Institute of Energy and Mechanical Engineering named after A.Burkitbayev
Department of "Technological machines and equipment"

EDUCATIONAL PROGRAM
6B06108 "Digital monitoring of machines and equipment"

Code and classification of the field of education	6B06 «Information and communication technologies»
Code and classification of training directions	6B061 «Information and communication technologies»
Group of educational programs	B057 «Information Technology»
Level based on NQF	6
Level based on IQF	6
Study period	4 years
Amount of credits	240

Almaty 2024

Educational program 6B06108 "Digital monitoring of machines and equipment" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council
Minutes # 12 dated «22» April 2024

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council
Minutes # 6 dated «19» April 2024

Educational program 6B06108 "Digital monitoring of machines and equipment" was developed by Academic committee based on direction 6B061 «Information and communication technologies»

Full name	Academic degree / academic title	Position	Place of work	Signature
Chairperson of Academic Committee:				
Yelemessov Kassym	Candidate of Technical Sciences, Professor	Director of the Institute of Energy and Mechanical Engineering	KazNRTU named after K.I. Satbayev	
Teaching staff:				
Kaliev Bakytzhan	Candidate of Technical Sciences, Associate Professor	Head of the department "Technological machines and equipment"	KazNRTU named after K.I. Satbayev	
Bortebayev Saiyn	Candidate of Technical Sciences, Associate Professor	Associate Professor	KazNRTU named after K.I. Satbayev	
Employers:				
Stvaev Nurzhan		Chairman of the Management Board of Alageum Group	Alageum Group LLP	
Students				
Moshanov Kanat		2nd year doctoral student	KazNRTU named after K.I. Satbayev	

Table of contents

List of abbreviations and designations

NCJS KazNRTU named after K. I. Satbayev– NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATBAYEV»;
SOSE – State obligatory standard of education of the Republic of Kazakhstan;
EP – educational program;
IWS – independent work of a student (student, undergraduate, doctoral student);
IWST – independent work of a student with a teacher (independent work of a student (undergraduate, doctoral student) with a teacher);
WC – working curriculum;
UC – university component;
CC – component of choice;
NQF – National Qualifications Framework; S
QF – Sectoral Qualifications Framework;
LO – learning outcomes;
KC – key competencies

1. Description of educational program

The field of professional activity of the bachelor of the educational program 6B06108 "Digital monitoring of machines and equipment" includes:

- sections of science and technology that contain a set of tools, techniques, methods and methods of human activity aimed at creating competitive mechanical engineering products and based on the use of modern methods and tools for design, calculation, mathematical, physical and computer modeling;
- organization and execution of works on creation, installation, commissioning, maintenance, operation, diagnostics and repair of technological machines and equipment, development of technological processes for the production of parts and assemblies;
- preparing graduates for production and technological activities related to the process of using software products aimed at meeting expectations and requirements for determining the reliability of machines and equipment, for organizational and management activities related to the maintenance of software products of the digital diagnostics class and technical condition management through information systems, data analysis.

The objects of professional activity of the bachelor are:

- technological machines and equipment of various complexes;
- technological equipment and means of mechanization and automation of technological processes;
- production technological processes, their development and development of new technologies;
- installation and repair of technological machines and equipment;
- means of information, metrological, diagnostic and management support of technological systems to achieve the quality of manufactured products;
- means of testing and quality control of technological machines and equipment;
- technological processes of assembling metal structures;
- methods of data analysis to determine the technical condition and forecast the reliability of machines and equipment;
- normative and technical documentation, systems of standardization and certification, methods and means of testing and quality control of products.

Types of professional activity are:

- experimental and research activities;
- calculation and design and analytical work;
- production and technological infrastructure;
- service and maintenance;
- installation and adjustment;
- organizational and managerial information.

The bachelor's professional activity subjects are:

- technological machines and equipment; power equipment;
- machine drive systems;
- traffic management systems;
- operator's life support systems;
- structural and operational materials;
- equipment for manufacturing, testing and recycling of technological machines;
- equipment for maintenance and repair of technological machines;
- control and measuring devices for the manufacture and operation of machines;
- modern tools for extracting and processing large amounts of data in the field of technical condition of machines and equipment;
- equipment for automating machine work processes;
- machine design equipment

2. Purpose and objectives of educational program

The purpose of the OP: Training of highly qualified and competitive specialists competent in the field of digital monitoring and predictive maintenance systems for process equipment in the mining, metallurgical and oil and gas industries. Development of personal qualities in students, formation of general cultural and professional competencies.

