NJSC Kazakh National Research Technical University named after K.I. Satpayev
Institute of Automation and Information Technologies
Department of Software Engineering

Working educational program
CURRICULUM PROGRAM

"Software Engineering"
PhD
in the field of Information and Communication Technologies under the Educational Program
“8D06101- Software Engineering»

2nd edition
in accordance with the State Standard of Higher Education 2022

Almaty 2022

The program is drawn up and signed by the parties:
From KazNRTU named after K.I. Satpayeva:

1. Director of the Institute of Automation and Information Technologies (IAaIT), Doctor of Technical Sciences, Professor — R.K. Uskenbaeva
2. Head of the Department of Software Engineering (SE), Ph.D., Associate Professor — A.N. Moldagulova

3. Deputy Director of IAaIT, PhD — A.B. Kasymova

4. Member of the educational and methodological group of the department of SE, PhD — N.K. Mukazhanov

Qualification:
Level 8 of the National Qualifications Framework
8D06 Information and communication technologies

Professional competencies: Software development

Brief description of the program:

1 Goals

The main focus of the doctoral program is on in-depth study of software development technologies, understanding the architecture of computer systems, and expanding knowledge in the field of development paradigms for distributed, resilient network applications.

The program is aimed at preparing a scientist who is able to independently conduct scientific research, independently develop complex software solutions, work in a team, and navigate modern Information Technologies. The educational program is built taking into account the current state of scientific and technological progress and trends in software development.

The development of the educational program was carried out on the basis of 3 documents defining directions and specializations in the field of IT - SWEBOK, the purpose of which is to combine knowledge in software engineering; SE2004 - training manual for training specialists in university programs in the field of software engineering; CC2005 - guidelines for the development of training programs for IT professionals. A team of international IT specialists has identified a set of areas of study and a set of disciplines that provide quality training in IT (CC2005), as well as the thematic composition of disciplines and a set of knowledge necessary and sufficient for IT specialists (SWEBOK, SE2004).

This educational program “Software Engineering” was developed on the basis of the main regulatory documents:

- State compulsory standard of technical and professional education, approved by Decree of the Government of the Republic of Kazakhstan dated August 23, 2012 No. 1080 (as amended as of August 15, 2017). Footnote. Clause 1 as amended by the Decree of the Government of the Republic of Kazakhstan dated 04/25/2015 No. 327 (put into effect from 09/01/2016); dated 05/13/2016 No. 292 (put into effect from 09/01/2017).
- Industry Qualification Framework (IQF). Industry: information and communication technologies. Approved by Minutes No. 1 of December 20, 2016 of the meeting of the Industry Commission in the field of information, informatization, communications and telecommunications.
- Law of the Republic of Kazakhstan “On Education” dated July 27, 2007 No. 319-III LRK;
- IEEE SWEBOK pooling knowledge on software engineering;
- CC2005 guidelines for the development of training programs for IT specialists;
- SE2004 training manual for training specialists in university programs in the field of software engineering.

The program is designed to implement the principles of democratic education management, expanding the boundaries of academic freedom and the powers of

educational institutions, which will ensure the training of elite, highly motivated personnel for innovative and knowledge-intensive sectors of the economy.

The educational program was developed based on an analysis of the labor functions of software engineers, system administrators, and data analysts, as stated in professional standards.

Representatives of Kazakh companies in the field of software product development participated in the development of the educational program.

2 Types of work activity

The program is aimed at the following areas of professional activity:

- Software development
- Distributed computing and data storage

Types of work activity:

- design and engineering;
- production and technological;
- experimental research;
- organizational and managerial;
- operational;
- scientific

3 Objects of professional activity

The objects of professional activity are:

- Computers, complexes, systems and networks;
- Computer systems for information processing and management;
- Automated control systems;
- Computer software.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

The educational program for the preparation of a Doctor of Philosophy (PhD) 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 preparing a PhD doctor in the field involves fundamental educational, methodological and research training and in-depth study of disciplines in relevant areas of science for sectors of the national economy, social sphere: information and communication technologies.

Doctoral educational programs in terms of professional training are developed on the basis of studying the experience of foreign universities and research centers that implement accredited training programs for PhDs or doctors in a specialized field.

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

The main criterion for the completion of the educational process for the preparation of Doctors of Philosophy (PhD) (doctors in the field) is the completion of at least 180 academic credits by the doctoral student, including all types of educational and scientific activities.

