

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"

Doctor of Philosophy (PhD) in the educational program 8D07110 - "Digital engineering of machinery and equipment"

2nd edition

in accordance with the State Educational Standard of Higher Education 2018

Almaty 2020

Developed:	Reviewed: meeting of the AC of the Institute	Approved: EMC of KazNRTU	Page 1 of 21
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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
K.K. Elemesov
L.A. Krupnik

From employers:

1. Member of the Council of the Institute,
Director-Vice-rector for methodological work
of the branch of KYAU "IVT" LLP

 Eskulov S. S.

2. General Director of Burmash LLP

 G.A. Kudaykulova

3. Commercial Director of JSC "AZTM"

 M. Kanatbaev

Approved at the meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K. Satpayev.

Qualification:

Level 8 National Qualifications Framework: Higher education, practical experience, and / or postgraduate education, practical experience.

Professional competence: high competence in the field of mechanical engineering and digital engineering; - ability to be creative in solving production and scientific problems; critical analysis of professional and scientific information; have the skills of analytical and experimental research activities; able to work on innovative projects using basic research methods; the ability to conduct patent research in order to ensure patent purity of new scientific and design solutions and assess their patentability.

Brief program description

1 The goal of the educational program “Digital Engineering of Machines and Equipment” is to train personnel for the system of higher, postgraduate education and the research sector with advanced scientific and pedagogical training.

2 Types of employment

Graduates of this SP can conduct the following professional activities:

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

Doctor in the specialty " Digital Engineering of Machines and Equipment ", depending on the type of professional activity, is prepared to solve the following professional tasks:

a. research activities:

- independent choice and justification of the goals and objectives of scientific research;
- independent selection and development of methods for solving the assigned tasks during laboratory, interpretation studies using modern equipment, instruments and information technologies (in accordance with the direction (profile) of the master's program);
- analysis and generalization of the results of research works using modern achievements of science and technology, advanced Kazakhstani and foreign experience;
- evaluation of the results of scientific research, preparation of scientific reports, publications, reports, drawing up applications for inventions and discoveries;

b. production and technological activities:

- independent preparation and conduct of industrial and scientific-industrial, laboratory and interpretation studies in solving practical problems (in accordance with the direction (profile) of the master's program);
- independent choice, preparation of laboratory equipment and instruments (in accordance with the direction (profile) of the master's program);
- collection, analysis and systematization of available specialized information using modern information technologies;
- complex processing and interpretation of field and laboratory information in order to solve scientific and production problems;
- determination of the economic efficiency of scientific and industrial work;

in. organizational and management activities:

- planning and organization of research and production field, laboratory and interpretation work;
- planning and organization of scientific and research and production seminars and conferences;

Pedagogical activity:

- participation in the preparation and conduct of seminars, laboratory and practical classes and practices, lectures;

3 Objects of professional activity

The objects of professional activity of the OP are:

- institutions of higher and postgraduate education;
- research and design organizations;
- enterprises of the mining and metallurgical and oil and gas industry;
- enterprises for the manufacture and production of technological equipment and the organization for the maintenance of technological machines.

EDUCATIONAL PROGRAM PASSPORT

1 Volume and content of the program

The Ph.D. educational program has a scientific and pedagogical orientation and involves fundamental educational, methodological and research training and in-depth study of disciplines in relevant areas of science for the system of higher and postgraduate education and the scientific field.

The educational program for the preparation of a doctor in profile assumes fundamental educational, methodological and research training and an in-depth study of disciplines in relevant areas of science for the sectors of the national economy and the social sphere: education, medicine, law, arts, economics, business administration and in the field of national security and military affairs.

Doctoral educational programs in terms of vocational training are developed on the basis of studying the experience of foreign universities and research centers that implement accredited training programs for PhD doctors or doctors in the profile.

The content of the educational program of specialized doctoral studies is established by the university itself.