OP tasks:

- studying the cycle of general education disciplines to ensure social and humanitarian education based

on the laws of socio-economic development of society, history, modern information technologies, the state language, foreign and Russian languages;

- study of the cycle of basic disciplines that provide knowledge of natural, general technical and economic disciplines as the basis of professional education;

- the cycle of basic disciplines is aimed at studying the main theoretical aspects of the reliability of technological machines, theoretical and practical methods, areas of human activity based on the creation of competitive technological machines and modern digital design methods and tools, predictive maintenance systems, mathematical, physical and computer modeling of technological processes;

- study of disciplines that form the skills of planning and organizing research work, designing reliable technologies and devices;

- familiarization with technologies and equipment of enterprises at different stages of practical training;

- mastering the skills and abilities of laboratory research, technological calculations, selection and design of equipment using modern computer technologies and programs

3. Requirements for evaluating the learning outcomes of an educational program

The scope of the bachelor's degree program is 240 credits, regardless of the form of study, the educational technologies used, the implementation of the bachelor's degree program using a network form, the implementation of the bachelor's degree program according to an individual curriculum, including accelerated learning.

Descriptors of the level and scope of knowledge, skills, and competencies

A – knowledge and understanding:

A1 - Ability to logically represent the acquired knowledge and understanding of systemic relationships within disciplines, as well as interdisciplinary relationships in modern science.

A2-Knowledge of approaches and methods of critical analysis, the ability to use them practically in relation to various forms and processes of production.

A3-perform basic calculations of the main parameters of technological machines, justify their choice depending on the production levels.

B-Applying knowledge and understanding

B1-Independent development and promotion of various options for solving professional problems using theoretical and practical knowledge

B2-put forward hypotheses for acquiring new knowledge necessary for daily professional activities and continuing education

B3 - on the basis of basic knowledge, be able to navigate adequately in various situations

C – forming judgments

C1 - on the basis of knowledge about economic patterns formation of hypotheses, forecasting and planning of economic activity of the enterprise.

C2 - be able to work in a team, correctly defend your point of view, and offer new solutions.

CC3 - skills of daily acquisition of new knowledge necessary for professional activity.

D – personal abilities

D1 - compliance with the standard of business ethics, possession of ethical and moral standards of behavior.

D2-ability to find a compromise, correlate your opinion with the opinion of the team

D3-know social and ethical values based on public opinion, traditions, customs, and social norms and be able to navigate them in their professional activities.

Completion competencies

General Cultural competencies (CA)	
OK 1	Ability to communicate in oral and written forms in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction
OK 2	Understanding and practical use of healthy lifestyle standards, including prevention issues, the ability to use physical culture to optimize performance
OK 3	Ability to analyze the main stages and patterns of historical development of society for the formation of civil
OK 4	Ability to use the basics of philosophical knowledge to form a worldview position

OK 5	Ability to critically use the methods of modern science in practical activities
OK 6	Awareness of the need and acquisition of the ability to independently learn and improve their skills throughout their working life
OK 7	Knowledge and understanding of professional ethical standards, proficiency in professional communication techniques
OK 8	Ability to work in a team tolerant perception of social, ethnic, confessional and cultural differences
OK 9	Ability to use the basics of economic knowledge in various fields of activity
General Professional competencies (GIC)	
OPK-1	Ability to acquire new knowledge with a high degree of independence using modern educational and information technologies
OPK-2	Possession of computer skills sufficient for professional activity with basic programming
OPK-3	Knowledge of the main methods, methods and means of obtaining, storing, processing information, the ability to use modern technical means and methods for solving communication problems. information technologies using traditional information carriers, distributed knowledge bases, as well as information in global computer networks
OPK-4	Understanding of the essence and significance of information in the development of modern society, the ability to receive and process information from various sources, the willingness to interpret, structure and formalize information in a form accessible to others
OPK-5	Ability to solve standard problems professional activity based on information and bibliographic culture with the use of information and communication technologies and taking into account the basic requirements of information security
Professional competencies (PC)	
PC 1	Ability to systematically study scientific and technical information, domestic and foreign experience in the relevant training profile
PC 2	Ability to take part in the preparation of scientific reports on the completed task and implement the results of research and development in the field of technological machines and equipment
PC 3	Ability to participate in work on innovative projects using basic research methods
PC 4	Ability to model technical objects and technological processes using standard packages and computer-aided design tools, willingness to conduct experiments using specified methods with processing and analysis
PC 5	Possession of approaches and methods of critical analysis, the ability to use in practice with regard to various forms and processes of technological processes of
SC 6	the Ability to learn a new technique, technological and technical documentation make adjustments with respect to operating conditions
7 PC	the Ability to participate in work on the calculation and design of details and units of technological machines in accordance with the technical tasks and use the standard tools of design automation
PC 8	Ability to conduct patent research to ensure the novelty of the new design solutions and their patentability and the identification of indicators of technical level of engineered products
PC 9	Ability to explore and optimize the modes of operation of technological machines during their operation
PC 10	the Ability to pre-technical-economic justification of design solutions
PC 11	the Ability to design technical equipment jobs with accommodation of technological equipment, the ability to learn the input equipment
PC 12	the Ability to participate in work on fine-tuning and development of technological processes during the preparation of the production of a new product, to check the quality of the installation and commissioning testing and commissioning of new types of products, components and parts manufactured products
PC 13	the Ability to check the technical condition and residual life of process equipment, arrange a routine inspection and maintenance of technological machines and equipment
PC 14	the Ability to carry out activities for the prevention of occupational accidents and occupational diseases, to monitor compliance with environmental safety of the operations

