

**NJSC «Kazakh national research technical university after K.I.Satpaev»**

**Institute of Metallurgy and Industrial Engineering**

**Department of "Technological machines, transport and logistics»**

## **CURRICULUM PROGRAM**

### **"DIGITAL ENGINEERING OF MACHINERY AND EQUIPMENT" (profile direction (1.5 years))**

**Master of engineering and technology in the educational program 7M07126 -  
"Digital engineering of machinery and equipment"**

2nd edition

in accordance with the State Educational Standard of Higher Education 2018

**Almaty 2020**

Developed by:	Reviewed: meeting of the AC of the Institute	Approved by: EMC of KazNRTU	Page 1 of 24
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**The program is compiled and signed by the parties:**

**from KazNRTU named after K.Satpayev:**




1. The head of the department TM&TL
2. Director of M&MI
3. Chairman of EMC TM&O Department



 K.K. Elemesov  
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**from employers:**

1. Head of the production Department of Altynalmas JSC deputy Director-Vice Rector for Methodical the work of the branch KNU LP "ICC"
2. General Director of Burmash LLP»
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Approved at the meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K. Satpayev.

**Qualification:**

Level 7 National Qualifications Framework:  
 7M071 Engineering and Engineering (Master):  
 7M07126 Digital engineering of machinery and equipment

Professional competence: training of scientific, technical and engineering personnel with world-class competences in the field of digital technologies based on the integration of fundamental physical-mechanical and practice-oriented engineering and technical education with research and development for enterprises of the oil and gas, mining and metallurgical complex.

**Brief description of the program:**

The educational program (EP) of higher vocational education ensures the implementation of the state educational standard taking into account the type of higher education institution, the educational needs and requests of students, and includes a working curriculum, syllabuses (work programs of training courses), disciplines (modules) and other materials providing the quality of training students.

The main idea of the educational program is to implement a continuous process of training new-generation professional personnel capable of working to transform the new scientific potential of Kazakhstan from raw materials to innovation through the development and implementation of sustainable trends in the field of digital service and maintenance services.

The uniqueness of the study program “Digital Engineering of Machinery and Equipment” is determined by the competencies that the master has, having completed his education in this program.

**Awarded degree / qualification:** Master of Engineering and Technology in the specialty 7M07126 - "Digital engineering of machinery and equipment"

1. The purpose of the educational program

The goal of the program is to provide knowledge of engineering methodology, deep theoretical knowledge, skills and abilities required in professional activities. The ability to use the methods and means of digital technical diagnostics of technological machines and own practical skills in their use, analysis and processing of results using technology and computer application programs. The ability to plan and organize the maintenance and repair of technological machines and equipment;

The objectives of the EP in the direction of "7M07126 - Digital engineering of machinery and equipment" are formulated based on the environmental conditions and the need to position the program as a competitive educational product on the world market. They are determined by the competencies acquired by graduates in the process of mastering the program at the university, and give consumers information about the areas of vocational training, the profile of the program and the types of professional activity for which graduates of this educational program of the magistracy are preparing. It reflects the features of the goals of educational training of specialists in the field of technical services with scientific and innovative thinking, owning advanced technologies in the modern operational and service industry, able to integrate in the conditions of global digital engineering and solving socially important tasks of the Kazakhstan and regional service market.

OP is focused on professional social order through the formation of specific competencies (scientific-pedagogical, professional) related to the necessary types of research and practical activities, adjusted to the requirements of employers.

## 2. Types of employment

A feature of this master's program is the training of graduates who are able to conduct the following types of professional activity:

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

## 3. Objects of professional activity

The objects of graduate professional activity are:

- secondary special educational institutions;
- manufacturing enterprises;
- design organizations;
- industrial institutes specializing in the design of technological equipment;
- organizations and companies specializing in the production of technological equipment.

## **EDUCATIONAL PROGRAM PASSPORT**

### **1 Volume and content of the program**

The term of study in the magistracy is determined by the volume of mastered academic credits. When mastering a set amount of academic credits and achieving the expected learning outcomes for a master's degree, the master's educational program is considered fully mastered. The profile master 90 academic credits with a study period of 1.5 years.

Planning the content of education, the method of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of the credit technology of education.

The master's degree program implements educational programs of postgraduate education in management training with advanced professional training.

The content of the magistracy educational program consists of:

- 1) theoretical training, including the study of cycles of basic and major disciplines;
- 2) practical training of undergraduates: various types of practices, professional internships;
- 3) experimental research work, including the implementation of a master's thesis;
- 4) intermediate and final certification.