The main criterion of completion of the educational process for the preparation of PhDs (PhDs) is a mastering of at least 180 academic credits by a doctoral student, including all types of educational and scientific activities.

The term of study in doctoral studies is determined by the amount of mastered academic credits. When mastering a set amount of academic credits and achieving the expected learning outcomes for a Ph.D. degree or in profile, the doctoral education program is considered fully mastered.

Training in doctoral studies is carried out on the basis of master's educational programs in two areas:

- 1) scientific and pedagogical with a study period of at least three years;
- 2) specialized with a study period of at least three years.

Content of professional activity:

pedagogical activity:

- performance of pedagogical work in educational institutions of various levels in the disciplines of the field;
- development of laboratory and research complexes;
- methodological support of the educational process;

research activities:

- collection, analysis of scientific and technical information, domestic and foreign experience on the subject of the study;
- development and research of theoretical and experimental models of objects of professional activity in various fields;
- development and research of methods of analysis, synthesis, optimization and prediction of the quality of the processes of functioning of objects;
- modeling of processes and objects on the basis of standard computer-aided design and research packages;
- formulation and conduct of experiments according to a given method and analysis of results;
- analysis of the results of experiments, preparation and preparation of reviews, reports and scientific publications;

organizational and management activities:

- the organization of interaction between the teams of the developer and the customer, making management decisions in the context of different opinions;
- finding a compromise between different requirements (cost, quality, deadlines) for both long-term and short-term planning, finding optimal solutions;

production and technological activities:

- author's support of the design, implementation and maintenance of technological equipment in production;
- a study of the quality indicators of the functioning of technological machines and the formation of technologies for their improvement.

Objectives of the educational program:

- to deepen the systemic knowledge of the doctoral students, allowing to give a critical assessment of the problems studied and discussed in the framework of modern production;
- develop skills in analyzing the designs of technological machines and equipment based on the use of modern digital technology;
- to deepen the ability to work with modern foreign and domestic scientific literature and to give their own assessment of the events in the creation of machines and equipment;

- to expand the fluency in English, necessary for writing scientific articles, reading foreign scientific literature, continuing education in foreign educational institutions, participating in international conferences and in negotiations with foreign partners;
- develop the ability to contribute to the development of new directions in the digitalization of technological machines and equipment through original scientific research.

2 Entry Requirements

The doctoral program accepts persons who have a master's degree and work experience of at least 1 (one) year or have completed residency training.

Enrollment in the number of doctoral students is carried out by admission committees of universities and scientific organizations on the basis of the entrance exam for groups of doctoral educational programs and a certificate confirming foreign language proficiency in accordance with European competencies (standards) of foreign language proficiency.

When enrolling in higher education institutions, doctoral candidates independently choose an educational program from the relevant group of educational programs.

Enrollment of persons for targeted training of doctors of philosophy (PhD) under the state educational order is carried out on a competitive basis.

The procedure for admission of citizens to doctoral studies 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 doctoral students is carried out by placing the state educational order for the training of scientific and pedagogical personnel, as well as paying tuition at the expense of citizens' own funds 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 postgraduate education, if they receive education at this level for the first time.

At the entrance, the doctoral candidate must have all the prerequisites necessary for mastering the relevant professional doctoral curriculum. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the doctoral student is allowed to master them on a fee basis. In this case, doctoral studies begin after full mastering by the pre-doctoral student.

3 Requirements to complete the course and receive a diploma

Those who have mastered the doctoral education program and defended their doctoral thesis, with a positive decision of the dissertation councils of the university with a special status or the Committee on Control in Education and Science of the Ministry of

Education and Science of the Republic of Kazakhstan on the results of the examination, are awarded a PhD profile and issued a state diploma with the application (transcript).

Persons who have received a PhD degree in order to deepen scientific knowledge, solve scientific and applied problems on a specialized topic, perform a post-doctoral program or conduct scientific research under the guidance of a leading scientist chosen by the university.