PC 15	the Ability to choose the main and auxiliary materials, methods of implementation of technological processes, to apply advanced methods of operation of technological equipment
PC 16	to Wield the main methods of calculation of parameters of technological equipment, the method of their selection on the directories and catalogs.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	6B06 «Information and communication technologies»
2	Code and classification of training directions	6B061 « Information and communication technologies»
3	Educational program group	B057 « Information Technology»
4	Educational program name	6B06108 “Digital monitoring of machines and equipment”
5	Short description of educational program	Educational program 6B06108 “Digital monitoring of machines and equipment” is aimed at preparing graduates for production and technological activities related to the process of using software products aimed at meeting the expectations and requirements for determining the reliability of machines and equipment, for organizational and management activities related to maintenance software products of the digital diagnostics class and technical condition management through information systems and data analysis.
6	Purpose of EP	Training of highly qualified and competitive specialists competent in the field of digital monitoring and predictive maintenance systems for process equipment in the mining, metallurgical and oil and gas industries. Development of personal qualities in students, formation of general cultural and professional competencies
7	Type of EP	Innovative
8	The level based on NQF	6
9	The level based on IQF	6
10	Distinctive features of EP	no
11	List of competencies of educational program	KK1. Communicativeness KK2 Basic literacy in natural science disciplines KK3. General engineering competencies KK4.Professional competencies KK5. Engineering-computer competencies KK6 Engineering-work competencies KK7. Socio-economic competences KK8. Special-professional competences
12	Learning outcomes of educational program	EO1: Apply the basic patterns and forms of regulation of social behavior, human and civil rights and freedoms when developing social projects, demonstrating respect for people, tolerance for another culture, and readiness to maintain partnerships. EO2: Demonstrate knowledge of sections of mathematics, physics and other natural sciences and apply them to solve engineering problems in the field of service maintenance of machines and equipment. EO3: Apply knowledge of economic laws, occupational safety and environmental standards, rules of moral development, and a culture of academic integrity at a

		professional level. EO4: Knows the basic methods, methods and means of obtaining, storing, processing information, knows how to use modern technical means and information technologies to solve communication problems using traditional information carriers, distributed knowledge bases, as well as information in global computer networks. EO5: Apply innovative methods of installation and assembly of process equipment components. Assess the technical condition and remaining service life of equipment, organize preventive inspections and routine repairs of equipment using diagnostic instruments, and process measurement results. EO6: Demonstrates an understanding of the fundamentals of programming, software creation, algorithm and data structure development, and object-oriented programming. EO7: Ready to carry out work on standardization, technical preparation for certification of technical means and equipment, organize metrological support of technological processes using standard quality control methods. EO8: Designs and creates software, web applications, mobile applications using the UML language, modern development tools, libraries, templates and Frameworks EO9: Possess programming skills in high-level languages, microcontroller programming tools and languages, software for modeling and researching process control systems. EO10: Possess methods of information processing and synthesis of automation systems, methods of designing and programming data management systems. Use the functionality of Scada systems in practice. EO11: Demonstrate theoretical knowledge and practical skills in the field of operational reliability and technical diagnostics of machines and equipment. Use the technical capabilities of microprocessor technology, means of receiving and transmitting information and software products to solve automation problems. EO12: Solve engineering problems using the basic laws of mechanics, electrical engineering, hydraulics, thermodynamics and heat and mass transfer. EO13: Use the principles of formulation and algorithms for solving research problems in order to systematically develop knowledge about project management. Assess technical and economic performance indicators of industrial enterprises. EO14 Apply theoretical and experimental methods for calculating machine parameters and application software to carry out design and verification calculations. Use the laws and methods of theoretical mechanics. Apply in practice methods for calculating parts and assessing the strength of materials.

13	Education form	full
14	Period of training	4 years
15	Amount of credits	240
16	Languages of instruction	Russian
17	Academic degree awarded	Bachelor of Engineering and Technology
18	Developer(s) and authors:	Academic Affairs Committee

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

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)													
				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
Cycle of general education disciplines Required component																	
1	Foreign language	English is a discipline of the general education cycle. After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. When moving from one level to another, the prerequisites and post-prerequisites of the disciplines	5	**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	5	**v**													
3	Information and communication technology	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	5	**v**													

		of base and different categories of applications																
4	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														
5	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														
6	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	3	v		v												