### **Objectives of the educational program:**

Task 1: Specialists' readiness for industrial and technological activities ensuring the introduction and operation of new digital developments at the local level.

Task 2: Willingness of specialists to search for and obtain new information necessary to solve professional problems in the field of knowledge integration in relation to their field of activity, to actively participate in the activities of an enterprise or organization.

Task 3: Specialists' readiness for scientific informational, ideological and problem communication in a professional environment and in a non-expert audience with a clear and deep rationale for their position, engage in organizational, managerial and operational service activities, be aware of the responsibility for making their professional decisions.

Task 4: Specialists' readiness for self-learning and continuous professional development throughout the entire period of scientific or professional activity.

## 2 Entry Requirements

The previous level of education of applicants is higher professional education (bachelor degree). The applicant must have a diploma of a fixed pattern and confirm the level of knowledge of English with a certificate or diplomas of a fixed pattern.

The procedure for admission of citizens to the magistracy is established in accordance with the “Model rules for admission to studies in educational organizations that implement educational programs of post-graduate education”.

The formation of a contingent of undergraduates is carried out through the placement of the state educational order for the training of scientific and pedagogical personnel, as well as tuition fees at their own expense of citizens and other sources. Citizens of the Republic of Kazakhstan shall be granted the state the right to receive, on a competitive basis, in accordance with the state educational order, free post-graduate education, if they receive education at this level for the first time.

At the "entrance" the undergraduate student should have all the prerequisites necessary for mastering the corresponding educational program of the magistracy. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a fee basis.

## 3 Requirements to complete the course and receive a diploma

**Awarded degree / qualifications:** A graduate of this educational program is assigned an academic degree of "Master of Engineering and Technology" in the direction of mining, metallurgy and oil and gas production.

A graduate who has mastered the master's degree program should have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use in professional activities new knowledge and skills, develop their innovative abilities;
- the ability to independently formulate research goals, establish the sequence of solving professional tasks;
- the ability to put into practice the knowledge of fundamental and applied sections of the disciplines that determine the direction (profile) of the graduate program;
- the ability to professionally choose and creatively use modern scientific and technical equipment to solve scientific and practical problems;
- the ability to critically analyze, represent, protect, discuss and disseminate the results of their professional activities;
- Possession of skills for the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

- readiness to lead the team in their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;
- readiness for communication in oral and written forms in a foreign language for solving problems of professional activity.

A graduate who has mastered the master's program must have professional competencies corresponding to the types of professional activity to which the master's program is oriented:

- production activities:
  - the ability to independently carry out production, field and laboratory and interpretation work in solving practical problems;
  - ability to professional exploitation of modern field and laboratory equipment and devices in the field of mastered master programs;
  - the ability to use modern methods of processing and interpreting complex information to solve production problems;
- project activity:
  - the ability to independently draw up and submit research and development projects;
  - readiness to design complex research and production works in solving professional problems;
- organizational and management activities:
  - readiness to use the practical skills of organizing and managing research and production works in solving professional problems;
  - readiness for practical use of regulatory documents in the planning and organization of research and production work;

When developing a master's program, all general cultural and general professional competencies, as well as professional competences related to the types of professional activities that the master's program is focused on, are included in the set of required mastering program results.

## 4 Work curriculum of the educational program

### 4.1. Duration 1.5 years

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN  
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY



APPROVED

Rector KazNRTU named after K. I. Satpayev  
I.K. Beisembetov

15.09.2020.

### MODULAR CURRICULUM

Education program 7M07126 - Digital engineering of machines and equipment

Form of study: full		Duration of training: 1,5 years		Academic Degree: Master of Engineering and Technology						
The cycle	code	Name of disciplines	Semester	Academic credits	Lect.	Lab.	Pract.	IWS	Type of control	Chair
<b>Profile training module</b>										
<b>Basic disciplines (BD) (26 credits)</b>										
<b>University component (UC) (16 credits)</b>										
BD 1.1.1	LNG202	Foreign language (professional)	1	6	0	0	3	3	Exam	EL
BD 1.2.1	HUM201	History and philosophy of science	1	6	2	0	1	3	Exam	SS
BD 1.3.1	HUM204	Management psychology	1	4	1	0	1	2	Exam	SEPMC
<b>Choice component (CC) (10 credits)</b>										
<b>Professional Engineering Training Module</b>										
BD1. 4.1	TEC525	Innovative drives of machinery and equipment	1	6	2	0	1	3	Exam	TMT&L
BD1. 4.2	TEC204	The mounting and launch - adjustment working								
BD1. 5.1	TEC547	Copyright	2	4	1	0	1	2	Exam	TMT&L
BD1. 5.2	TRA231	Automated systems for solving logistics problems			1	1	0			
<b>Major disciplines ( MD) (45 credits)</b>										
<b>The module of innovative technologies</b>										
<b>University component (CC)</b>										
MD2. 1.1	TEC527	Digital methods and means of technical diagnostics of technological machines and equipment	1	6	2	0	1	3	Exam	TMT&L
MD2. 1.2	TEC209	Heattechnical equipment and power plants								
MD2. 2.1	TEC532	The use of digital technology in the design and construction of technological machines	1	6	2	0	1	3	Exam	TMT&L
MD2. 2.2	TEC211	Tribotekhnika and lubricant materials in technological machines and equipment								
MD2. 3.1	TEC535	Innovative welding methods	2	6	2	0	1	3	Exam	TMT&L
MD2. 3.2	TEC203	Instrumentation and equipment technology machines and equipment								
MD2. 4.1	TEC537	Modern problems in the mining and metallurgical complex	2	6	2	0	1	3	Exam	TMT&L
MD2. 4.2	TEC226	Methods and means of measurement and control of parameters of technological cars								