The duration of doctoral studies is determined by the volume of completed academic credits. When mastering the established volume of academic credits and achieving the expected learning outcomes for obtaining a Doctor of Philosophy (PhD) degree or according to the profile, the doctoral educational program is considered fully mastered.

Doctoral training is carried out on the basis of master's degree programs in two areas:

1) scientific and pedagogical with a period of study of at least three years;

2) specialized with a period of study of at least three years.

Contents of the OP

- General educational complex of disciplines
- Disciplines of software development methodologies
- Network application development disciplines
- Database development disciplines
- Disciplines of software development project management

Objectives of the educational program:

To provide practice-oriented training for scientific and production specialists in the field of software product development, who are able to apply various technologies, knowledge and skills of software development and project activities.

To prepare specialists in scientific activities and production for production and technological activities related to the process of development and modification of software products aimed at meeting the expectations and requirements of users, for organizational and managerial activities related to the maintenance of software products of various classes and categories, and management of information systems.

Create conditions for continuous professional self-improvement, development of social and personal competencies (broad cultural outlook, active citizenship, determination, organization, hard work, communication skills, ability to reason and make organizational and managerial decisions, mastery of modern information technologies, fluency in several languages, desire to self-development and commitment to ethical values and a healthy lifestyle, the ability to work in a team, responsibility for the final result of one's professional activities, civic responsibility, tolerance), social mobility and competitiveness in the labor market.

2 Admission requirements

Doctoral studies accept persons who have a master's degree and work experience of at least 1 (one) year or who have completed residency training.

Admission to the number of doctoral students is carried out by the selection committees of universities and scientific organizations based on the results of the entrance exam for groups of doctoral educational programs and a certificate confirming knowledge of a foreign language in accordance with the pan-European competencies (standards) of foreign language proficiency.

When enrolling in universities, doctoral students independently choose an educational program from the appropriate 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 admitting citizens to doctoral studies is established in accordance with the "Standard Rules for Admission to Study in Educational Organizations Implementing Educational Programs of Postgraduate Education."

The formation of a contingent of doctoral students is carried out by placing a state educational order for the training of scientific and teaching personnel, as well as paying for training at the expense of citizens' own funds and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive, on a competitive basis, in accordance with the state educational order, free postgraduate education if they are receiving education at this level for the first time.

At the "entrance", the doctoral student must have all the prerequisites necessary to master 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 paid basis. In this case, doctoral studies begin after the doctoral student has fully mastered the prerequisites .

3 Requirements for completion of training and obtaining a diploma

Persons who have mastered the doctoral educational program and defended their doctoral dissertation, with a positive decision by the dissertation councils of a university with a special status or the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, based on the results of the examination, are awarded the degree of Doctor of Philosophy (PhD) or Doctor of Philosophy profile and is issued a state diploma with an appendix (transcript).

Persons who have received a PhD degree , to deepen scientific knowledge, solve scientific and applied problems on a specialized topic, carry out a postdoctoral program or conduct scientific research under the guidance of a leading scientist at a selected university.

3.1 Requirements for key competencies of doctoral graduates:

1) have an idea:

- about the main stages of development and paradigm shifts in the evolution of science;

- about the subject, ideological and methodological specifics of natural (social, humanitarian, economic) sciences;
- about scientific schools of the relevant field of knowledge, their theoretical and practical developments;
- about scientific concepts of world and Kazakhstani science in the relevant field;
- on the mechanism for introducing scientific developments into practical activities;
- about the norms of interaction in the scientific community;
- about the pedagogical and scientific ethics of the research scientist;

2) know and understand:

- modern trends, directions and patterns of development of domestic science in the conditions of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of world and Kazakhstani science in the relevant field;
- realize and accept the social responsibility of science and education;
- fluent foreign language for scientific communication and international cooperation;

3) be able to:

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

4) have the skills:

- critical analysis, evaluation and comparison of various scientific theories and ideas;
- analytical and experimental scientific 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 scientific research processes;
- systematic understanding of the field of study and demonstrate the quality and effectiveness of the selected scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team management;
- responsible and creative attitude towards scientific and scientific-pedagogical activities;
- conducting patent searches 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 scientific-pedagogical activities in conditions of rapid updating and growth of information flows;
- in conducting theoretical and experimental scientific research;
- in setting and solving theoretical and applied problems in scientific research;
- in conducting a professional and comprehensive analysis of problems in the relevant field;
- in matters of interpersonal communication and human resource management;
- in matters of university training of specialists;
- in conducting examination of scientific projects and research;
- in ensuring continuous professional growth.