3.1 Requirements for key competencies of doctoral graduates:

1) have an idea:

- about the main stages of development and the change of paradigms in the evolution of science;
- about the subject, world outlook and methodological specificity of natural (social, humanitarian, economic) sciences;
- about scientific schools of the corresponding branch of knowledge, their theoretical and practical developments;
- about scientific concepts of world and Kazakhstan science in the relevant field;
- about the mechanism of implementation of scientific developments in practical activities;
- about the norms of interaction in the scientific community;
- on the pedagogical and scientific ethics of a research scientist;

2) know and understand:

- current trends, trends and patterns of development of domestic science in the context of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of world and Kazakhstan science in the relevant field;
- (recognize and accept) the social responsibility of science and education;
- perfectly foreign language for scientific communication and international cooperation;

3) be able to:

- organize, plan and implement the research process;
- analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;
- analyze and process information from various sources;
- conduct an independent scientific study, characterized by academic integrity, on the basis of modern theories and methods of analysis;
- generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- choose and effectively use modern research methodology;
- plan and forecast their further professional development;

4) have skills:

- critical analysis, evaluation and comparison of various scientific theories and ideas;
- analytical and experimental research activities;
- planning and forecasting research results;
- oratory and public speaking at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordinating and implementing research processes;
- a systematic understanding of the field of study and demonstrate the quality and effectiveness of selected scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership and team management;
- responsible and creative attitude to scientific and scientific-pedagogical activity;
- carrying out patent search and experience in transferring scientific information using modern information and innovative technologies;
- protection of intellectual property rights to scientific discoveries and developments;
- free communication in a foreign language;

5) be competent:

- in the field of scientific and educational activities in the context of rapid updating and growth of information flows;
- in carrying out theoretical and experimental research;
- in the formulation and solution of theoretical and applied problems in scientific research;
- in carrying out professional and comprehensive analysis of problems in the relevant field;
- in matters of interpersonal communication and human resource management;
- in matters of university training specialists;
- in the examination of scientific projects and research;
- in ensuring continuous professional growth.

3.2 Requirements for the research development of the PhD student:

- 1) compliance with the main issues of the doctoral education program, which defends a doctoral dissertation;
- 2) relevant and contains scientific novelty and practical significance;
- 3) is based on modern theoretical, methodological and technological achievements of science and practice;

4) is based on modern methods of processing and interpreting data using computer technology;

5) is performed using modern scientific research methods;

6) contains research (methodical, practical) sections on the main protected provisions.

3.3 Requirements for the organization of practices:

The practice is carried out in order to develop practical skills of scientific, scientific, pedagogical and professional activities.

Doctoral education program includes:

1) pedagogical and research practice - for students on the program of the doctor of philosophy;

2) practical training - for students under the program of specialized doctoral studies.

In the period of teaching practice, doctoral students, if necessary, are invited to conduct classes in undergraduate and graduate programs.

The research practice of the doctoral candidate is carried out with the purpose of studying the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as consolidating practical skills, applying modern methods of scientific research, processing and interpreting experimental data in the dissertation research.

The internship of a doctoral candidate is carried out in order to consolidate the theoretical knowledge gained in the learning process, and improve the professional level.

The content of research and industrial practice is determined by the theme of the doctoral dissertation.

4 Working curriculum of the educational program

4.1. Training period 3 years

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



APPROVED

Rector KazNRTU named after K. I. Satpayev
 Beyssembetov I.K.
 « 25.05. 2020.

