IJSC «Kazakh National Research Technical University» named after K.I. Satpayev»
Mining and Metallurgical Institute named after O. A. Baikonurov

Department of Materials Science, Nanotechnology and Engineering Physics

Working curriculum
CURRICULUM PROGRAM

8D07114 - "NANOMATERIALS AND NANOTECHNOLOGIES"
Doctor of Phylosophy (PhD)

«Nanomaterials and nanotechnologies»
based on the following specialty that is no longer valid in the specialty Classifier:
«6D074000-Nanomaterials and nanotechnologies»

1st edition

in accordance with the SMSE of Higher Education 2018

Almaty 2021

The program is compiled and signed by the parties:

From KazNRTU named after K. Satpayev:
1. Head of MN&EP Department _____ Kakimov U.K.
2. Director of IMM named after O.A. Baykonurov _____ Rysbekov K.B.
3. Chairman of Sc.Method.Council of MN&EP Department _____ Telesheva A.B.

Approved at the meeting of the Academic Board of the Kazakh National Research Technical University named after K. Satpayev. Minutes № 3 dated 25.06.2021.

Approved at a meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K. Satpayev. Protocol №3 from 19.12.2018.

Professional competence:

- possess information: about fundamental and applied problems in the field of nanomaterials, creation of new technologies for their production and processing and their innovative potential in near and far abroad; about the concepts and trends in the development of a new generation of materials with a unique set of properties;

- know: current trends in the development of materials science and the need for nanomaterials for special purposes; principles of implementation of scientific programs for solving fundamental and applied problems of modern nanotechnologies using information technologies and computer modeling;

- be able to: plan and organize research work and production activities; determine the main directions of development of theoretical and applied nanomaterials science; apply the methods of an analytical approach to the formation of a given level of structure and properties of materials from the standpoint of the relationship between the technological environment and the control parameters of the process;

- to have skills: representation, analysis, generalization and formation of scientific and technical problems for the implementation of innovative projects for the creation of promising and improvement of traditional technologies for obtaining nanomaterials; management of production and research activities in substantiating the criteria for assessing the technical and economic efficiency of designed industries; - organization of the production process;

- be competent in the following issues: orientation of scientific and technological achievements in the development of advanced materials and highly efficient technologies for business processes; monitoring the environmental safety of the production of clean and safe materials; relationship between man and the environment, economic and material costs in the field of engineering and technology.

Brief description of the program:

The educational program "Nanomaterials and Nanotechnologies" is designed to train personnel in scientific, pedagogical and (or) professional activities, with the award of a Doctor of Philosophy (PhD) degree. The content of the program is aimed at maximum satisfaction of the needs of domestic needs in the areas of industrial production, technological engineering, scientific and innovative activities, represented by large companies, operating enterprises, research centers and laboratories. In this regard, the goals of the program are:

- providing scientific and engineering training for doctoral students to successfully solve the problems of various industries related to the production and use of various nanomaterials;

- development of theoretical foundations for the production of new nanomaterials and the development of technological processes for the production and processing of finished products

from these materials;

- involvement in project activities through participation in solving real problems of the industry in the country and abroad;

- getting ideas about management, organization and management of production in modern conditions.

The field of professional activity of a Doctor of Philosophy (PhD) in the field of nanotechnology and engineering is associated with the totality of acquired fundamental scientific and general professional knowledge and covers the following types of work:

- scientific and pedagogical work at universities and colleges;

- fundamental and applied research work in national companies, research centers, universities and laboratories;

- production and technological work at manufacturing enterprises in various sectors of the economy;

- organizational and managerial work in state institutions, companies and firms.

The objects of professional activity are:

- employees of national companies (KazAtomprom), research centers (JSC "National Center for Space Research and Technology", Institute of Metallurgy and Ore Beneficiation, LLP "Physical technical institute", Institute of Combustion Problems), business structures, government bodies of industry and committees on science and technology, teachers of higher educational institutions)

PASSPORT OF THE EDUCATIONAL PROGRAM

1.Program volume and content

The educational program for the doctor of philosophy (PhD) has a scientific and pedagogical orientation and involves fundamental educational, methodological and research training, as well as in-depth study of disciplines in the relevant areas of science for the system of higher and postgraduate education and the scientific sphere. The content of the educational program "materials Science and engineering" is developed on the basis of studying the experience of foreign universities and research centers.

The main criterion for the completion of the educational process for the preparation of doctors of philosophy (PhD) (doctors in the profile) is the development of a doctoral student at least 180 academic credits, including all types of educational and scientific activities.

The duration of doctoral studies is determined by the amount of academic credits earned. When you complete the set amount of academic credits and achieve the expected learning outcomes for the degree of doctor of philosophy (PhD) or profile, the educational program of the doctoral program is considered fully completed.

Doctoral training is carried out on the basis of master's degree programs.

The content of the educational program

EP "Nanomaterials and Nanotechnologies" includes theoretical training in the disciplines of general education, basic and specialized components; additional types of training and final certification.