3.2 Requirements for research and development work for a student in the Doctor of Philosophy (PhD) program:

1) compliance with the main issues of the doctoral educational program on which the doctoral dissertation is being defended;

2) is 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 data processing and interpretation using computer technology;

5) is carried out using modern scientific research methods;

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

3.3 Requirements for organizing practices:

The internship is carried out with the aim of developing practical skills in scientific, scientific-pedagogical and professional activities.

The doctoral educational program includes:

1) teaching and research practice - for students in the Doctor of Philosophy program;

2) industrial practice – for students in a specialized doctoral program.

During the period of teaching practice, doctoral students, if necessary, are involved in conducting classes in undergraduate and graduate courses.

The doctoral student's research practice is carried out with the aim 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 dissertation research.

The doctoral student's practical training is carried out with the aim of consolidating the theoretical knowledge acquired during the training process and improving the professional level.

The content of research and production practice is determined by the topic of the doctoral dissertation.

4 Working curriculum of the educational program

4.1.

Форма обучения: очная Срок обучения: 3 года Академическая степень: Доктор PhD

Код дисциплины	Наименование дисциплин	Цикл	Общий объём в кредитах	Всего часов	Аудиторный объём лек/лаб/пр	СРО (в том числе СРОП)	Форма контроля	Распределение аудиторных занятий по курсам и					
								1 курс		2 курс			
								1 семестр	2 семестр	3 семестр	4 семестр	5 семестр	6 семестр
ЦИКЛ БАЗОВЫХ ДИСЦИПЛИН (БД)													
М-1. Модуль базовой подготовки (вузовский компонент)													
MET322	Методы научных исследований	БД ВК	5	150	2/0/1	105	Э	5					
LNG305	Академическое письмо	БД ВК	5	150	0/0/3	105	Э	5					
компонент по выбору													
CSE305	Фундаментальные основы распределенных интеллектуальных систем	БД КВ	5	150	2/0/1	105	Э	5					
CSE306	Big Data Storage Systems And Computations												
ЦИКЛ ПРОФИЛИРУЮЩИХ ДИСЦИПЛИН (ПД)													
М-2. Модуль профильной подготовки (компонент по выбору)													
CSE302	Research Projects For Software Development	ПД КВ	5	150	2/0/1	105	Э	5					
CSE307	High Load Distributed Computing												
CSE323	Теория и технология Blockchain	ПД КВ	5	150	1/1/1	105	Э	5					
CSE327	Прогнозная аналитика и интеллектуальный анализ данных												
М-3. Практико-ориентированный модуль													
AAP350	Педагогическая практика	БД ВК	10						10				
AAP355	Исследовательская практика	ПД ВК	10							10			
М-4. Научно-исследовательский модуль													
AAP336	Научно-исследовательская работа докторанта, включая прохождения стажировки и выполнение докторской диссертации	НИРД (ВК)	5					5					
AAP347	Научно-исследовательская работа докторанта, включая прохождения стажировки и выполнение докторской диссертации	НИРД (ВК)	40						20	20			
AAP356	Научно-исследовательская работа докторанта, включая прохождения стажировки и выполнение докторской диссертации	НИРД (ВК)	60								30	30	
AAP348	Научно-исследовательская работа докторанта, включая прохождения стажировки и выполнение докторской диссертации	НИРД (ВК)	18										18
М-5. Модуль итоговой аттестации													
ECA303	Написание и защита докторской диссертации	ИА	12										12
Итого по УНИВЕРСИТЕТУ:								30	30	30	30	30	30

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

The third level descriptors within the Comprehensive Qualifications Framework of the European Higher Education Area (CQ-EHEA) reflect learning outcomes that characterize the student's abilities:

1) demonstrate a systematic understanding of the field of study, mastery of skills and research methods used in the field of software development;

2) demonstrate the ability to think, design, implement and adapt a substantial research process with a scientific approach;

3) contribute with their own original research to expand 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 your knowledge and achievements to colleagues, the scientific community and the general public;

6) promote, in academic and professional contexts, the technological, social or cultural development of society based on knowledge.

In the process of mastering the educational program, a Doctor of Philosophy must have the following key competencies.