MODULAR EDUCATIONAL PROGRAM

Education program 8D07110 - "Digital engineering of machines and equipment"

Full-time study		Term of study: 3 years	Academic Degree: Doctor of Philosophy (PhD)							
Cycle	Code	Name of course	Semester	Academic credits	lecture	laboratory	practice	MSIW	Type of control	Department
Profile training module (45 credits)										
Basic disciplines (BD)										
Institute component										
BD 1.1.1	LNG304	Academic writing	1	6	2	0	1	3	Exam	EL
BD 1.2.1	MET321	Research methods	1	6	2	0	1	3	Exam	MPHE&TSM
Optional component										
BD1.3.1	TEC302	Innovative methods for processing experimental results	1	6	2	0	1	3	Exam	TMT&L
BD1.3.2	TEC303	Methods of search and analysis of scientific and technical information								
Practice-oriented module										
	AAP350	Pedagogical practice	2	10					Report	TMT&L
Profile disciplines (PD)										
Optional component										
Module of innovative technologies and equipment										
PD1.1.1	TEC304	Innovative technology and technology in science and production	1	6	2	0	1	3	Exam	TMT&L
PD1.1.2	TEC305	Methods and tools for diagnosing the technical condition of machines and mechanisms								
PD1.2.1	TEC307	Digitization of operational and service processes	1	6	2	0	1	3	Exam	TMT&L
PD1.2.2	TEC309	Digital technologies in science and education								
Practice-oriented module										
	AAP349	Research scientific training	3	10					Report	TMT&L
Research module										
AAP	AAP345	Doctoral student research work, including internships and doctoral dissertations	2	24					Report	
AAP	AAP345	Doctoral student research work, including internships and doctoral dissertations	3	24					Report	
AAP	AAP346	Doctoral student research work, including internships and doctoral dissertations	4	25					Report	
AAP	AAP346	Doctoral student research work, including internships and doctoral dissertations	5	25					Report	

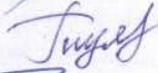
AAP	AAP346	Doctoral student research work, including internships and doctoral dissertations	6	25					Report	
The module final assessment										
FA	ECA303	Writing and defending a doctoral dissertation	6	12					Defense of dissertati ons	
In total:				185						

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

The third level descriptors within the framework of the Comprehensive Qualifications Framework of the European Higher Education Area (RC-EHEA) reflect the learning outcomes that characterize the learner’s abilities:

- 1) demonstrate a systematic understanding of the field of study, mastering the skills and research methods used in the field of digital engineering of machinery and equipment;
- 2) demonstrate the ability to think, design, implement and adapt the essential research process with a scientific approach;
- 3) to contribute by own original research to the expansion of the boundaries of the scientific field, which deserves publication at the national or international level;
- 4) critically analyze, evaluate and synthesize new and complex ideas;
- 5) communicate their knowledge and achievements to colleagues, the scientific community and the general public;
- 6) to promote the advancement in the academic and professional context of the technological, social or cultural development of a society based on knowledge.

6 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 data on 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, and 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 Brief Course Description

Research Methodology

CODE- MET321

CREDIT – 6 (2/0/1/3)

The purpose of the discipline is to develop doctoral students ' knowledge about approaches to solving fundamental and applied problems, innovations and innovation processes, and to develop their abilities in the methodology of forming scientific theories. Based on the analysis, systematization and generalization of research results in the field of geological exploration through the use of a complex of geological and geophysical methods, to develop the ability of doctoral students to apply their knowledge in the process of fundamental geological research; solutions to applied geological research; development of forecast maps; marketing and implementation of developments in geological exploration organizations.

BRIEF DESCRIPTION

In the course of studying the discipline, doctoral students will have knowledge in the field of science, its specifics and structure, will consider the social functions of science and the subject and tasks of scientific research. Special attention will be paid to the main features of the development of science, the concept of scientific revolutions. The course will cover methods of empirical research. Observation. Experiment. Measurements. High-quality modeling. Methods of theoretical research. Abstracting and idealizing. Formalization. Scientific fact. Generalization. System analysis. Quantitative modeling. Methods of applied research. General logical research methods. Analysis. Synthesis. Analogy. Private and special methods of scientific research. Innovative method. Methods of analysis and organization of innovation implementation. The process of innovation implementation. At the end of the course, doctoral students must acquire knowledge and practical skills in applying theoretical and practical knowledge in the process of conducting independent scientific research, process fundamental and current scientific information in the chosen direction, independently make generalizations and scientific conclusions.