MD2.5.1	TEC534	Innovative construction materials of technological machines	2	6	2	0	1	3	Exam	TMT&L
MD2.5.2	TEC202	Innovative equipment and technologies in industry								
MD2.6.1	TEC542	Predictive maintenance systems for process equipment	2	6	2	0	1	3	Exam	TMT&L
MD2.6.2	TEC544	Intelligent management of technological equipment complexes								
<b>Practice-oriented module</b>										
MD2.7	AAP246	Internship	3	9					Report	TMT&L
<b>Research module (18 credits)</b>										
MSE RW	AAP221	Master's student experimental research work, including internship and master's project implementation	2	4					Report	TMT&L
MSE RW	AAP220	Master's student experimental research work, including internship and master's project implementation	3	14					Report	TMT&L
<b>Module of final attestation (12 credits)</b>										
FA	ECA206	Registration and defense of the master's thesis	3	12					Defense of dissertation	
In total:				101						

Vice-Rector for Research and Academic Affairs



D. Nauryzbaeva

Chairman of APC



K. Tulegenova

Director of the Institute of M&IE



K. Yelemessov

Head of department TMT&L

K. Yelemessov

## 5 Descriptors of the level and volume of knowledge, skills, abilities and competencies

Requirements for the level of training of a graduate student are determined on the basis of Dublin descriptors of the second level of higher education (magistracy) and reflect the mastered competencies expressed in the achieved learning results.

Learning outcomes are formulated both at the level of the entire master's educational program and at the level of individual modules or academic disciplines.

The descriptors reflect learning outcomes that characterize the learner's abilities:

1) demonstrate developing knowledge and understanding in the field of digital diagnostics of equipment for mining, metallurgical and oil and gas production, based on advanced knowledge of this field, in the development and / or application of ideas in the context of the study;

2) to apply at the professional level their knowledge, understanding and abilities to solve problems in a new environment, in a wider interdisciplinary context;

3) to collect and interpret information for the formation of judgments, taking into account social, ethical and scientific considerations;

4) clearly and unambiguously communicate information, ideas, conclusions, problems and solutions, both to specialists and non-specialists;

5) training skills necessary for independent continuation of further education in the field of digital diagnostics of the equipment for mining, metallurgical and oil and gas production.

## 6 Competences to complete the training

6.1 Requirements for core competencies of graduate students should:

1) have an idea:

- on current trends in the development of scientific knowledge;
- about actual methodological and philosophical problems of natural (social, humanitarian, economic) sciences;

- about the contradictions and socio-economic consequences of globalization processes;

- about the current state of the economic, political, legal, cultural and technological environment of the global business partnership;

- on the organization of strategic enterprise management, innovation management, theories of leadership;

- about the main financial and economic problems of enterprises.

2) know:

- methodology of scientific knowledge;

- the main driving forces of changes in the structure of the economy;

- features and rules of investment cooperation;

- at least one foreign language at a professional level, allowing for scientific research and practical activities.

3) be able to:

- apply scientific methods of knowledge in professional activities;
- critically analyze existing concepts, theories and approaches to the study of processes and phenomena;
- integrate knowledge gained in various disciplines, use them to solve analytical and management tasks in new unfamiliar conditions;
- to conduct a microeconomic analysis of the economic activity of the enterprise and use its results in the management of the enterprise;
- put into practice new approaches to the organization of marketing and management;
- to make decisions in complex and non-standard situations in the field of organization and management of the economic activity of an enterprise (company);
- put into practice the norms of the legislation of the Republic of Kazakhstan in the field of regulation of economic relations;
- to think creatively and creatively to solve new problems and situations;
- to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- summarize the results of experimental research and analytical work in the form of a master's thesis, article, report, analytical note, etc.