A – knowledge and understanding:

A1 – Architectures and types of computers;
A2 – Operating systems;
A3 – Programming languages;
A4 – Programming technologies;
A5 – Database models;
A6 – Methods for organizing authorized access to data;
A7 – Protocols for interaction of computer systems;
A8 – Interprocessor communication architectures;
A9 – Methods for automating business processes ;
A10 – Models and types of data analysis;
A11 – Principles and models of artificial intelligence;
A12 – Techniques for modeling, composition and decomposition of systems;
A13 – Principles of consistency and integrity;
A14 – Methods of system/structural analysis;
A15 – Software life cycle;
A16 – UML – as a basic tool for describing technical systems;
A17 – SQL – as a basic data management tool;
A18 – Typical architectures of information systems/software;

A19 – Types of software;
A20 – Process design methods;
A21 – Methods for designing software interfaces;
A22 – And software design/development/debugging/maintenance tools;
A23 – Basic algorithms and data structures;
A24 – Standards, methodological and regulatory materials for software development;
A25 – Methods and models of conducting scientific activities;
A26 – Basic approaches, tools and models for managing project activities;
A27 – standards for building IT infrastructure.

B – application of knowledge and understanding:

B1 - Analysis of the subject area, determination of goals, objectives and methods for achieving the planned result of the project/research;
B2 - Determining deadlines for completing tasks, creating specifications of requirements and technical specifications;
B3 - Formalization of tasks, determining the priority of their implementation;
B4 - Selection of optimal ways to solve problems;
B5 - Planning the stages of the project;
B6 - Modeling the structure of the subject area;
B7 - Determination of functional and operational requirements for system components;
B8 - Using UML standards to present technical documentation, diagrams, models;
B9 — Maintaining protocols of project implementation;
B10 — Generation of reporting documentation;
B11 - Design of database models;
B12 - Development and design of software interfaces;
B13 - Construction of algorithms for computational processes;
B14 — Writing /testing/debugging/maintenance/integration of program codes and products;
B15 — Creation of decision-making systems based on Artificial Intelligence models
B16 — Creation /Support/Audit of IT infrastructure;

C – formation of judgments:

C 1 — About trends in IT
C 2 - On the applicability of tools and technologies to solve the problem
C 3 — On the adequacy of the designed model
C4 - On the effectiveness of the methods and models used

D – personal abilities *:*

D 1 - Ability to set goals and plan ways to achieve them
D 2 — Ability to conduct project/operational activities
D3 - Ability to conduct scientific research
D 4 — Ability to organize the work of the IT department
D5 - Ability to organize work on collecting, storing and processing information used in the field of professional activity

ECTS Diploma Supplement

The application was developed according to the standards of the European Commission, Council of Europe and UNESCO/CEPES. This document serves only for academic recognition and is not an official confirmation of an educational document. Not valid without a higher education diploma. The purpose of completing the European Annex is to provide sufficient information about the diploma holder, the qualifications he has 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 used to transfer grades 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 confirm national higher education for foreign employers. When traveling abroad for professional recognition, additional legalization of an education diploma will be required. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

7 Description of disciplines

English for Research Purposes

CODE – LNG301
CREDIT – 6 (0/0/3)
PREREQUISITE – ENGLISH LEVEL C2/B2

PURPOSE AND OBJECTIVES OF THE COURSE
Introduce students to the world of scientific writing to more effectively develop their scientific writing skills.

BRIEF DESCRIPTION OF THE COURSE

The course aims to develop writing, reading and speaking skills, and to communicate progress in their research to support ideas rather than simply summarizing other people's work, and to encourage students to take a variety of approaches to their own learning.

KNOWLEDGE , ABILITIES, SKILLS AT COMPLETION OF THE COURSE
Understand basic information and language of scientific presentations; understand how the material is organized, listen to the main points of scientific speech, review the text to understand its main idea, style and purpose; predict the content of a text, scan text for specific information, take notes and use them to write summaries, analyze the structure of a research paper, recognize the cohesion of paragraphs, organize information logically, write research papers in an area of study, participate in discussion, offer and respond to opinions.

Big Data Storage Systems & Computations

CODE -
CREDIT – 6 (0/0/3)
PREREQUISITE – ENGLISH LEVEL C2/B2

PURPOSE AND OBJECTIVES OF THE COURSE

The goal of the discipline is to master the principles and obtain practical skills in organizing and technologies for storing, transforming and analytical processing of big data. Construction of algorithms and models for processing big data.

The objectives of the course are to develop skills in researching the use of tools for working with big data in information systems to solve practical problems.