		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 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															
7	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**		**v**											
Cycle of general education disciplines Component of choice																	
8	Fundamentals of anti-corruption culture and law	Purpose: to increase the 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. Contents: improvement of socio-economic relations of the Kazakh	5	**v**		**v**											

		society, psychological features of corrupt behavior, formation of an anti-corruption culture, legal responsibility for acts of corruption in various fields															
9	Fundamentals of economics and entrepreneurship	Purpose: To develop basic knowledge of economic processes and skills in entrepreneurial activities. Content: The course aims to develop skills in analyzing economic concepts such as supply and demand, and market equilibrium. It includes the basics of creating and managing a business, developing business plans, risk assessment, and strategic decision-making	5	v		v											
10	Fundamentals of scientific research methods	Purpose: to form a systematic understanding of the methodology of scientific cognition among students; to develop scientific thinking skills; to form experience in organizing and conducting scientific research; to develop a competence-based approach to the use of methods and rules for conducting research in the field of mechanical engineering, related processes and their technologies. Contents: stages of scientific research, terms and concepts, methods of conducting an experiment, mathematical methods of processing research results. Concepts of engineering, laboratory and industrial experiment, bench research	5	v			v										
11	Ecology and life safety	Purpose: formation of ecological knowledge and consciousness, obtaining theoretical and practical knowledge on modern methods of rational use of natural resources and	5			v											

		environmental protection. Contents: the study of the tasks of ecology as a science, the laws of the functioning of natural systems and aspects of environmental safety in working conditions, environmental monitoring and management in the field of its safety, ways to solve environmental problems; life safety in the technosphere, emergencies of a natural and man-made nature.																
12	Basics of Financial Literacy	Purpose: formation of financial literacy of students on the basis of building a direct link between the acquired knowledge and their practical application. Contents: using in practice all kinds of tools in the field of financial management, saving and increasing savings, competent budget planning, obtaining practical skills in calculating, paying taxes and correctly filling out tax reports, analyzing financial information, orienting in financial products to choose adequate investment strategies	5	v		v												
Cycle of basic disciplines University component																		
13	Mathematics I	Purpose: to introduce students to the fundamental concepts of linear algebra, analytical geometry and mathematical analysis. To form the ability to solve typical and applied problems of the discipline. Contents_ Elements of linear algebra, vector algebra and analytical geometry. Introduction to the analysis. Differential calculus of a function of	5		v													

		one variable. The study of functions using derivatives. Functions of several variables. Partial derivatives. The extremum of a function of two variables															
14	Physics	Purpose:To form ideas about the modern physical picture of the world and scientific worldview, the ability to use knowledge of fundamental laws, theories of classical and modern physics. Contents_ physical fundamentals of mechanics, fundamentals of molecular physics and thermodynamics, electricity and magnetism, vibrations and waves, optics and fundamentals of quantum physics.	5		v												
15	Mathematics II	Purpose: To teach students integration methods. To teach you how to choose the right method for finding the primitive. To teach how to apply a certain integral to solve practical problems. Contents_ integral calculus of the function of one and two variables, series theory. Indefinite integrals, methods of their calculation. Certain integrals and applications of certain integrals. Improper integrals. Theory of numerical and functional series, Taylor and Maclaurin series, application of series to approximate calculations	5		v												
16	Engineering and computer graphics	Purpose: To develop students' knowledge of drawing construction and skills in developing graphical and textual design documentation in accordance with standards. Content: Students will study ESKD	5							v			v				

		standards, graphic primitives, geometric constructions, methods and properties of orthogonal projection, Monge's projection, axonometric projections, metric tasks, types and features of connections, creating part sketches and assembly drawings, detailing, and creating complex 3D solid objects in AutoCAD															
17	Fundamentals of the specialty	The purpose of studying the discipline is to form students' understanding of the basics of mining and metallurgical and oil and gas production, extraction, processing and transportation of minerals, machinery and equipment used in the mining and metallurgical and oil and gas industry. During the study, students will be introduced to the technological processes and the main equipment of the mining and metallurgical and oil and gas industries, the main methods of maintenance, the principles of predictive analytics of equipment	4						v					v			
18	Thermodynamics, heat transfer and thermal engineering installations	The main issues and methods for obtaining, converting, transferring and using thermal energy, the fundamental principles of operation and schemes of heat engineering installations, to teach how to evaluate and compare the energy and economic indicators of heat power plants, to effectively use the means of production in technological processes. The study of the physical foundations, devices, principle of operation and technical characteristics of the main and auxiliary heat and power equipment and systems	5		v										v		

19	Theoretical and applied Mechanics	To involve students in the development and solution of tasks that help bridge the gap between scientific theory and engineering practice. Contents Theoretical mechanics, theory of mechanisms and machines. Theoretical mechanics deals with the general laws of mechanical movements of material bodies and the mechanical interactions between them. In the theory of mechanisms and machines, general methods of research, construction, and kinematics of mechanisms and machines are studied	5												v		v
20	Basics of hydraulics and hydraulic drives of technological machines	Application of knowledge in the field of technical fluid mechanics (hydraulics), for the calculation of hydraulic pressure systems, hydraulic machines, hydraulic and pneumatic actuators, widely used in the oil industry. Full hydraulic calculation of various hydraulic systems, hydraulic and pneumatic equipment drives. Getting the basics of knowledge in the field of hydraulics - theoretical fluid mechanics in the field of hydraulic and pneumatic actuators	5												v		v
21	Strength of materials	Purpose: To teach students integration methods. To teach you how to choose the right method for finding the primitive.Stretching and compression. Pressure in sections and deformations of a direct core. Mechanical properties of materials at a stretching and com-pression. Calculation on durability and rigidity at a stretching-compression. Geometrical charac-teristics of flat sections. Shift and torsion. Cal-	6												v		v