Taking into account the goals of the program, the list of disciplines of the university component and the component includes disciplines of an interdisciplinary and multidisciplinary nature that provide training at the junction of a number of fields of knowledge (for example, the discipline "Advanced Research in Materials Science", read in English, aimed at studying advanced trends in nanotechnology science on nanomaterials scientific publications in international journals). At the same time, all specialized disciplines are aimed at deepening ideas in the field of materials science and engineering, mastering the methodological knowledge necessary for solving scientific and engineering problems and developing research thinking (“Physical and chemical methods for studying hardening materials”, “Software for the structure formation of materials”, “Physics low-dimensional structures and systems”).

The objectives of the educational program:

- In accordance with the professional competencies of a Doctor of Philosophy (PhD), who was trained in the educational program "Nanomaterials and Nanotechnologies", the objectives of the program are:
- coverage of the theoretical foundations for the formation of the structure and properties of nanomaterials used in technology, including powder, composite, ceramic, etc.;
- study of technological ways to improve traditional and create new nanomaterials;
- scientific analysis of the features of the influence of application, thermal and other types of treatments on the structure and properties of a wide class of nanomaterials.

2 Requirements for applicants

Persons who have a master's degree and at least 1 (one) year of work experience or have completed residency training are accepted for doctoral studies.

Admission to the number of doctoral students is carried out by the admissions committees of Universities and research organizations based on the results of the entrance exam for groups of educational programs of doctoral studies and a certificate confirming foreign language proficiency in accordance with the common European competencies (standards) of foreign language proficiency.

When enrolling in universities, doctoral students independently choose an educational program

from the corresponding group of educational programs.

Enrollment of individuals 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» Standard rules for admission to training in educational organizations that implement 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 pedagogical 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 free postgraduate education on a competitive basis in accordance with the state educational order, if they receive this level of education for the first time.

At the "entrance", the doctoral student must have all the prerequisites necessary for the development of the corresponding professional training program of the doctoral program. 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 diploma

Persons who have mastered the educational program of doctoral studies and defended their doctoral dissertation, with a positive decision of 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)

Individuals who have received a PhD degree, in order to deepen their scientific knowledge, solve scientific and applied problems on a specialized topic, perform a postdoctoral program or conduct 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 of:

- the main stages of development and change of paradigms in the evolution of science;
- about the subject, ideological and methodological specifics of natural (social, humanitarian, economic) Sciences;
- about scientific schools of the relevant branch of knowledge, their theoretical and practical developments;
- about scientific concepts of world and Kazakhstan science in the relevant field;
- on the mechanism of implementation of scientific developments in practice;
- on 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 Russian science in the context of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of world and Kazakhstan science in the relevant field;
- (realize and accept) the social responsibility of science and education;
- perfect 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 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 forecast your future professional development;

4) have the skills:

- critical analysis, evaluation and comparison of various scientific theories and ideas;
- analytical and experimental research activities;
- planning and forecasting of research results;
- public speaking and public speaking at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
– planning, coordination and implementation of the processes of scientific research;
- a 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 to scientific and educational activities;
- conducting patent search and experience in transmitting 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 conditions of rapid updating and growth of information flows;
- in conducting theoretical and experimental scientific research;
– in the formulation and solution of theoretical and applied problems in scientific research;
- to conduct a professional and comprehensive analysis of problems in the relevant field;
- interpersonal communication and human resource management;
– in matters of University training of specialists;
- in carrying out expertise of scientific projects and research;
- to ensure continuous professional growth.

3.2 requirements for R & D of a student in the doctor of philosophy (PhD) program):

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

2) relevant and contains scientific novelty and practical significance;

3) based on modern theoretical, methodological and technological achievements of science and practice;

4) based on modern methods of data processing and interpretation using computer technologies;

5) is carried out using modern methods of scientific research;

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

3.3 requirements for the organization of practices:

The practice is conducted for the purpose of developing practical skills in scientific, scientific-pedagogical and professional activities.

The educational program of the doctoral program includes:

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

2) industrial practice - for students in the program of specialized doctoral studies.

During the period of teaching practice, doctoral students, if necessary, are involved in conducting classes in bachelor's and master's degrees.

The research practice of a doctoral student is conducted in order to study the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as to consolidate practical skills, apply modern research methods, process and interpret experimental data in a dissertation research.

Practical training of a doctoral student is carried out in order to consolidate the theoretical knowledge obtained in the course of training and improve the professional level.

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

4. The working curriculum of the educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV

SATBAYEV UNIVERSITY

Approved
Chairman of the Board
Rector of KazNRTU named after K.I. Satbayev
Ibragimov M.K.
2021

WORKING CURRICULUM of the educational program for recruitment for 2021-2022 academic year

Educational program 8D07103 - "Materials Science and Engineering"

Group of educational programs D101 - "Materials science and technology of new materials"