Academic writing

CODE-LNG304

CREDIT – 6 (2/0/1/3)

The aim of the course is to develop skills and competencies in the field of research and development of skills in writing qualifying research. The study of the discipline is based on the development and improvement of skills in the field of written scientific and methodological communication, which provides a high level of training for doctoral students, necessary for effective communication in the scientific and academic environment. The objectives of the discipline are to familiarize doctoral students with the basic requirements for writing in a scientific language; formation of skills to Express reasoned ideas and opinions in writing, using professional vocabulary and terminology; development of text editing skills; teaching techniques for correct and logical

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construction of the structure of scientific research; preparation for writing articles, scientific papers and annotations; learning techniques for free and reasoned presentation of thoughts on a scientific professional problem.

Methods of search and analysis of scientific and technical information

CODE-TEC303

CREDIT – 6 (2/0/1/3)

COURSE GOALS AND OBJECTIVES

During the course, students will be introduced to the methods of searching, systematization, processing and analysis of large amounts of scientific and technical information using modern applications and information systems; methods of processing and analysis of archival materials on paper and their digitization for subsequent use of information systems. Their acquisition of knowledge and skills of rational search, selection, accounting, analysis, processing and use of information by various methods and methods in a variety of sources.

The main objectives of the discipline are:

- instill a culture of design of research papers based on the standard
- learn how to use bibliographic, abstract, and full-text databases at all stages of research: search, order, study, analyze, Refine information about special literature, and design research results;
- teach the rules of bibliographic description of electronic documents in General and their components in bibliographic references and references based on GOST Standards.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

- the possibility of using foreign languages to study articles from the archives of scientific journals published in foreign electronic resources
- theoretical foundations of scientific research; normative documents, standards, including the design of research reports and bibliographic descriptions of literature sources;
- problems in the field of production technology, equipment operation, production organization;
- use various sources of scientific and technical information;
- formulate and solve problems that arise in the course of research and require in-depth professional knowledge;
- draw conclusions and formulate recommendations for practical use of the research results.

Innovative methods for processing experimental results

CODE-TEC302

CREDIT – 6 (2/0/1/3)

COURSE GOALS AND OBJECTIVES

The purpose of mastering the discipline "Innovative methods for processing experimental results" is a strict concise presentation of the basics of the modern theory of engineering and physical experiment, focused on its practical use, both in research laboratories and in

the preparation of doctoral theses. The main goal is to gain practical mastery of mathematical methods for processing experimental data.

The objectives of the discipline are:

- introduction to the directions and features of research in the field of digitalization of machinery and equipment;
- introduction to the main stages of research;
- study of methods for organizing and conducting experimental research;
- study of methods for processing and presenting experimental results;
- study of methods of digitalization and automation of experimental research.

BRIEF DESCRIPTION

The course program includes the study of methods for planning experiments, determining their number to obtain reliable results. Skills are acquired in using The box Wilson method of steep ascent. The possibilities of programs for static processing of results of laboratory and industrial experiments are studied. Methods of constructing graphs and empirical formulas with obtaining characteristics of reliability, tightness of connection, coefficient of variation, and other indicators are mastered.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, students must demonstrate the following educational results:

Know:

- modern methods of research of processes and phenomena in the professional field of activity;
- modern methods of mathematical processing of experimental results;
- modern regulatory documents and requirements for the presentation and registration of experimental results.

To be able to:

to perform the processing of the research results of modern mathematical methods;

- use the idea of the methodological foundations of scientific knowledge and creativity, the role of scientific information in the development of science;
- perform a literary review of scientific and technical literature on a given topic, including with the involvement of information technologies, critically analyze and synthesize information;
- interpret and present research results;
- formalize the results of scientific research in the form of scientific and technical reports in accordance with GOST, make abstracts, prepare scientific publications.