4) have skills:

- solving standard scientific and professional tasks;
- scientific analysis and solving practical problems in the organization and management of the economic activities of organizations and enterprises;
- research problems in the field of management and marketing and use the results to improve the methods of enterprise management;
- professional communication and intercultural communication;
- oratory, correct and logical design of their thoughts in oral and written form;
- Expansion and deepening of knowledge necessary for everyday professional activities and continuing education in doctoral studies;
- use of information and computer technologies in the field of professional activity.

5) be competent:

- in the field of research methodology in the specialty;
- in the field of modern problems of the world economy and the participation of national economies in world economic processes;
- in the organization and management of the enterprise;
- in the implementation of industrial relations with various organizations, including the bodies of state service;
- in ways to ensure continuous updating of knowledge, expansion of professional skills and abilities.

**Competencies acquired by students during the development of the educational program «Digital engineering of machines and equipment»**

<b>Basic competencies (B)</b>	
B1	Possess knowledge of the philosophical concepts of natural science and the basics of the methodology of scientific knowledge in the study of various levels of organization of matter, space and time; the ability to actively social mobility; the willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences
B2	Study of the basics of education management, management of global educational processes, analysis and selection of strategic initiatives, project as a strategy for managing the development of an educational institution/organization, special and managerial competencies
B3	understanding the nature and significance of the relationship between production processes and their impact on the operational efficiency of trouble-free use of technological equipment of mining, metallurgical and oil and gas production, which allows rational use of natural resources, waste-free technology and reduce the negative impact on the environment
B4	Ability to freely use the state language and a foreign language as a means of business communication; ability to actively communicate in scientific, industrial and socio-public spheres of activity; readiness for independent research work and work in a scientific team, the ability to generate new ideas (creativity)
<b>Professional competencies (P)</b>	
P1	The ability to formulate problems, tasks and methods of scientific research, to obtain new reliable facts based on observations, experiments, scientific analysis of empirical data, to refer scientific works, to make analytical reviews of accumulated information in world science and industrial activities, to summarize the results obtained in the context of previously accumulated knowledge in science and to formulate conclusions and practical recommendations based on representative and original research results
P2	Professional competence, including in accordance with the requirements of industry professional standards, providing deep theoretical knowledge and practical skills in the field of technology for the development of solid minerals and hydrocarbons
P3	Master the basics of designing, expert and analytical activities and performing research using modern approaches, methods, equipment and computer systems. It is able to make descriptions of the principles of operation and device of the designed products and objects with justification of the adopted technical decisions.
P4	Skills of development of technological maps of processes of restoration and increase of wear resistance of details, practical skills of drawing up design and technical documentation; practical skills of verification of compliance of the developed technological process to requirements of standards, specifications and other normative documents
P5	Ready to independently or as part of a team to organize the work of production enterprises for the operation, diagnosis, repair and maintenance of equipment in accordance with the specifics of production
P6	It is able to receive and process information from various sources using modern information technologies, is able to apply applied software tools in solving practical issues using personal computers with the use of General and special purpose software tools, including in remote access mode

**Foreign language (professional)**

Professional English for Project Managers

CODE-LNG202

CREDIT – 6 (0/0/3/3)

PREREQUISITES-Academic English, Business English, IELTS 5.0-5.5

course GOALS AND OBJECTIVES

The aim of the course is to develop undergraduates ' knowledge of English for their current academic research and to improve their performance in project management.

**BRIEF DESCRIPTION OF THE COURSE**

The course is aimed at developing vocabulary and grammar for effective communication in the field of project management and improving reading, writing, listening and speaking skills at the Intermediate level. Undergraduates are expected to acquire and expand their business English vocabulary and learn grammatical structures that are often used in the context of management. The course consists of 6 modules. The 3rd module of the course ends with an intermediate test, and the 6th module is followed by a test at the end of the course. The course ends with a final exam. Undergraduates also need to study independently (MIS). MIS - independent work of undergraduates under the guidance of a teacher.

**KNOWLEDGE, SKILLS AT THE END OF THE COURSE**

Upon successful completion of the course, it is expected that undergraduates will be able to recognize the main idea and main message, as well as specific details when listening to monologues, dialogues and group discussions in the context of business and management; understand written and oral speech in English on topics related to management; write management texts (reports, letters, emails, meeting minutes) following a common structure with a higher degree of grammatical accuracy and using business words and phrases, talk about various business situations using the appropriate business vocabulary and grammatical structures - in pair and group discussions, meetings and negotiations.