Form of education: full time Duration of study: 3 years Academic degree: Philosophy Doctor (PhD)

year of study	Code	Name of the discipline	Cycle	Total amount in credits	Total hours	Auditory amount Lec/Lab/Prac	IWS (including IWSL), in hours	Prerequisites	Code	Name of the discipline	Cycle	Total amount in credits	Total hours	Auditory amount Lec/Lab/Prac	IWS (including IWSL), in hours	Prerequisites
		1 semester								2 semester						
1	MET322	Scientific research methods	BD VK	5	150	2/0/1	105		AAP345	Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation	SRWD	24				
	LNG305	Academic writing	BD VK	5	150	0/0/3	105		AAP350	Pedagogical practice	BD	10				
	PHY316	Advanced structural hardening technologies	BD VK	5	150	2/0/1	105									
	PHY317	Applied problems in material science	PD VK/KV	5	150	2/0/1	105									
	PHY318	Material structure forming software	ПД КВ	5	150	2/0/1	105									
		Total		25						Total		34				
		3 semester								4 semester						
2	AAP345	Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation	SRWD	24					AAP346	Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation	SRWD	25				
	AAP355	Research practice	PD	10												
		Total		34						Total		25				
		5 semester								6 semester						
3	AAP346	Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation	SRWD	25					AAP346	Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation	SRWD	25				
									ECA303	Writing and submission of a doctoral dissertation	FA	12				
		Total		25						Total		37				
										Overall		180				

Decision of the Academic Council of KazNRTU named after K. Satbaev. Protocol № 3 from "25" 06 2021.

The decision of the Educational and Methodological Council of KazNRTU named after K. Satbaev. Protocol № 6 from "14" 06 2021

Decision of the Academic Council of the M&IE Institute. Protocol № ____ from "____"_____ 2021.

Vice-rector for academic affairs Zhautikov B.A.

Director of the M&IE Institute Kaybekov K.B.

Head of the MNnEP department Kakimov U.K

Chairman of the Specialty Council Serikkanov A.S.

The number of credits for the entire period of study	
Discipline cycles	**Credits**
Cycle of general education disciplines	0
Cycle of basic disciplines (BD VK, BD KV)	25
Cycle of major disciplines (PD VK, PD KV)	20
Total theoretical training:	**45**
SRWD	123
Writing and submission of a doctoral dissertation	12
OVERALL:	**180**

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

Requirements to the level of Master's degree are determined on the basis of the Dublin Descriptors of the second level of higher education (Master's degree) and reflect the mastered competencies, expressed in the achieved results of training.

The learning outcomes are formulated both at the level of the entire Master's degree program and at the level of individual modules or academic discipline.

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

1) Demonstrate evolving knowledge and understanding in materials science and engineering, based on advanced knowledge in materials science, new materials production and processing technologies, when developing and/or applying ideas in the context of research;

2) professionally apply their knowledge, understanding and abilities to solve problems in a new environment, in a broader interdisciplinary context;

3) to collect and interpret information to form judgments taking into account social, ethical and scientific considerations;

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

5) training skills necessary for independent continuation of further training in the field of industrial production, technological engineering, scientific and innovation activities.

6 Competencies for completion of training

6.1 Requirements to the key competencies of graduates of scientific and pedagogical masters, shall:

1) have an idea:

about the role of science and education in public life;

modern trends in the development of scientific knowledge;

actual methodological and philosophical problems of natural (social, humanitarian, economic) sciences;

the professional competence of a higher school teacher;

on contradictions and socio-economic consequences of globalization processes;

2) to know:

2) know: methodology of scientific cognition;

principles and structure of scientific activity organization;

psychology of cognitive activity of students in the process of education;

psychological methods and means to increase efficiency and quality of education;

3) be able to:

3) be able to use the knowledge gained for the original development and application of ideas in the context of scientific research;

critically analyze existing concepts, theories and approaches to process and phenomenon analysis;

integrate knowledge gained from different disciplines to solve research problems in new unfamiliar conditions;

by integrating knowledge to make judgments and decisions based on incomplete or limited information;

apply the knowledge of pedagogy and psychology of the higher school in their pedagogical activities;

apply interactive teaching methods;

carry out informational, analytical and bibliographic work involving modern information technologies;

think creatively and approach creatively to solving new problems and situations;

be fluent in a foreign language at a professional level that allows to conduct scientific research and teach special subjects in higher education institutions;

summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

4) have skills:

4) have skills in: research activities, solving standard scientific problems;

realization of educational and pedagogical activity on credit technology of training;

methods of teaching professional disciplines;

use of modern information technologies in the educational process;

professional communication and intercultural communication;

Oratorical art, correct and logical design of their thoughts in oral and written form; expansion and deepening of knowledge necessary for everyday professional activity and further education in doctoral studies.

5) be competent:

in the field of research methodology;

in the field of scientific and scientific-pedagogical activities in higher education institutions;

in the issues of modern educational technologies;

in the implementation of scientific projects and research in the professional field;

in the ways to ensure constant updating of knowledge, expanding professional skills and abilities.

B - Basic knowledge, skills and abilities

B1 - physical theories and concepts for explanation of structural regularities in materials; complexes of physical and mechanical properties of materials and technological methods of their change by influence on structural parameters; technological route maps of technological processes; principles of rational choice of materials to ensure their optimal application in constructions and products; information sources, databases for solving professional tasks; methods of conducting, analysis and evaluation of experimental results investigated

B2 - analysis of structure and properties of a certain class of materials using modern methods of research and scientific instruments (electro-physical, optical, electron-microscopic, X-ray); modeling the structure and properties of materials based on mathematical processing of scientific research results and the use of software products of material science in solving real problems and problems of science and production; selection and use of materials in technological processes of mechanical engineering, energy,

B3 - the basic technical and economic requirements to the equipment, modern technical means, methods and modes of preparation of initial material, processing for the purpose of reception of demanded properties and quality of production; questions of labour protection and safety precautions, a basis of the law and the nature protection legislation, a basis of patenting and scientific organization of work; independent working out and teamwork at the decision of professional problems with application of theoretical and practical knowledge.