Own:

- the ability to use the idea of the methodological foundations of knowledge in the development of science;
- skills to independently analyze the scientific essence of research problems, the ability to solve problems that arise in the course of research activities;
- willingness to use the latest achievements of science and advanced technologies in research work;

- the ability to plan and set goals and form research tasks, choose methods of experimental work;
- willingness to present research results in the form of reports, abstracts, scientific publications and scientific discussions.

Innovative equipment and technologies in science and production

CODE-TEC304

CREDIT – 6 (2/0/1/3)

COURSE GOALS AND OBJECTIVES

- formation of knowledge about the types, features, and current problems of development of industrial technologies and innovations used in the activities of enterprises, development of the necessary skills for their application.
- the ability to choose the necessary research methods, modify existing ones and develop new methods based on the tasks of a particular study;
- choose the necessary research methods, modify existing ones and develop new methods based on the tasks of a particular study

BRIEF DESCRIPTION

The course program includes questions related to new methods of forecasting engineering structures with reference to promising technologies. Innovative methods for assessing the quality of equipment and methods for selecting operational parameters are being developed. Special attention is paid to the digitalization of these processes, promising techniques for parameter control and decision-making methods. Studies the world experience in improving equipment and technologies.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

- principles, forms and methods of organization of production and technological processes; innovative technologies and equipment.
- ability to develop a plan and program for the organization of innovative activities of the research and production division, to carry out a feasibility study of innovative projects and programs

Methods and tools for diagnosing the technical condition of machines and mechanisms

CODE-TEC305

CREDIT – 6 (2/0/1/3)

GOALS OF MASTERING THE DISCIPLINE

The purpose of the discipline is to develop doctoral students' knowledge and skills in the application of digital methods for predicting the technical condition and reliability of objects, studying the basics of the theory of diagnostics, studying the basic concepts, techniques and innovative methods for diagnosing the technical condition of parts, mechanisms and products.

The objectives of the discipline are determined by the requirements of the qualification characteristics of the specialty and are aimed at teaching undergraduates to use digital

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computer technologies and forms of organization of diagnostics in the maintenance and repair of technological machines and equipment, as well as to use in practice the data of assessing the technical condition of technological machines and equipment obtained using digital diagnostic equipment and indirect signs.

BRIEF DESCRIPTION

The course program includes the study of the application of technical diagnostics to maintain machines in working condition; methods for predicting their resource based on the results of technical diagnostics using modern tools and calculation programs, the study of modern instrumental methods and diagnostic tools, digitalization of parameter control, determination of the technical condition and monitoring of machines and mechanisms.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of studying the course, masters should:

Know:

- the main provisions of the theory of measurement
- classification of types, methods and technical digital diagnostic tools;
- fundamentals of ensuring the unity of measurement;
- ways to determine the source data for diagnostics;
- features of diagnostics of specific types of machines and equipment in accordance with the specialty;
- the content and sequence of work when taking readings, processing measurement results and obtaining a conclusion about the equipment being diagnosed;
- criteria for the operability of technological equipment;
- basic guidelines and technical materials used for digital diagnostics of various machines and equipment;
- rules for performing functional diagrams of the object being diagnosed;
- methods for processing measurement results and justifying decisions;
- trends in the development of technical diagnostics;
- types, role and significance of conformity assessment of the technical condition of machinery and equipment;
- basic digital circuits and types of diagnostics;
- basic provisions and principles of quality management for digital diagnostics of the technical condition of machines;
- methods for detecting and eliminating errors in digital diagnostics;
- methods of controlling the quality of digital diagnosis;

Be able to:

- reasonably apply methods of digital technical diagnostics;
- select measuring instruments for specific application conditions;
- perform the simplest processing of the results of multiple measurements;
- calculate the main characteristics of digital diagnostic parameters;
- calculate the simplest dimensional chains;
- to use the normative documents in its activities;

- prepare and execute scientific, technical and service documentation.
- implement data collection of regulatory documents to perform the work via digital diagnostics of machinery and equipment;
- plan the stages of digital diagnostics;
- analyze the results of quantitative evaluation of diagnostic parameters;
- apply a process approach in practice, combine theory and practice;
- analyze the use of the principles of the quality management system;

Possess:

- methods and technologies of digital equipment diagnostics;
- skills in working with digital diagnostics tools.