BRIEF DESCRIPTION OF THE COURSE

The discipline examines the theoretical and practical aspects of using big data technologies in information systems. The lecture course examines trends in the development of infrastructure solutions for processing and storing big data.

KNOWLEDGE , ABILITIES, SKILLS AT COMPLETION OF THE COURSE

must know:
- basic principles of using big data in enterprise architecture;
- basic methods of analytical processing of big data;

should be able to:
- use MapReduce technologies and software built on the basis of software when working with big data

High Load Distributed Computing

CODE -
CREDIT – 6 (0/0/3)
PREREQUISITE – ENGLISH LEVEL C2/B2

PURPOSE AND OBJECTIVES OF THE COURSE

The goal is to master models for building high-load systems
Tasks:

- Analysis of problems where models of high-load systems are used
- Operating principles of high-load systems and limitations
- Analysis of software products designed to solve problems of building high-load systems

BRIEF DESCRIPTION OF THE COURSE

The course is based on modern problems of building scalable systems. The main task is to overcome the systems of limitations imposed by hardware by optimally distributing the load on each link of the computer. Thus, determining the architecture that best meets the requirements for the number of requests processed by end systems. Building high-load systems is not a trivial task, which has led to the emergence of a large number of software products, and also forced large companies to expand the product line and functionality of existing ones. In many tasks for building high-load systems, combinations of approaches and software products are used to achieve maximum system efficiency. It is these practical approaches that are studied within disciplines and such software products as Redis , RabbitMQ , Orleans , Ceph .

KNOWLEDGE , ABILITIES, SKILLS AT COMPLETION OF THE COURSE
Upon completion of the course, students will:

- Know the nature of the problem in high-load systems
- Class of problems of high-load systems
- Models for building high-load systems
- Software products for building high-load systems

Know

- Software for building high-load systems

Be able to

- Apply models and techniques for building high-load systems

Virtualization and Containerization Technology

CODE – LNG201
CREDIT – 6 (0/0/3)
PREREQUISITE – ENGLISH LEVEL C2/B2

PURPOSE AND OBJECTIVES OF THE COURSE

The goal is to master models for building scalable systems based on virtualization and containerization. Studying the basic software models of virtual machines, studying the basic software models of containers.
Tasks:

- Exploring the concepts of virtualization and containerization
- Exploring the concept of orchestration

BRIEF DESCRIPTION OF THE COURSE

The course covers the fundamentals of building a virtual machine infrastructure and supporting virtualization hardware. As well as support for the software part of containerization. Studying the source codes of existing virtualization and containerization projects. The course is based on modern requirements and trends towards building loosely coupled scalable information systems. The microservice model regulates the approach of fragmenting complex solutions, classically built as a monolithic software module, into loosely coupled elements that interact with each other through asynchronous messages. This allows you to develop each of the modules independently and focus on specific system performance if necessary. Such systems are characterized by a high degree of fault tolerance , since each component is as autonomous as possible. Such approaches require a revision of classical solutions towards the implementation of the integrity model with alternative approaches, since in most cases there is no direct connection between objects of different modules. Also, the microservices model relies as much as possible on the concept of asynchronous interaction, which imposes its own obligations to model the integrity and guarantee the execution of the operation in each individual case independently.

KNOWLEDGE , ABILITIES, SKILLS AT COMPLETION OF THE COURSE
Upon completion of the course students will:
Understand

- What is a virtual machine
- What is a container

Know

- Virtualization and containerization platforms

Be able to

- Apply microservice architecture to build scalable information systems

Machine Learning & Deep Learning

CODE -
CREDIT – 6 (0/0/3)
PREREQUISITE – ENGLISH LEVEL C2/B2

PURPOSE AND OBJECTIVES OF THE COURSE

The goal of the course is to master the basic theory and practice of machine learning methods based on widely used open access libraries. Learn to apply machine learning models in practical software development problems.

Main objectives of the course:

- Consider the main machine learning models and the problems they solve
- Gain an understanding and experience of neural networks
- Consider modern methods of data classification and clustering
- Exploring current trends in deep learning models research

BRIEF DESCRIPTION OF THE COURSE

The course focuses on deep learning models. As a field within machine learning, deep learning models illustrate the quantitative-qualitative transition. New models and their properties require separate study and practice in tuning the metaparameters of such models.

KNOWLEDGE , ABILITIES, SKILLS AT COMPLETION OF THE COURSE
Upon completion of the course students will:
Understand

- Features of deep learning models
- Current directions of research in the field of AI

Know

- Objectives and applications of deep learning models

Be able to

- Use machine learning models

The doctoral educational program includes:

- research practice;
- industrial practice .