P - Professional competencies:

P1 - to carry out competent, scientifically grounded choice of materials on the basis of extensive theoretical and practical knowledge in the professional field and development of research culture as a result of expansion of ideas about the specialty and formation of the integral view on science of materials;

P2 - to carry out industrial and technological types of professional activity; to solve engineering tasks in the field of obtaining and processing of materials and products from them; to conduct the

necessary research and measurements, using modern scientific equipment; to analyze and interpret the data obtained, to draw conclusions;

P3 - to use the rules of safety and labor protection in conditions of industrial activity.

O - Human, social and ethical competencies

O1 - Ability to be guided by ethical and legal standards;

O2 - Ability to work in an international context;

O3 - Willingness to be aware of the social significance of their future profession, self-development, advanced training;

O4 - Ability to analyze socially significant processes and phenomena, to participate responsibly in social and political life.

C - Special and managerial competences:

C1-competence in production and management, design and development, organizational, technological and scientific-pedagogical fields on the basis of modern training means of information technologies and information resources.

C2-competence to carry out professional functions within one or more types of activities on the basis of the final results of training, taking into account the specifics of these activities, market requirements to organizational, management and professional competencies.

6.2 Requirements for research work of a master's degree student in scientific and pedagogical master's degree:

1) Corresponds to the profile of the Master's degree program on which the master's thesis is performed and defended;

2) is relevant and contains scientific novelty and practical significance;

3) is based on modern theoretical, methodical and technological achievements of science and practice;

4) is performed using modern methods of scientific research;

5) contains research (methodical, practical) sections on the main protected provisions;

6) is based on the best international experience in the relevant field of knowledge.

6.3 Requirements for organization of practices:

The educational program of scientific and pedagogical master's degree includes two types of practices that are conducted in parallel with theoretical training or in a separate period:

1) Pedagogical in the DB cycle - in the university;

2) research in the DB cycle - at the place of the dissertation.

Pedagogical practice is carried out for the purpose of forming practical skills of teaching and learning methods. In this case, the master's degree students are involved in conducting classes at the undergraduate level at the discretion of the university.

The research practice of the master's degree is carried out for the purpose of acquaintance with the newest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific researches, processing and interpretation of experimental data.

7 ECTS Diploma Supplement

The application is 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 a document of education. It is not valid without a higher education diploma. The purpose of the European Appendix is to provide sufficient data on the holder of the diploma, the qualification obtained, the level of this qualification, the content of the study program, the results, the functional purpose of the qualification, as well as information on the national education system. The model of the Appendix, on which the transfer of grades will be carried out, uses the European Transfer or Credit Transfer System (ECTS).

The European Diploma Supplement gives the opportunity to continue education in foreign universities, as well as to confirm national higher education for foreign employers. When going abroad for professional recognition you will need additional legalization of the diploma of education. The European supplement to the diploma is filled in English upon individual request and is issued free of charge.

SCIENTIFIC RESEARCH METHODS

CODE - MET322

CREDIT – (2/0/1/3)

PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course: is to acquire knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry.

Objectives of the course:

- familiarization with the basic theoretical provisions, laws, principles, terms, concepts, processes, methods, technologies, tools, operations of scientific activity;
- study of methods of planning and organization of scientific research;
- familiarity with the general methodology of scientific conception, creativity, the general scheme of the organization of scientific research, the practice of using methods of scientific knowledge in the field of the relevant industry (mining and metallurgical complex);
- study of methods of planning and organization of scientific research;
- familiarity with the general methodology of scientific conception, creativity, the general scheme of the organization of scientific research, the practice of using methods of scientific knowledge in the field of the relevant industry (mining and metallurgical complex);
- study of the mechanism of scientific search, analysis, conducting experiments, organizing surveys, compiling questionnaires, etc.–
- mastering the skills of choosing a scientific research topic and selecting the necessary bibliographic publications and information materials on the research topic;
- practice working with scientific databases (ORCID, SCOPUS, Google Scolar, Web of Science, Elsevier, ClarivateAnalytics, Science Direct, Wiley InterScience, Cambridge Journals Online, RSCI, ProQuest Dissertations & Theses, databases of metallurgical and Canadian societies TMS and Met Soc, patent databases Derwent Innovations Index, etc.), the study of scientometry and scientometric indicators; the practice of selecting a journal for publication (understanding quartiles Q1, Q2, Q3, Q4 WoS, CiteScore percentiles in the Scopus database),
- the study of basic research methods;
- study of procedures for setting and solving scientific problems of information processes and informatization of enterprises and organizations;
- familiarity with the possibilities of conducting scientific research in the international community in the field of fundamental and applied metallurgy;
- study of standards and regulations for registration of research results, preparation of scientific projects, reports, publications for seminars and conferences;
- consideration of procedures for searching global networks for information on scientific developments, opportunities for scientific contacts, applications for scientific grants of various levels;
- familiarity with the procedures for testing the results of scientific research, preparation of publications based on the results of scientific research;
- study of the methods of presentation of scientific materials and the formation of the manuscript of scientific work, the design of a PhD dissertation.