Digitalization of operational and service processes

CODE-TEC307

CREDIT – 6 (2/0/1/3)

COURSE GOALS AND OBJECTIVES

The purpose of the discipline is to familiarize doctoral students with the basics of digitalization of technological processes in the operational and service production of machinery and equipment.

Tasks of the disciplines:

- introduction to methods of improving the efficiency of technological processes and production using digital technologies;
- study of technologies with the use of digital sensors and microprocessor technology, remote monitoring and control of parameters of technological machines;
- modeling of production situations and optimization of material and labor resources in the management of repair and service facilities.

BRIEF DESCRIPTION

As a result of studying the course, doctoral students should:

Know:

- digital means of measuring the performance of technological equipment, their scope, device and design features;
- main technological parameters of devices and functional blocks of technological equipment and methods of their measurement – - technical and metrological characteristics of devices and functional blocks of automation systems;
- methods of diagnostics and restoration of operability of technological equipment, individual mechanisms and components;

Be able to:

- perform technical control of compliance of device parameters and functional blocks of digitalization and automation systems with established standards;
- choose diagnostic methods and measurement tools to identify the causes of malfunctions and failures;
- evaluate the performance of devices and functional blocks of digitalization and automation systems based on indicators of technical diagnostic tools;

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- calculate reliability indicators of devices and functional blocks of automation systems;
- identify the causes of malfunctions and failures of devices and functional blocks of technological equipment using visual control

Digital technologies in science and education

CODE-TEC309

CREDIT – 6 (2/0/1/3)

COURSE GOALS AND OBJECTIVES

Formation of skills to work with the main information technologies in educational and research activities, identification of priority areas for the development of the educational process based on the analysis of the possibilities of digital technologies, based on the hypothesis of the need for their scientifically based implementation in the work of organizations of higher and professional education, based on the culturological approach developed in Russian science.

BRIEF DESCRIPTION OF THE COURSE

The course program includes the study of the use of digital technologies in science and education - in the search, processing and analysis of large amounts of scientific and technical information using special computer programs; in the use of digital technologies and software tools in modeling and research of technological objects; in modeling and creating new equipment samples; in pedagogical practice when presenting educational materials and evaluating residual knowledge.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

- the ability to put into practice the skills and abilities in the organization of research and project work using information technology.

Doctoral dissertation defense

CODE-ECA303

The CREDIT is 12

The purpose of completing the doctoral thesis is the evaluation of the scientific-theoretical and research / analysis level students formed their professional and managerial skills, readiness for independent performance of professional tasks and its compliance with the training requirements of professional standards and educational programs of doctoral studies.

BRIEF DESCRIPTION

Doctoral thesis – scientific work of doctoral candidate, which is an independent study which developed the theoretical principles, the totality of which can be qualified as a new scientific breakthrough, or solved a scientific problem, or set forth scientifically grounded technological, economic or technological solutions, implementation of which makes a significant contribution to the economic development of the country.

Doctoral dissertation-the result of research/experimental research work of a doctoral student, conducted during the entire period of study of the doctoral student.

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The defense of a doctoral dissertation is the final stage of preparation of a doctoral student. The doctoral dissertation must meet the following requirements –

- the topic of the dissertation must be related to priority areas of scientific development and / or state programs or programs of fundamental or applied research;
- the content of the dissertation, the goals and objectives set, and the scientific results obtained must strictly correspond to the topic of the dissertation;
- the dissertation is carried out in compliance with the principles of independence, internal unity, scientific novelty, reliability and practical value.

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