**Management psychology**

CODE-HUM204

CREDIT – 4 (1/0/1/2)

PREREQUISITE –

The course is aimed at teaching undergraduates the basics of management psychology. It will examine the specifics of management psychology, psychological patterns of management activity, personality and its potential in the management system; motivation and effectiveness in the organization, leadership and leadership in modern management of organizations, social group as an object of management, psychological foundations of managerial decision-making, business communication and management conflicts, psychology of responsibility, creating an image as an integral part of the culture of communication, psychology of advertising.

**Copyright**

CODE-TEC547

CREDIT – 4 (1/0/1/2)

**PREREQUISITE**

When studying the discipline, theoretical and practical training of future undergraduates is carried out on the technical and legal foundations of copyright, protection of "know-how" and licensing activities, legal protection of industrial property objects, preparation and filing of patent applications and their examination. Familiarity with the role and meaning of objects and subjects of copyright, the conditions of patentability of inventions and industrial designs and the possibilities of their licensing, allows students to master: the sequence of registration of copyrights, the content of copyrights; ability to protect the rights of authors and patent holders; ability to make copyright registration abroad; basics of legal protection and protection of "know-how"

**KNOWLEDGE, SKILLS, SKILLS AT the end of the COURSE**

As a result of mastering the discipline, the master must:

Know:

- objects of intellectual property;
- rights and obligations of authors and owners of intellectual property objects;
- ways to protect the rights of authors and owners of intellectual property;
- legislation regulating relations in the field of intellectual property protection;
- rules for registration of intellectual property rights;
- major international organizations in the field of intellectual property protection;

Be able to:

- make applications for industrial property objects;
- apply options for calculating the price of a license to use an industrial property object (primarily technical ones);
- protect the rights of authors and owners of intellectual property objects;
- conduct patent research;
- use the information resources of FIPS;

Own:

- ideas about the legislation regulating relations in the field of intellectual property protection
  - rules for processing applications for industrial property objects;
  - ways to protect intellectual property rights.
- the skills of carrying out of patent researches.

**Automated systems for solving logistics problems**

CODE – TRA231

CREDIT – 4 (1/1/0/2)

PREREQUISITE –

The purpose of the discipline is the acquisition of skills for solving logistics problems by undergraduates using automated systems. Specialized logistics company management software. Features of the implementation of the KANBAN system. MySAP Buisness Suite e-business platform. Integrated SAP NetWeaver integration platform. Logistics software based on the SAP platform. Automated SAP platform technologies for Supply Chain Management (SCM) and Customer Ralationship Management (CRM).

**Innovative drives for machinery and equipment**

CODE-TEC525

CREDIT – 6 (2/0/1/3)

PREREQUISITE

The purpose of the discipline is to form a system of knowledge, skills, and skills in the field of design, operation, maintenance, and evaluation of the technical condition of industrial machine drives.

Tasks of the discipline:

- formation of knowledge about the features of innovative designs, layout and operating modes of mechanical, hydraulic and pneumatic drives of mining, metallurgical and oil and gas machines;
- formation of skills to assess the technical condition and residual life, organize preventive inspection and maintenance of mechanical, hydraulic and pneumatic drives of mining, metallurgical and oil and gas machines;
- formation of skills in applying methods for calculating design and operating parameters of innovative mechanical, hydraulic and pneumatic drives of mining, metallurgical and oil and gas machines.

**KNOWLEDGE, SKILLS AT THE END OF THE COURSE**

As a result of mastering the discipline, the master must:

Know:

- features of innovative design and basic layout schemes, methodology for selecting and calculating rational parameters of operation of mechanical, hydraulic and pneumatic drives of technological machines;
- main malfunctions of hydraulic and pneumatic drives of technological machines and their diagnostic signs, methods and means of assessing the technical condition of hydraulic and pneumatic drives of mining machines;

Be able to:

- apply standard calculation methods when selecting and justifying design and operating parameters of hydraulic and pneumatic drives of technological machines and equipment;

- organize preventive inspection and maintenance of hydraulic and pneumatic drives of technological machines and equipment;

Own:

- skills in using reference and scientific and technical literature when performing design and operational calculations of hydraulic and pneumatic drives of technological machines and equipment;

- skills in assessing the technical condition of hydraulic and pneumatic drive units of technological machines, can use measuring and diagnostic equipment.