		culation on durability and rigidity at torsion. A bend. Normal and tangents of a pressure at a bend. Calculation on durability at a bend. The theory of the intense and deformed conditions. A hypothesis of a limiting condition. Complex resistance. Stability of balance of deformable systems. Dynamic loading															
22	Interchangeability, standardization and technical measurements	Studying the basic laws and concepts of standardization and interchangeability, methods and means of controlling deviations of the shape, roughness and waviness of the surfaces of parts, the role of standardization in improving the quality of machines Interchangeability binds in a single whole design, production technology and control products. Standardization and unification of parts and elements contribute to the acceleration and cheapening of the design and manufacture of products	5							v							
23	Construction materials processing machinery and equipment	The solution of the most important technical problems associated with the creation and development of the most economical materials, increasing the accuracy, reliability and performance of mechanisms and devices depends largely on the development of materials science and technology for producing and processing materials, concretization of knowledge about the relationship between the composition, structure and properties of materials used for management of the structure and properties of structural materials	5					v									v

24	Intellectual data analys	The discipline "Intelligent Data Analysis" helps to form ideas about the types of problems arising in the field of Data Mining and methods of their solution that will help students to identify, formalize and successfully solve practical problems of data analysis, develop theoretical knowledge, practical skills on the application of modern methods of data mining in various spheres of human activity	5							v			v				
25	Bases of designing and details of cars	Purpose: to acquire knowledge of calculations and design of machine parts and assemblies, taking into account the criteria of strength, reliability and stability.Contents_ general principles of design and construction, construction of models and calculation algorithms for standard machine parts taking into account performance criteria, fundamentals of theory and methodology for calculating standard machine parts, computer technologies for designing assemblies and machine parts. Basic requirements for machine parts and assemblies	5										v				v
26	Electrotechnics and microelectronics	Electrical and magnetic circuits. Basic definitions, parameters and methods of calculation of DC electrical circuits. Analysis and calculation of linear AC circuits. Analysis and calculation of electrical circuits with nonlinear elements. Analysis and calculation of magnetic circuits. Electromagnetic devices and electrical machines. Fundamentals of electronics and	5												v		

		electrical measurements. The element base of modern electronic devices. Semiconductor elements. Electronic equipment power supply devices. Amplifiers of electrical signals. Electronic amplifiers and generators. Elements of pulse technology. Pulse and auto-generator devices. Fundamentals of digital and microelectronics. Microprocessor tools															
27	Fundamentals of Artificial Intelligence	Purpose: to familiarize students with the basic concepts, methods and technologies in the field of artificial intelligence: machine learning, computer vision, natural language processing, etc. Contents: general definition of artificial intelligence, intelligent agents, information retrieval and state space exploration, logical agents, architecture of artificial intelligence systems, expert systems, observational learning, statistical learning methods, probabilistic processing of linguistic information, semantic models, natural language processing systems	5						**v**								
28	Algorithmization and programming basics	The course explores the fundamental concepts of programming: operator, variable, procedure, function, data type. The main structures of algorithms are considered, such as linear, branched, cyclic. The course examines the basic forms of data representation: strings, structures, arrays, lists. Separate topics are devoted to the creation of widely used sorting algorithms, searching for the minimum and maximum values in an array,	4						**v**								

		string processing, iterative and recursive algorithms, building flowcharts of algorithms and developing programs based on them															
29	The dynamics and durability of technological machines	Students study the criteria for calculating technological machines and structures for strength. To learn the formulation and analysis of calculation results, the ability to determine operating stresses, to master a number of accurate and approximate methods for determining the characteristics of operational loads, considering the bearing capacity of parts and structures as a random variable, to be able to calculate dynamic loads in drives and other parts of technological machines	4												v		v
30	Technology of manufacturing technological machines	Mastering the discipline is based on the study of the methodology for calculating the economic efficiency of the method of obtaining blanks, normalizing operations; application of operations design methodology; methods for calculating the minimum allowances, cutting conditions, the required amount of technological equipment, methods for ensuring the specified accuracy of manufacturing parts, technological processes for the production of standard parts and assemblies of machines and equipment	5					v								v	
31	Technical diagnostics of technological machines	The course is aimed at studying the theoretical foundations of technical diagnostics and obtaining practical skills in the use of non-destructive testing methods to assess the technical condition of technological machines and equipment; to familiarize students	4											v		v	

		with the basics of the theory of technical diagnostics, types of technical condition, controlled parameters, technical diagnostics systems; to study the physical foundations of non-destructive testing methods for detecting and diagnosing malfunctions of technological equipment; familiarization with equipment for non-destructive testing, test methods, acquisition of practical skills															
32	Basics of cybersecurity	Objective: to study the key aspects of protecting information systems and networks from various types of threats, including attacks on software, malware, phishing, insider threats and others. Contents: Introduction. Principles of cybersecurity. Data encryption. Access control. Security audit. Developing security policies and responding to incidents. Legal and ethical aspects in the field of cybersecurity regulating the use of information technologies	5							**v**	**v**						
33	Operating systems	The purpose of studying the discipline is to acquire the primary skills necessary for studying system programming and operating system administration, including the skills of configuring and analyzing operating systems. Special attention will be paid to the three main subsystems of operating systems: process management (processes, threads, CPU scheduling, synchronization and deadlocks), memory management (segmentation, pagination, paging), file	5								**v**		**v**				