BRIEF DESCRIPTION OF THE COURSE

The subject of the discipline "Methods of scientific research" is the problem of presenting the methodology of scientific creativity to novice researchers, the organization of scientific work, the use of methods of scientific cognition and the application of logical laws and rules in practice.

The program of the course "Methods of scientific research" is aimed at intensive study of the problems faced by researchers in the process of solving various scientific problems characteristic of modern society.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

- professional: knowledge: about critical thinking; about general scientific methods and their application in scientific research; about some special methods and their application in scientific research; about methods of collecting and processing scientific data; about the role of technical sciences and engineering research in modern science; have concepts about methods of system and correlation analysis, modeling and optimization methods;

- managerial: to make plans for the analysis of literary data, the performance of experimental work; to formulate goals, concepts and objectives of the proposed research; to apply methods of ranking, abstraction and formalization in the analysis of literary and experimental scientific data; to work with measuring instruments and experimental data obtained; to perform SWOT analysis of scientific data and technological solutions; to assess risks and ways to prevent them when planning scientific research; submitting applications for projects of any type; work with scientific databases and scientometric indicators.

- communicative: the ability to work in a team; the manifestation of initiative; logical judgments; the ability to effectively cooperate with other people, to build subject-subject relationships in the process of professional activity, the development of collective solutions to specific technical and theoretical problems**.**

ACADEMIC WRITING

CODE - LNG304

Academic credits – 5 (2/0/1/2)

PREREQUISITES –

THE PURPOSE OF THE COURSE is the development of skills and competencies in the field of research and the formation of skills in writing qualification studies. The study of the discipline is based on the development and improvement of skills in the field of written scientific and methodological communication, providing a high level of training of doctoral students necessary for effective communication in the 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 for expressing reasoned ideas and opinions in writing, using professional vocabulary and terminology; - development of text editing skills; - teaching techniques for correct and logical construction of the structure of scientific research; - preparation for writing articles, scientific papers and annotations; - study of techniques for a free and reasoned presentation of thoughts on a scientific professional problem.

BRIEF DESCRIPTION OF THE DISCIPLINE The course is designed to update and develop knowledge in the field of scientific research and writing qualification papers. The course is aimed at developing and improving competencies in the field of written scientific communication, providing a high level of training for doctoral students necessary for effective communication in the academic environment. The objectives of the discipline are to familiarize doctoral students with the basic requirements for writing in a scientific language; the formation of written scientific communication skills; formation of skills to express ideas in writing and to argue them; teaching methods of structuring academic papers; preparation for writing articles, scientific papers and annotations; formation of skills for free and reasoned presentation of thoughts on a scientific problem using appropriate vocabulary in a professional language; development of text editing skills.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline , the doctoral student must:

To know:

-grammatical phenomena necessary for written presentation, translation and editing; - complex syntactic constructions of scientific and business speech; - technology of structuring academic text; - features of the scientific style of written texts; principles of organization of scientific texts; - vocabulary representing a neutral scientific style, the structure of business writing; - basic terms, concepts and categories of the specialty language; - various ways of hypothesizing and constructing evidence.

Be able to:

-apply the acquired knowledge when preparing and writing a research paper in a written format;

- freely read the original literature of the relevant branch of knowledge in a foreign language;

- work with bibliography;

- to formalize information extracted from foreign sources in the form of a translation, abstract, annotation;

- to compare the content of different sources of information on the problem of scientific research, to critically evaluate the opinion of the authors;

- organize your own ideas correctly, justify them clearly and convincingly, and express them competently in writing.

Own:

-the language of the specialty (professional conceptual and terminological apparatus) in the amount of at least 4000-4500 units. Of these, 3000-3300 units are neutral and scientific vocabulary in a wide and narrow profile, 1200 units of vocabulary related to the chosen specialty for the development of oral speech;

- the main methods of reading original literature in the specialty of various styles and genres;

- the style of written communication related to the doctoral student's scientific work;

- culture of thinking, the ability to generalize and analyze information;

- skills of analyzing a scientific text.

Demonstrate ability and willingness:

- to extract and reproduce basic information in a foreign language in writing;
- use reference materials in a foreign language;
- to self-development, improvement of their foreign language competence;
- establish professional contacts with native speakers, exchange information in a foreign language;
- to scientific work using the language of the specialty

Physical-chemical methods for investigation of strengthening materials

CODE-PHY302

CREDIT – 5 (2/0/1/2)

THE PURPOSE AND OBJECTIVES OF THE COURSE

Course objective:

- obtaining basic knowledge on modern technologies for strengthening materials and surfaces and applying them in practice in the development of strengthening technologies based on the structural theory of structural strength and the hierarchy of defect-structural levels of solids.

Course objective:

- combining knowledge in the field of structure, physical and chemical interactions, methods of strengthening treatments, methodology for developing and obtaining a given structural and phase state and properties of structural and functional materials for various purposes.

