone Project	The purpose of the discipline is the formation of a complex of theoretical knowledge and practical skills in management, maintenance and support of technical preparation of production. Practical possibilities are considered and professional skills of students to work in a team are formed. Students solve real engineering and technical problems of production, formation and implementation of the life cycle of machine-building products based on the collection of information, critical assessment of the feasibility of the project, in-depth analysis and execution of the project report.	5									v	v			

## 5. Curriculum of the educational program



KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K. SATPAYEV



APPROVED

Chairman of the Management Board-

Rect. of KNTU named after K. Satpayev

M.M. Begentaev

12.12.2023

### CURRICULUM

of Educational Program on enrollment for 2023-2024 academic year

Educational program 6B07105- "Industrial engineering"

Group of Educational programs B064 - "Mechanics and metalworking"

Form of study: full-time				Duration of study: 4 years				Academic degree: Bachelor of Engineering and Technology							
Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	classroom volume of lek/lab/p	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG 108	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG 104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Module of physical training															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Module of information technology															
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM 137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						
HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM 120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E				3				
HUM 134	Socio-political knowledge module (culturology, psychology)		5	150	2/0/1	150	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM 136	Fundamentals of Anti-corruption Culture and Law	GED, CCH	5	150	2/0/1	150	E				5				
MNG 489	Fundamentals of Economics and Entrepreneurship														
MSM500	Fundamentals of scientific research methods														
CHE 656	Ecology and life safety														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY 111	Physics I	BD, UC	5	150	1/1/1	105	E	5							
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
PHY 112	Физика II	БД, БК	5	150	1/1/1	105	E		5						
M-7. General technical training module															
MSM132	Introduction to engineering design	BD, UC	5	150	1/2/0	105	E	5							
CHE815	General chemistry	BD, UC	4	120	1/1/1	75	E	4							
MSM102	Basics of interchangeability	BD, UC	5	150	1/1/1	105	E			5					
GEN408	Resistance of materials	BD, UC	5	150	1/1/1	120	E				5				
MSM106	Probabilistic models in industrial engineering	BD, UC	5	150	1/1/1	105	E					5			
GEN412	Theoretical mechanics	BD, UC	5	150	2/0/1	105	E			5					
MSM133	Structural materials and heat treatment	BD, UC	5	150	1/2/0	105	E			5					
MSM410	Theory of mechanisms and machine parts	BD, UC	5	150	1/1/1	105	E					5			
ELC101	Electrical engineering and electronics	BD, UC	5	150	1/1/1	105	E			5					
MCH531	Qualimetry in mechanical engineering	BD, UC	5	150	2/0/1	105	E					5			
MSM401	Metalworking machines	BD, UC	5	150	1/0/2	105	E					5			
MSM419	Economics of a machine-building enterprise	BD, UC	5	150	1/0/2	105	E							5	
MSM435	Cutting theory	BD, UC	4	120	1/1/1	75	E				4				
MSM427	Automated design in mechanical engineering	BD, UC	6	180	1/2/1	120	E							6	
MSM149	Hydraulics and hydropneumatic drive	BD, CCH	5	150	1/0/2	105	E					5			
3201	Elective	BD, CCH	5	150	1/0/2	105	E						5		
3202	Elective	BD, CCH	5	150	1/0/2	105	E						5		