		systems and operating system support for															
34	Object oriented programming	The course covers topics such as: the paradigm of object-oriented programming; classes and objects; principles of creating scalable software using a high-level method for designing business environment concepts in a programming language; programming languages C++, Java and C#; principles of abstractions, encapsulation, inheritance, polymorphism; software design patterns; practical skills in creating software products	5						**v**		**v**						
Cycle of basic disciplines Component of choice																	
35	Oil and gas production technologies	Students study the basics of well construction technology, oil and gas production. Acquisition of skills for competent choice of the method of opening productive objects, designing the design of wells, choosing methods for influencing the productive formation, calculating the modes of operation of the "well-formation" system. The study of techniques and technologies used in the oil and gas industry, methods of construction and operation of wells, collection and preparation for transportation of oil and gas in the fields, underground gas storage. Acquisition of skills in calculating wells, the need for materials for the preparation of drilling fluid, drilling mode parameters, physical properties of oil and gas, gas	5						**v**								

		well flow rates															
36	Mining technologies	The aim of the course is to contribute to the development of scientific and technical thinking and the acquisition by students of the necessary knowledge and practical skills in the field of technology of stripping and mining operations in open development Objectives of the course: study of the level of mining and the need for them in the national economy, information about mineral deposits and the condition of their occurrence; familiarization with the methods of mining and prospects for their development; the essence of underground mining and the main mine workings; the main production processes and technical and economic indicators of mines; methods of opening and systems development of mineral deposits; basic technological processes	5					**v**									
37	Technologies of metallurgical production	The purpose of teaching the discipline is to give students in-depth knowledge about the basic theoretical and technological provisions of the production of ferrous and non-ferrous metals; the ability to solve complex technological problems; to have the skills of independent work on the organization and management of experimental studies of technological processes at existing metallurgical units and promising experimental and pilot industrial complexes. The objectives of studying the	5					**v**									

		discipline are to master the general laws of processes occurring in ferrous and non-ferrous metallurgy units; to master methods for calculating the charge, material and thermal balances of the process, intensification of technological processes and control of melting; to get acquainted with promising technologies in metallurgy, including hydrometallurgy															
38	Legal regulation of intellectual property	Purpose: the goal is to form a holistic understanding of the system of legal regulation of intellectual property, including basic principles, mechanisms for protecting intellectual property rights and features of their implementation. Content: The discipline covers the basics of IP law, including copyright, patents, trademarks, and industrial designs. Students learn how to protect and manage intellectual property rights, and consider legal disputes and methods for resolving them	5	**v**			**v**										
39	Fundamentals of sustainable development and ESG projects in Kazakhstan	Purpose: the goal is for students to master the theoretical foundations and practical skills in the field of sustainable development and ESG, as well as to develop an understanding of the role of these aspects in the modern economic and social development of Kazakhstan. Contents: introduces the principles of sustainable development and the implementation of ESG practices in Kazakhstan, includes the study of national and international standards, analysis of successful ESG projects and	5	**v**		**v**											

		strategies for their implementation in enterprises and organizations															
Cycle of profile disciplines University component																	
40	Installation and repair of technological machines	The acquisition by students of theoretical knowledge and practical skills on the basics of designing technological processes for the repair and restoration of worn parts, assembly units, machines and equipment; Determination of optimal modes of performance of production processes; quality control of repair of machines and equipment. Organization and engineering support of high-quality installation of equipment, methods of mechanization and automation of technological processes and rules for safe work	5					**v**						**v**			
41	Instrumentation and automation of technological machines	Formation of the future specialist knowledge of the design of devices, their purpose and principles of operation. As well as special training of engineering and technical personnel with scientific and practical knowledge in the field of operation, as it solves relevant engineering and scientific problems in the field of quality, performance properties and rational use of fuels, oils, lubricants and technical fluids	5					**v**						**v**			
42	Fundamentals of reliability of technological machines	The course provides students with knowledge and skills that provide a creative approach to solving problems of reliability and durability of technological machines and equipment necessary to increase the level of	5					**v**						**v**			**v**

		automation, reduce huge repair costs from machine downtime, and ensure safety during equipment operation. When studying disciplines, students master the issues of ensuring the reliability and durability of technological equipment; principles of rational use of technical parameters of technological machines															
43	Geomonitoring of the technical condition of technological machines	Formation of future specialist knowledge on the design of diagnostic devices, their purpose and principles of operation directly at the place of production work, the use of devices for their intended purpose, assessment of the state of equipment, as well as special training of engineering and technical personnel with scientific and practical knowledge in the field of operation, t .To. it solves topical engineering, technical and scientific problems in the field of quality, operational properties and rational use of these devices	5				**v**							**v**			
44	Application design patterns	The course is aimed at studying the main design patterns and the canonical library of typical design patterns. Discusses specific problems and common design errors that developers face when writing code. The course covers information about how to decompose an application into layers, approaches to organizing business logic, the use and main aspects of the implementation of each solution under consideration, supported by examples of UML diagrams and source code.	5						**v**		**v**						