BRIEF DESCRIPTION OF THE COURSE

Classification (hierarchy) of structural levels of solids: composite materials, macro-level – grain structure and its size and morphological characteristics, meso-level-subgrain, cellular and modulated structure, micro – level-atomic – molecular structure. A new conceptual model of the atomic-molecular structure of solids: hierarchy and fractality of real structures; stochasticity and probability of evolution of complex systems; irreversibility, non-uniformity, nonlinearity and unpredictability of processes in open systems; autowave nature of material objects and processes; fractality and self-organization of structures of different levels under external influences. Structural theory (model) of structural strength based on dissipative-synergetic structures and dislocation-disclosure mechanisms of structural strengthening. Methods of structural strengthening of volumes and surfaces of solids: intensive plastic deformation with the formation of ultradisperse structures of different dimensions, molecular beam epitaxy and high-dose ion implantation with the formation of non-equilibrium modulated mesostructures of increased strength and wear resistance, etc. Structurally modified forms of carbon – fullerenes and nanotubes, their General characteristics, methods of production and use in structural hardening processes.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

KNOWLEDGE

- methods for obtaining, complex research and testing of structurally reinforced materials and ways to assess their compliance with the specified requirements;
- General regularities of structural modification of volume-and surface-hardened materials ;
- traditional and new technological processes and techniques for creating a given structural-phase state when implementing structural strengthening mechanisms.

SKILLS

- solve standard and new tasks of professional activity in the field of advanced technologies for volumetric and surface structural strengthening of materials;
- combine theoretical and practical knowledge of the structural model of structural strength to predict the possibilities of strengthening under different technological influences;
- use modern global information resources in computational and analytical activities in the development of new materials and reinforcing technologies.

SKILLS

- analysis and generalization of scientific and technical information on promising methods and technologies of structural strengthening;
- self-organization and self-education using all available means of the cognitive process;
- selection and evaluation of the possibilities of applying the optimal technology and mode of structural hardening to obtain a given level of structure, operational and technological properties.

Physics of low-dimensional structures and systems

CODE-PHY303

CREDIT -5(2/0/1/2)

PURPOSE AND OBJECTIVES OF THE DISCIPLINE

The purpose of this discipline is:

- The purpose of the course is to form ideas about the physical properties of electronic systems of various dimensions, how the decrease in dimension affects physical phenomena, and what new effects appear in this case;

The objectives of the discipline are as follows:

- To explain to students the fundamental concepts of solid state physics for systems with a reduced dimension and instill in them the basics of understanding the physical processes occurring in these systems under external influences, as well as to give elementary ideas about the use of these phenomena in modern fields of technology.

BRIEF DESCRIPTION OF THE COURSE

In the course of the discipline "Physics of low-dimensional structures and systems" studying the main provisions of the theory of nanostructures (systems of quantum wells, filaments, dots and semiconductor superlattices); features of low-dimensional systems; dimensional quantization; electronic properties of nanostructures; two-dimensional electron gas in MIS structures; quantum Hall effect in two-dimensional electron gas; transport phenomena in nanostructures; tunneling through quantum-dimensional structures; problems of one-electronics; features of the optical properties of nanostructures.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

Doctoral student

Must have an idea about:

- the state of science and production in the country, problems of modern nanomaterials, including issues of technology and effective application of new developments.

Must know:

- manifestation of wave properties in the kinetic phenomena of mesoscopic structures;
- envelope wave function method for describing electronic states in heterostructures;
- quantum integer and fractional Hall effects;
- magnetic superlattices and giant magnetoresistance.

Must be able to:

- understand the magnetic and electrostatic effects of Bohm-Aharonov;
- perform quantization of the band electronic spectrum;
- analyze superlattices and Bloch oscillations;
- understand quantum well and dot lasers.

MATERIALS STRUCTURE FORMING SOFTWARE

CODE-PHY318

CREDITS – 5 (2/0/1/2)

Purpose of the course:

- obtaining basic knowledge on modern technologies for strengthening materials and surfaces and applying them in practice in the development of strengthening technologies based on the structural theory of structural strength and the hierarchy of defect-structural levels of solids.

Course objectives:

- combining knowledge in the field of structure, physico-chemical interactions, methods of hardening treatments, methodology for developing and obtaining a given structural-phase state and properties of structural and functional materials for various purposes.

BRIEF DESCRIPTION OF THE COURSE

Classification (hierarchy) of structural levels of solids: composite materials, macro-level - grain structure and its dimensional and morphological characteristics, meso-level - subgrain, cellular and modulated structure, micro-level - atomic-molecular structure. A new conceptual model of the atomic-molecular structure of solids: hierarchy and fractality of real structures; stochasticity and probability of evolution of complex systems; irreversibility, non-uniformity, nonlinearity and unpredictability of processes in open systems; autowave nature of material objects and processes; fractality and self-organization of structures of different levels under external influences. Structural theory (model) of structural strength based on dissipative-synergetic structures and dislocation-disclosure mechanisms of structural hardening. Methods of structural hardening of volumes and surfaces of solids: intensive plastic deformation with the formation of ultrafine structures of different dimensions, molecular beam epitaxy and high-dose ion implantation with the formation of nonequilibrium modulated mesostructures of increased strength and wear resistance, etc. Structurally modified forms of carbon - fullerenes and nanotubes, their general characteristics, methods of production and use in structural hardening processes.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

knowledge

- methods of obtaining, complex research and testing of structurally reinforced materials and methods of assessing their compliance with specified requirements;
- general patterns of structural modification of bulk- and surface-hardened materials ;
- traditional and new technological processes and techniques for creating a given structural-phase state when implementing structural hardening mechanisms.