The doctoral student's research practice is carried out with the aim 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 dissertation research.

The doctoral student's practical training is carried out with the aim of consolidating the theoretical knowledge acquired during the training process and improving the professional level.

The doctoral student's research work must:

- correspond to the main issues of the specialty in which the doctoral dissertation is being defended;
- be relevant, contain scientific novelty and practical significance;
- be based on modern theoretical, methodological and technological achievements of science and practice;
- be based on modern methods of data processing and interpretation using computer technology;
- be carried out using modern scientific research methods;
- contain research (methodological, practical) sections on the main protected provisions.

The experimental research work of a doctoral student must:

- correspond to the main issues of the specialty in which the doctoral dissertation is being defended;
- be relevant, contain scientific novelty and practical significance;
- be based on modern achievements of science, technology and production and contain specific practical recommendations, independent solutions to management problems of a complex, cross-functional nature;
- carried out using advanced information technologies;
- contain experimental and research (methodological, practical) sections on the main protected provisions.

Preparation and defense of a doctoral dissertation

CODE -

CREDIT – 4

PRE-REQUISITE – no

PURPOSE AND OBJECTIVES OF PREPARATION AND DEFENSE OF THE DISSERTATION

A dissertation is a qualifying scientific work in a specific specialty of an educational program for the preparation of a Doctor of Philosophy (PhD) .

The purpose of completing a doctoral dissertation is to assess the scientific-theoretical and research-analytical level of the doctoral student, the developed professional and managerial competencies, readiness to independently perform professional tasks and the compliance of his training with the requirements of the professional standard and the doctoral educational program.

The topic of the dissertation must be related to priority areas of scientific development and/or government 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.

The purpose of preparing and defending a dissertation is for the doctoral student to master the skills of independently conducting scientific research and competently presenting the research results.

The tasks of preparing and defending a dissertation are: setting research goals, theoretical and experimental research of the object, developing control algorithms and synthesizing a control system.

SUMMARY OF THE DISSERTATION

Doctoral dissertation is the scientific work of a doctoral student, which is an independent study in which theoretical principles have been developed, the totality of which can be qualified as a new scientific achievement, or a scientific problem has been solved, or scientifically based technical, economic or technological solutions have been outlined, the implementation of which makes a significant contribution to the development of the country's economy.

The main part of the dissertation must contain:

- choice of direction of research, including justification for the direction of research, methods for solving problems and their comparative assessment, description of the selected general methodology for conducting research work;
- setting the goal, object and subject of research, research objectives;
- the process of theoretical and (or) experimental research, including determining the nature and content of theoretical research, research methods, calculation methods, justification for the need for experimental work, operating principles of the developed

objects, their characteristics;

- generalization and assessment of research results, including an assessment of the completeness of the solution to the problem and proposals for further areas of work, assessment of the reliability of the results obtained and their comparison with similar results of domestic and foreign work.

Each section of the dissertation should end with main conclusions and form the basis for the next section.

The presentation in the main part of the dissertation must be strictly substantiated, holistic and logical. Spelling, grammatical and punctuation errors should not be allowed in the dissertation. The style of presentation of the dissertation text must be correct from a scientific point of view. No one's emotional judgments and statements, expressions from fiction, everyday expressions, jargon, etc. are allowed.

ACQUIRED KNOWLEDGE , SKILLS AND SKILLS

The dissertation is written independently, contains a set of new scientific results and provisions put forward by the author for public protection and testifies to the author’s personal contribution to science. New solutions proposed by the author must be reasoned and evaluated in comparison with known solutions.

A dissertation of applied significance provides information on the practical use of the scientific results obtained by the author, confirmed by copyright certificates, patents and other official documents, and a dissertation of theoretical significance provides recommendations for the use of scientific findings.

The main content of the dissertation is published in scientific, scientific-analytical and scientific-practical publications.

The main scientific results of the dissertation for the degree of Doctor of Philosophy (PhD) are published in at least 7 (seven) publications on the topic of the dissertation, including at least 3 (three) in scientific publications recommended by the authorized body, 1 (one) in international scientific publication, which, according to the information database of the Thomson Reuters company (ISI Web of Knowledge , Thomson Reuters) non-zero impact factor or included in the Scopus database , 3 (three) in the proceedings of international conferences, including 1 (one) in the proceedings of foreign conferences.

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Содержание