45	Database Systems	Different types of data storage during creation of ecologically safe chemical and biochemical productions are considered, algorithms of the organization of effective access to data, differentiations of access rights to data are considered. A practical and theoretical part of a course puts the main emphasis on relational model of data and the SQL language for the solution of professional tasks and the complete description of schemes and processes of biotechnology and chemical engineering in terms of technological safety	5						**v**				**v**				
46	Microprocessor-based systems in the control systems	This course is intended for students to build distributed and concentrated control systems, principles of building industrial controllers, programming tools and programming languages of industrial controllers. As a result of mastering the discipline, the student will be able to develop software for industrial controllers using modern development tools and programming languages	5											**v**			
47	SCADA-system	This course is intended for students to study the principles of building software and hardware complexes (STC), choosing hardware, learning the principles of building and choosing SCADA systems when solving problems of automation of technological processes and industries. As a result of mastering the discipline, the student will be able to develop a justification and choice of automated tasks, to make the most appropriate	5										**v**				

		choice of hardware and software. The study of the SCADA-system gives a visual representation of the process and provides, as a rule, a graphical interface to the operator for monitoring and control															
48	Algorithm for diagnosing and predicting machine failures based on artificial intelligence and IoT technology	Objective: to form the students' knowledge system in the theory and practice of application of productive technologies. Data monitoring, equipment condition diagnostics and failure prediction, visualization of results and maintenance planning. Content: within the framework of the course students will learn the basics of knowledge about technical means of obtaining information about the state of machines, systems of data collection, analysis and storage; formation of knowledge and skills of application of artificial intelligence IoT technology for diagnostics and prediction of residual life of machines	6				v					v					
49	Software platforms and technical systems for predictive analytics	Goal: to develop a system of knowledge among students in the field of theory and practice of using predictive technologies in the maintenance and repair of technological equipment. Contents: as part of the course, students will master the basics of knowledge about technical means of obtaining information about the condition of machines, collection systems, familiarization and acquisition of knowledge about the architecture of software and hardware systems, the training core of the system, the	6				v						v		v		

		database and their integration with process control systems															
Cycle of profile disciplines Component of choice																	
50	Technologies of predictive analytics in the organization of maintenance and repair of oil and gas machinery and equipment	Goal: to develop a system of knowledge among students in the field of theory and practice of using predictive technologies in the maintenance and repair of technological equipment and systems in oil and gas production. Contents: as part of the course, students will master the basics of using information technologies (control systems - SCADA) and knowledge of using the capabilities of big data analysis, artificial intelligence, Internet of things, cloud services in predictive analytics technology	5					**v**						**v**			
51	Technologies of predictive analytics in the organization of maintenance and repair of mining machines and equipment	Goal: to develop a system of knowledge among students in the field of theory and practice of using predictive technologies in the maintenance and repair of technological equipment and systems in mining. Contents: as part of the course, students will master the basics of using information technologies (control systems - SCADA) and knowledge of using the capabilities of big data analysis, artificial intelligence, Internet of things, cloud services in predictive analytics technology	5					**v**						**v**			
52	. Technologies of predictive analytics in the organization of maintenance and repair of	Goal: to develop a system of knowledge among students in the field of theory and practice of using predictive technologies in the	5					**v**						**v**			**v**

	metallurgical machines and equipment	maintenance and repair of technological equipment and systems in metallurgical production. Contents: as part of the course, students will master the basics of using information technologies (control systems - SCADA) and knowledge of using the capabilities of big data analysis, artificial intelligence, Internet of things, cloud services in predictive analytics technology															

5. Curriculum of educational program

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

SATBAYEV UNIVERSITY

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

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

Educational program 6B06108 - "Digital monitoring of machines and equipment"
Group of educational programs B057 - "Information Technology"