SKILLS

- to solve standard and new tasks of professional activity in the field of advanced technologies of volumetric and surface structural hardening of materials;
- combine theoretical and practical knowledge on the structural model of structural strength to predict the possibilities of hardening under different technological influences;
- to use modern global information resources in computational and analytical activities in the field of development of new materials and reinforcing technologies.

skills

- analysis and generalization of scientific and technical information on promising methods and technologies of structural hardening;
- self-organization and self-education using all available means of the cognitive process;
- selection and evaluation of the possibilities of applying the optimal technology and mode of structural hardening to obtain a given level of structure, operational and technological properties.

RESEARCH WORK OF A DOCTORAL STUDENT, INCLUDING INTERNSHIPS AND THE IMPLEMENTATION OF A DOCTORAL DISSERTATION

CODE - AAR344

CREDIT – 24

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the doctoral program is to prepare, taking into account the prospects for the development of the country, competitive highly qualified personnel with high spiritual and moral qualities, capable of independent thinking and ensuring progressive scientific, technical, socio-economic and cultural development of society.

The main tasks of doctoral studies:

- meeting the needs of the individual in the field of vocational education, creating conditions for the implementation of the principle of individualization and differentiation of the learning process;
- deepening the theoretical and practical individual training of a doctoral student in the chosen direction of science and pedagogical activity;
- the development of the most important and stable knowledge by a doctoral student, providing a holistic perception of the scientific picture of the world;
- formation of students' ability to self-improvement and self-development, needs and skills of independent creative mastery of new knowledge;
- training of specialists capable of solving modern scientific and practical problems and carrying out research, management and teaching activities in higher educational institutions.

BRIEF DESCRIPTION OF THE COURSE

The research work of a doctoral student should:

1) correspond to the main problems of the specialty in which the doctoral dissertation is being defended;

2) be relevant, contain scientific novelty and practical significance;

3) be based on modern theoretical, methodological and technological achievements of science and practice;

4) be based on modern methods of data processing and interpretation using computer technology;

5) be carried out using modern methods of scientific research;

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

The results of research / experimental research work at the end of each period of their passage are issued by the doctoral student in the form of a brief report.

The final result of the research/ experimental research work of a doctoral student is a doctoral dissertation.

The topic of the doctoral dissertation is determined taking into account its relevance no later than two months after admission to the doctoral program. The direction of the dissertation research, as a rule, should be related to national priorities, or state programs, or programs of fundamental or applied research.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

- have an idea: about the main stages of development and paradigm shift in the evolution of science; about the subject, ideological and methodological specifics of natural (social, humanitarian, economic) sciences; about scientific schools of the relevant branch of knowledge, their theoretical and practical developments; about scientific concepts of world and Kazakh science in the relevant field; about the mechanism of implementation of scientific developments in practice; about the norms of interaction in the scientific community; about the pedagogical and scientific ethics of a researcher.
- to know and understand:

modern trends, trends and patterns of development of Russian science in the context of globalization and internationalization;

methodology of scientific knowledge; achievements of world and Kazakh science in the relevant field;

(realize and accept) the social responsibility of science and education; perfect foreign language for

scientific communication and international cooperation;

- be able to:

organize, plan and implement the process of scientific research; analyze, evaluate and compare various theoretical concepts in the field of research 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;

- have the skills of: critical analysis, evaluation and comparison of various scientific theories and ideas; analytical and experimental scientific activities;

planning and forecasting of research results; public speaking and public speaking at international scientific forums, conferences and seminars; scientific writing and scientific communication; planning, coordination and implementation of 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 to scientific and scientific-pedagogical activity; conducting patent search and experience in the transfer of scientific information using modern information and innovative technologies;

protection of intellectual property rights to scientific discoveries and developments; free communication in a foreign language;

- be competent: in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows;

in carrying out theoretical and experimental scientific research; in setting and solving theoretical and applied problems in scientific research.

PEDAGOGICAL PRACTICE

Code - AAP350

Credits – 10

PURPOSE AND OBJECTIVES OF THE COURSE

The objectives of the pedagogical practice are:

- the formation of professional competencies among doctoral students that ensure readiness for pedagogical activity in universities, the design of the educational process in accordance with the profile of training and conducting certain types of training sessions using innovative educational technologies;

-development of practical skills and skills of professional-pedagogical and educational-methodical work in higher educational institutions;

-consolidation of psychological and pedagogical knowledge in the field of professional pedagogy and acquisition of skills of a creative approach to solving scientific and pedagogical tasks.