**Methods and means of measurement and control of parameters of technological cars**

CODE – TEC226

CREDIT – 6 (2/0/1/3)

PREREQUISITE –

Methods and gauges and the control of technological cars. Devices and methods of measurement of temperatures, pressure, expenses of liquids and gases, linear and angular sizes, measurement of forces and the moments, not destroying control of materials and products, parameters of movement and vibration, structure of gases, quality of technical liquids, quality of fuel and oils. Metrological and dynamic characteristics of measuring apparatuses and the control. A choice of means of measurement and the control of parameters of the process equipment depending on their design and operation conditions. An estimation of accuracy and reliability of measuring apparatuses. Rules of installation and operation of means of measurements.

Kinds of tests of the process equipment - control, issledovatel'skie, parametrical, delivery, diagnostic, resource, etc. Test beds and the equipment. An estimation of a technical condition of the process equipment by results of tests.

The organization of carrying out laboratory and a practical training on discipline with application of measuring apparatuses, the control and tests. Requirements of safety precautions regulations at tests of cars in educational laboratories. A technique of working out of subjects of independent works the master (IWM). Rules of working out of test tasks on discipline

**Digital methods and tools for technical diagnostics of technological machines and equipment**

CODE-TEC527

CREDIT – 6 (2/0/1/3)

the purpose of studying the discipline is to form undergraduates ' knowledge on assessing the current technical condition of the main technological mining, metallurgical and oil and gas equipment, choosing the most informative diagnostic signs about their condition, methods of collecting and processing diagnostic information, choosing tools and methods of decision-making, planning maintenance and repair of equipment.

Developed by:	Reviewed: meeting of the AC of the Institute	Approved by: EMC of KazNRTU	Page 16 of 24
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When studying the discipline, training is provided on the technique and technology of digital vibration diagnostics of equipment, analysis of the main defects of technological machines and their diagnostic features, the basics of technical diagnostics of the mechanical part of drives, parametric diagnostics of production equipment. Special attention is paid to methods for recognizing the state of equipment, predicting its changes, and planning maintenance and repair work.

The task of studying the discipline is to acquire the necessary skills and abilities for their application in the operation of industrial equipment in the industry.

As a result of mastering the discipline, the master must:

Know:

- systems of technical maintenance and repair of equipment of technological machines, their advantages and disadvantages;
- existing digital methods for assessing the technical condition of technological equipment;
- tools for collecting and processing diagnostic information;
- methods for forming a set of diagnostic features and evaluating their informativeness;
- digital methods of technical condition assessment;
- models and methods for analyzing signals of fast-moving processes;
- defects of various machines and their diagnostic parameters;
- methods of parametric diagnostics of technological equipment.

To be able to:

- to carry out statistical processing of measuring signals;
- определять determine the main operational parameters of the equipment;
- оценивать evaluate the effectiveness and reliability of diagnostic results;
- планировать plan maintenance and repair work based on an assessment of the current technical condition of the equipment.

### **Intelligent management of technological equipment complexes**

CODE – TEC544

CREDIT – 6 (2/0/1/3)

PREREQUISITE

The discipline provides studying of questions of the organization and operation of the enterprises on service of production complexes of the technological equipment in system of branch appointment. The purpose of teaching - the development of the methodology of management of complex technological equipment of industrial enterprises of mining, metallurgical and oil industries and methods of calculation of their production capacity, as well as the study of optimal control algorithms of production systems in the maintenance of production facilities.

**Tribotekhnika and lubricant materials in TMandE**

CODE – TEC211

CREDIT – 6 (2/0/1/3)

PREREQUISITE

The main idea of the friction and tribotechnology friction concept, lubrication and wear .: Course Objectives. Course structure. Basic definitions. Concept of friction, lubrication concept. Concept of deterioration. Concepts of micro- and nanotribology. solid surface. The surface of a physical object. surface topology. Modern methods of investigation surface. Contact Interaction of Solids. The elastic and plastic contact smooth bodies. Adhesion interaction of bodies. Contact rough surfaces. Physics of sliding friction and rolling. The main factors of friction. Calculation of the coefficient of sliding friction. Frictional self-excited vibrations. Thermal friction problem. The main factors of rolling friction. Calculation of the coefficient of rolling friction. The physics of fluid friction. The main factors of fluid friction. The physical laws of fluid motion. Petrov Formula. Formula Zhukovsky. Reynolds equation. Wear Physics. Basic mechanisms of wear: abrasive wear, adhesive wear, fatigue wear, corrosion-wear, combined types of wear. Methods and means of measuring and control wear. Tribological database. anotribologiya. The friction at the atomic and molecular level. Methods of molecular dynamics simulation of processes of friction, lubrication and wear. Methods and means of measuring and control properties of nanomaterials.