3203	Elective	BD, CCH	5	150	2/1/0	105	E							5	
AAP196	Training Practice	BD, UC	2							2					
<b>CYCLE OF PROFILE DISCIPLINES (PD)</b>															
<b>M-8. Module of production and technological preparation</b>															
HYD482	Labor protection and industrial safety (by industry)	BD, UC	5	150	2/0/1	105	E							5	
MSM176	Technology of mechanical engineering	PD, UC	5	150	1/0/2	105	E							5	
MSM129	Technological processes of machine-building production	PD, UC	5	150	2/1/0	105	E						5		
MSM411	Automated design systems for machine structures	PD, UC	4	120	1/2/0	75	E								4
4301	Elective	PD, CCH	5	150	1/2/0	105	E								5
3302	Elective	PD, CCH	4	120	1/2/0	75	E						4		
4303	Elective	PD, CCH	6	180	2/1/1	120	E							6	
4304	Elective	PD, CCH	6	180	2/0/2	120	E							6	
3305	Elective	PD, CCH	5	150	1/0/2	105	E						5		
4306	Elective	PD, CCH	5	150	2/1/0	105	E								5
AAP197	Industrial practice I	PD, UC	4								4				
AAP198	Industrial practice II	PD, UC	6										6		
<b>M-9. Management training module</b>															
4307	Elective R&D	PD, CCH	5	150	2/0/1	105	E								5
<b>M-10. Module of final attestation</b>															
ECA108	Final examination	FE	8												8
<b>M-11. Module of additional types of training</b>															
AAP500	Military affairs	ATT	0												
<b>Total based on UNIVERSITY:</b>								31	29	32	28	30	30	33	27
								60		60		60		60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
		required component (RC)	university component (UC)	component of choice (CCH)	Total
GED	Cycle of general education disciplines	51		5	56
BD	Cycle of basic disciplines		101	15	116
PD	Cycle of profile disciplines		24	36	60
	<b>Total for theoretical training:</b>	<b>51</b>	<b>125</b>	<b>56</b>	<b>232</b>
FA	Final attestation	8			8
	<b>TOTAL:</b>	<b>59</b>	<b>125</b>	<b>56</b>	<b>240</b>

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 5 or "24" 11 2024.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 3 or "17" 11 2024.

Decision of the Academic Council of the Institute E&ME. Protocol № 11 or "11" 10 2024.

Vice-Rector for Academic Affairs

E&ME Institute Director

ME Department Head

Specialty Council representative from employers

B. A. Zhautikov

K. Yelemessov

E. Nugman

I. Dyusebaev





APPROVED  
Director of the Institute E&ME  
K. Nemessov  
2023.

MAJOR ELECTIVE DISCIPLINES educational program for the 2023-2024 academic year admission  
Educational program 6B07105 - "Industrial engineering"  
Group of Educational programs B 064 - "Mechanics and metalworking"

Full-time study

Study duration : 4 years

Academic degree: Bachelor of Engineering and Technology

Full-time study			Study duration : 4 years		Academic degree: Bachelor in Engineering and Technology					SIWT
Year of study	Code of elective	Code of discipline	Name of discipline	Semestr	Cycle	Credits	Total hours	lec/lab/pr	(including SIWT) in	
General technical training module										
3	3201	MSM150	Calculation and design of cutting tools	6	БД KB	5	150	1/0/2	105	
		MSM190	Production of cutting tools					1/0/2		
	3202	MSM422	Drives of CNC machines	6	БД KB	5	150	2/1/0	105	
		MSM463	Operation of machines with program control					2/1/0		
	3203	ISO121	Dynamics of mechanical processing of workpieces	6	БД KB	5	150	2/0/1	105	
		ISO170	Design of procurement production					2/0/1		
	3302	MSM425	3D modeling and 3D printing	6	ПД KB	4	120	1/2/0	75	
		MSM424	Process modeling in mechanical engineering					1/2/0		
	3305	MSM159	Design and calculation of technological equipment	5	ПД KB	5	150	1/2/0	105	
		MSM431	Progressive methods of surface treatment					1/2/0		
Module of production and technological preparation										
4	4301	MSM426	Design of machining on CNC machines	8	ПД KB	5	150	1/0/2	105	
		MSM428	Development of control programs					1/2/0		
	4303	MSM429	Automation of technological processes in mechanical engineering	7	ПД KB	6	180	2/1/1	120	
		MSM430	Robotization of machine-building production					2/0/2		
	4304	MSM457	Organization and planning of machine-building production	7	ПД KB	6	180	1/2/0	120	
		MSM421	Production design					2/0/1		
	4306	MCH149	CAM(Solidworks, Inventor)	8	ПД KB	5	150	1/2/0	105	
		MSM119	Additive manufacturing					2/0/1		
	Management training module									
4307	MNG481	Theory and practice of project management		8	ПД KB	5	150	2/0/1	105	
	MSM418	Capstone Project						1/2/0		

Credits numbers of elective disciplines over the entire period of study	
Cycle of disciplines	Credits
Cycle of basic disciplines (B)	15
Cycle of special disciplines (S)	36
Overall:	51

Decision of the Academic Council of the Institute\_E&ME\_. Protocol № 11 от 10.10.2024г.

ME Department Head

E. Nugman

Specialty Council representative from employers

I. Dyusebaev