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/pr	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	5semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG 108	Foreign language	GED, RC	5	150	0/0/3	105	E	5							
LNG 108	Foreign language	GED, RC	5	150	0/0/3	105	E		5						
LNG104	Kazakh (russian) language	GED, RC	5	150	0/0/3	105	E	5							
LNG 104	Kazakh (russian) language	GED, RC	5	150	0/0/3	105	E		5						
M-2. Module of physical training															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difference	2	2	2	2				
M-3. Information technology module															
CSE 677	Information and communication technology	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	GE		5						
HUM132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM120	Module of socio-political knowledge (sociology, political science)	GED, RC	3	90	1/0/1	60	E				3				
HUM134	Module of socio-political knowledge (cultural studies, psychology)		5	150	2/0/1	105	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM136	Fundamentals of anti-corruption culture and law	GED, CCH	5	150	2/0/1	105	E			5					
MNG489	Fundamentals of economics and entreprenеurship														
MSM500	Fundamentals of scientific research methods														
CHE 656	Ecology and life safety														
MNG564	Basics of Financial Literacy														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY468	Physics	BD, UC	5	150	1/1/1	105	E	5							
MAT102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
M-7. Basic training module															
GEN429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E	5							
TEC606	Fundamentals of the specialty	BD, UC	4	120	2/0/1	75	E	4							
TEC577	Thermodynamics, heat transfer and thermal engineering installations	BD, UC	5	150	2/0/1	105	E			5					
GEN411	Theoretical and applied mechanics	BD, UC	5	150	2/1/0	120	E			5					
TEC461	Basics of hydraulics and hydraulic drives of technological machines	BD, UC	5	150	2/0/1	105	E					5			
GEN443	Strength of materials	BD, UC	6	180	2/1/1	120	E				6				
TEC463	Interchangeability, standardization and technical measurements	BD, UC	5	150	2/0/1	105	E			5					
TEC460	Construction materials processing machinery and equipment	BD, UC	5	150	2/1/0	105	E		5						
CSE525	Intellectual data analys	BD, UC	5	150	1/1/1	105	E							5	
GEN125	Bases of designing and details of cars	BD, UC	5	150	1/1/1	105	E				5				
ELC103	Electrotechnics and microelectronics	BD, UC	5	150	2/1/0	105	E					5			
CSE831	Fundamentals of Artificial Intelligence	BD, UC	5	150	1/0/2	105	E							5	
CSE554	Algorithmization and programming basics	BD, UC	4	120	1/1/1	75	E					4			
TEC555	The dynamics and durability of technological machines	BD, UC	4	120	2/0/1	75	E					4			
PED189	Technology of manufacturing technological machines	BD, UC	5	150	2/0/1	105	E				5				
TEC607	Technical diagnostics of technological machines	BD, UC	4	120	2/0/1	75	E						4		
CSE524	Basics of cybersecurity	BD, UC	5	150	1/1/1	105	E						5		
CSE681	Operating systems	BD, UC	5	150	1/1/1	105	E						5		
CSE127	Object oriented programming	BD, UC	5	150	1/1/1	105	E						5		
TEC583	Oil and gas production technologies	BD, CCH	5	150	2/0/1	105	E					5			
TEC584	Mining technologies				2/0/1										
TEC585	Technologies of metallurgical production				2/0/1										
MNG562	Legal regulation of intellectual property				2/0/1										
MNG563	Fundamentals of sustainable development and ESG projects in Kazakhstan				2/0/1										
AAP179	Training Practice	BD, UC	2		0/0/2				2						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-8. Module of professional activity															
TEC586	Installation and repair of technological machines	PD, UC	5	150	2/0/1	105	E							5	
PED193	Instrumentation and automation of technological machines	PD, UC	5	150	2/0/1	105	E					5			
TEC587	Fundamentals of reliability of technological machines	PD, UC	5	150	2/0/1	105	E						5		

TEC588	Geomonitoring of the technical condition of technological machines	PD, UC	5	150	2/0/1	105	E									5
CSE695	Application design patterns	PD, UC	5	150	1/1/1	105	E						5			
CSE700	Database Systems	PD, UC	5	150	1/1/1	105	E							5		
AUT422	Microprocessor-based systems in the control systems	PD, UC	5	150	2/1/0	105	E							5		
AUT402	SCADA-system	PD, UC	5	150	2/1/0	105	E							5		
TEC612	Algorithm for diagnosing and predicting machine failures based on artificial intelligence and IoT technology	PD, UC	6	180	2/0/2	120	E									6
TEC613	Software platforms and technical systems for predictive analytics	PD, UC	6	180	2/0/2	120	E									6
TEC610	Technologies of predictive analytics in the organization of maintenance and repair of oil and gas machinery and equipment	PD, CCH	5	150	2/0/1	105	E									5
TEC609	Technologies of predictive analytics in the organization of maintenance and repair of mining machines and equipment				2/0/1											
TEC611	Technologies of predictive analytics in the organization of maintenance and repair of metallurgical machines and equipment				2/0/1											
AAP143	Industrial internship I	PD, UC	2								2					
AAP183	Industrial internship II	PD, UC	3										3			
M-9. Module of final attestation																
ECA108	Writing and defense of the thesis/project	IA	8													8
M-10. Module of additional types of training																
AAP500	Military training	DVO	0													
	Total for UNIVERSITY:							31	29	27	33	28	32	30	30	
								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		109	5	176
PD	Cycle of profile disciplines		57	5	
	Total for theoretical training:	*51*	*166*	*15*	*232*
FA	Final attestation	8			8
	TOTAL:	59	166	15	240

Decision of the Academic Council of Kaztu named after K.Satpayev. Protocol № 11 от "22" 04 2024 y.

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

Decision of the Academic Council of the Institute E&ME . Protocol № 4 от "19" 01 2024 y.

Vice-Rector for Academic Affairs — B.K. Uskenbayeva

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

Head of department TM&E — B.Z. Kaliev

Specialty Council representative from employers — A.T. Shakenov