**Innovative welding methods**

CODE-TEC535

CREDIT – 6 (2/0/1/3)

PREREQUISITE –

The purpose of teaching the course is to develop students ' knowledge and skills in the use of innovative welding methods, in the Assembly and installation of modern structures, the effective use of appropriate equipment and equipment, operating parameters

The objectives of the course are to teach students to develop the technological process in the optimal direction; to be able to choose the best options for the production of joints for each specific combination of materials; to be able to conduct scientific research on the properties and structure of welded joints

**BRIEF DESCRIPTION OF THE COURSE**

Welding in the solid state. The process of welding under the action of pulsed pressures is explosion welding. Cold welding of metals. Cold welding tools. Cold welding machines. Shear welding. Mechanism of formation of a welded joint. Ultrasonic welding of metals. Installations for ultrasonic welding. Explosion welding. Diffusion welding. Welding installations for diffusion welding. friction welding of metals. Installations for friction welding. Arc welding in controlled atmosphere chambers. Welding in the environment of protective gases. Installations for welding in the environment of

Developed by:	Reviewed: meeting of the AC of the Institute	Approved by: EMC of KazNRTU	Page 18 of 24
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protective gases. Welding with a non-consumable electrode. Welding using protective covers (micro-chambers). Electron beam welding. Light beam welding. Welding with a laser.

**KNOWLEDGE, SKILLS AT THE END OF THE COURSE**

The student will be able to independently discuss the applicability of a particular type of welding from the category of special welding for a particular material.

**Instrumentation and equipment technology machines and equipment**

CODE – TEC203

Credit – 6 (2/0/1/3)

PREREQUISITE-

Purpose of study: Give an idea of the modern control and measuring devices and equipment of technological machinery and equipment

Brief content: Measuring instruments and control. Measurement and control of weight values. Measurement and control of geometric quantities. Measurement and control of mechanical quantities. Methods and means of measurement and control of temperature. Measurement and control of electrical and magnetic quantities. Measurement of optical radiation quantities. Measurement of acoustic quantities. Measurement and control of pressure. Measurement and flow control and quantity of liquids and gases. Measurement equipment and signaling of liquid level. Gas analyzers and liquid. Analyzers composition and physico-chemical properties of crude ore. The choice of means of measurement and control.

Expected results: The master will be able to independently select modern instrumentation for the design and operation of technological machines and equipment

**The mounting and launch - adjustment working**

CODE – TEC204

Credit – 6 (2/0/1/3)

PREREQUISITE-

The correct installation and operation of electromechanical equipment dependent reliability and durability of their work. This discipline examines hardware installation rules and technology of its implementation. The problems of commissioning, diagnosis of the condition of the electromechanical equipment. We study the system and operation of process technology machinery and their maintenance, the procedure of drawing up technical maintenance cards electromechanical equipment.

**Modern problems in the mining and metallurgical complex**

CODE-TEC537

Credit – 6 (2/0/1/3)

PREREQUISITE-

the purpose and objective of the discipline is to train specialists in the field of mining and metallurgical production, to acquire the necessary skills for independent theoretical and practical activities.

The objectives of the discipline are to study modern problems of the mining and metallurgical complex, to gain skills in applying new modern methods in mining and metallurgical production.

**BRIEF DESCRIPTION OF THE COURSE**

The current state of mineral resources provision for the needs of the mining and metallurgical complex. The essence and state of combined technology for developing mineral deposits. New problems of technology in the integrated development of minerals. Physical and geological foundations of Geotechnology. Development systems that ensure complete extraction of mineral reserves. Forecasting of new methods of development of mineral deposits.

**KNOWLEDGE, SKILLS AT THE END OF THE COURSE**

The process of studying the course is aimed at developing the ability to search for and optimize technical and technological solutions in the extraction and processing of minerals.

As a result of studying the discipline, a master's student should:

Know:

- current problems of the mining and metallurgical complex; tasks facing specialists in mining and metallurgical production; about the limitations and irreplaceability of mineral resources.

Be able to:

- find a rational field of application of new modern methods in mining and metallurgical production; apply combined, complex, and other development technologies; perform basic calculations to assess the economic feasibility of developing mineral deposits.

Possess:

- methods for optimizing the parameters of development and completeness of extraction of minerals from the subsurface.

**Innovative construction materials for technological machines**

CODE-TEC534

CREDIT – 6 (2/0/1/3)

PREREQUISITE –

The purpose of this course is to study the natural relationships between the composition, structure and properties of structural materials.