The main objectives of pedagogical practice are:

-development of professional and pedagogical orientation of doctoral students;

-development of doctoral students' skills of structuring and transformation of scientific knowledge into educational material, oral and written presentation of subject material;

-introduction of doctoral students to real problems solved in the educational process of higher professional education institutions;

- study of modern educational technologies, methods, techniques, technologies of pedagogical activity in higher educational institutions;

-mastering the skills of diagnostics, monitoring and evaluation of the effectiveness of educational activities;

-acquisition of experience in teaching at the university.

BRIEF DESCRIPTION OF THE COURSE

Pedagogical practice in the system of postgraduate education is an important and integral component of the educational programs of doctoral studies and represents a type of practical activity of students in the implementation of the educational and educational process in higher education, including the teaching of training courses, the organization of educational activities of students, scientific and methodological work, obtaining skills and practical teaching skills.

Pedagogical practice is aimed at the formation of a comprehensive psychological-pedagogical and informational-methodological readiness of a doctoral student for scientific and pedagogical activity at the university.

Pedagogical practice is carried out during the period of theoretical training without interruption from the educational process in the amount established by the state mandatory standard of postgraduate education

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

Upon completion of pedagogical practice, a doctoral student should:

- know: the

legal and regulatory foundations of the functioning of the higher education system;

the procedure for the implementation of the main provisions and documents regulating the activities of the university to improve educational, methodological and scientific work at the university;

modern approaches to modeling scientific and pedagogical activity;

the order of organization of planning, management and provision of the educational process using the latest learning technologies;

basic principles, methods and forms of organization of the scientific and pedagogical process in an economic university;

means and methods of activating the cognitive activity of students; basic requirements for the theoretical, practical and methodological readiness of a university teacher.

- be able to:

use educational technologies, methods and techniques of conducting lectures and practical classes;

to use the interrelationships of research and educational processes in the presentation of the subject

material, including the possibility of attracting their own scientific research as a means of improving the educational process;

to carry out methodological work on the design and organization of the educational process; to speak to the audience and create a creative atmosphere during the training sessions; to analyze difficulties arising in pedagogical activity and develop an action plan to solve them; to choose adequate ways of planning and conducting training sessions; to compose tasks, exercises, tests on various topics; to structure and competently transform scientific knowledge into educational material.

- own:

skills of scientific-methodical and educational-methodical work in higher education; methodology and technology of conducting training sessions (lectures, seminars, practical classes, consultations on discipline, course design, checking various types of homework);

experience in the use of modern information technologies in educational and scientific processes; skills of public speaking, academic writing and scientific style of presentation of educational material; methods of self-assessment and self-analysis of the results and effectiveness of classroom classes of various types

RESEARCH PRACTICE

CODE – AAP355

CREDIT 10

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the research practice is: analytical review of scientific and patent literature on the subject of scientific research in the field; acquisition of skills to work on modern scientific and/ or technological equipment; acquisition of skills for independent research work, as well as work as part of research teams.

The task of research practice is focused on the acquisition of skills and solutions of the following nature: to be able to analyze and critically evaluate the results of their own scientific research, as well as leading specialists and scientists in the relevant field of research; to be able to identify scientific priorities, as well as formulate current scientific tasks and problems; to be able to justify and formulate the relevance, theoretical and practical significance of the chosen topic of scientific research; to develop and improve the ability to conduct independent research in accordance with the developed program; to acquire skills in presenting the results of research in the form of a scientific report, article, report or separate sections of a dissertation.

BRIEF DESCRIPTION OF THE COURSE

Research practice is a type of research activity aimed at deepening and systematizing the theoretical and methodological training of a doctoral student, practical mastery of the technology of research activities, acquisition and improvement of practical skills in performing scientific and experimental work in accordance with the requirements for the level of training of a PhD doctor.

The doctoral student's research practice is conducted at the place of study or in scientific organizations, which can be considered as experimental platforms for conducting research related to the subject of a doctoral dissertation. During the practice, doctoral students are given the opportunity to conduct experimental research according to a pre-developed program that takes into account the tasks of the doctoral dissertation.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE

During the research practice , the doctoral student must:

to study: sources on the topic being developed for use in the performance of a doctoral dissertation; special literature on the selected research topic, including domestic and foreign authors; research methods; methods of analysis and processing of experimental data; requirements for the design of a master's thesis and scientific and technical documentation.

to perform: a scientific experiment in accordance with the plan of research work; collection, statistical processing, analysis and systematization of scientific information on the topic of the dissertation for writing a scientific article and preparing an analytical review and other chapters of the doctoral dissertation; comparison of the results obtained with domestic and foreign studies; formulation of the main hypothesis, preliminary conclusions; analysis of the scientific, methodological and practical significance of the research; preparation of a doctoral dissertation on the basis of collected, generalized and scientifically processed information.

WRITING AND SUBMISSION OF A DOCTORAL DISSERTATION

CODE - ECA303

CREDIT – 12

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

SHORT DESCRIPTION

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

A doctoral dissertation is the result of a doctoral student's research /experimental research work carried out during the entire period of the doctoral student's studies.

The defense of a doctoral dissertation is the final stage of master's degree preparation. The Master's thesis must meet the following requirements:

- The topic of the dissertation should 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, 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.

Contents