Developed by:	Reviewed: meeting of the AC of the Institute	Approved by: EMC of KazNRTU	Page 20 of 24
---------------	--	-----------------------------	---------------

The main objectives of the course are to form undergraduates' ideas about obtaining innovative metals and alloys; classification and properties of modern structural materials;

knowledge of the basics of the crystal structure of metals; methods and methods of changing the properties of metals in the production process;

□ the ability to determine the properties of metals by their micro-and macrostructure; measure the hardness of structural materials; choose innovative structural materials for technological machines in accordance with their purpose; choose tool materials for processing various structural materials.

#### BRIEF DESCRIPTION OF THE COURSE

Historical review of the use of materials, basic concepts about materials: a modern classification of materials (metallic and non-metallic materials, ferrous and non-ferrous metals and their alloys), application of materials; Basic properties of materials: physical, chemical, mechanical and technological, building materials: the process of crystallization, types of crystal lattices, phase in alloys; Diagrams of state of alloys: diagrams of state of double alloys, the phase diagram of iron-carbon alloys; Heat treatment of metals and alloys: the main types of heat treatment, chemical-thermal and thermo mechanical treatment; Classification and marking of metals and alloys: carbon and alloy steels; gray, ductile and high-strength cast irons; aluminum, copper, titanium and their alloys, the main properties and structure of non-metallic materials: plastics, glass, ceramics and wood materials.

The course program provides lectures, laboratory and practical classes, as well as organization of independent work of students, group and individual consultations.

In the course of studying this course, the master's student must attend a course of lectures, perform laboratory and practical work provided by the program. A special place in the development of this course is given to independent work of students.

#### KNOWLEDGE, SKILLS AT THE END OF THE COURSE

- know the basics of the crystal structure of new metals; methods for obtaining metals and alloys; methods and methods for changing the properties of metals and alloys; as well as the classification of modern structural materials and their basic properties;

be able to determine the properties of metals and alloys by their micro-and macrostructure; measure the hardness of structural materials; choose structural materials for products manufactured in training workshops; choose tool materials for processing various structural materials.

#### **Master's project defense**

CODE-ECA206

The CREDIT is 12

The purpose of the master's thesis is

to demonstrate the level of scientific/research qualifications of the master's student, the ability to independently conduct scientific research, test the ability to solve specific

scientific and practical problems, knowledge of the most General methods and techniques for solving them.

**BRIEF DESCRIPTION**

Master thesis – graduation qualification scientific work, which is a generalization of the results of independent studies undergraduates one of the pressing problems of a particular specialty relevant branch of science that has internal unity and reflects the progress and results of the development of the chosen topic.

Master's thesis-the result of research /experimental research work of a master's student, conducted during the entire period of study of a master's student.

Master's thesis defense is the final stage of master's degree preparation. The master's thesis must meet the following requirements –

- the work must conduct research or solve current problems in the field of operation and digital diagnostics of technological equipment in the mining, metallurgical and oil and gas industries;
- the work should be based on identifying important scientific problems and solving them;
- decisions must be scientifically based and reliable, have internal unity;
- the dissertation work must be written individually;

**7 ECTS Diploma Supplement**

The application is developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and does not constitute official proof of education. Without a diploma of higher education is not valid. The purpose of completing the European application is to provide sufficient information about the diploma holder, the qualifications obtained by him, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. In the application model, which will be used for the transfer of estimates, the European system of transfer or credit transfer (ECTS) is used.

The European Diploma Supplement provides an opportunity to continue education in foreign universities, as well as to confirm national higher education for foreign employers. When traveling abroad for professional recognition will require additional legalization of the diploma of education. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

**7.1 Annex to the certificate according to the standard ECTS**

The app is developed according to the standards of the European Commission, the Council of Europe and UNESCO/Sepes. This document serves only for academic

Developed by:	Reviewed: meeting of the AC of the Institute	Approved by: EMC of KazNRTU	Page 22 of 24
---------------	--	-----------------------------	---------------

recognition and is not an official confirmation of the document of education. It is not valid without a higher education diploma. The purpose of filling out the European application is to provide sufficient information about the diploma holder, the qualification they have received, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model that will be used for transferring ratings uses the European credit transfer or transfer system (ECTS).

The European diploma Supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When traveling abroad for professional recognition, additional legalization of the diploma of education will be required. The European diploma Supplement is completed in English upon individual request and is issued free of charge.

## Content

1 Volume and contents of the program	5
2 Entry Requirements	6
3 Requirements to complete the course and receive a diploma	6
4 Work curriculum of the educational program	8
5 Descriptors of the level and volume of knowledge, skills, abilities and competencies	10
6 Competences to complete the training	10
7 ECTS Diploma Supplement	22