NJSC "Kazakh National Research Technical University named after K.I. Satbayev"
Institute of Chemical and Biological Technologies
Chemical Processes and Industrial Ecology

EDUCATION PROGRAM

"INNOVATIVE TECHNOLOGIES AND NEW INORGANIC MATERIALS"

Doctor of Philosophy (PhD) by education program of
"8D07109 - Innovative technologies and new inorganic materials"

2nd edition
in accordance with the State Educational Standard of Higher Education 2018

Almaty 2020

The program is compiled and singed by the parties:

from KazNRTU named after K.I. Satbayev:

1. Head of the Department of CP&IE _____ Sh.N. Kubekova

2. Director of the Institute of C&BT Z.K. Tuiebakhova

From employers:

1. First Deputy General Director
of JSC "Institute of Chemical Sciences
named after A.B. Bekturov",
Doctor of Technical Sciences,
Professor, Correspon. member NAS RK U.Zh. Dzhusipbekov

Approved at the meeting of the Academic Council of the Kazakh National Research Technical University named after K.I. Satbayev.
Protocol No. 17 dated 26.06.2020

Qualifications:
Level 8 of the National Qualifications Framework:
8D07 - Engineering, Manufacturing and Construction Industries
8D071 - Engineering (PhD)

Professional competence: organization of innovative activities in the field of modern technologies of inorganic substances, organization and implementation of scientific and educational, experimental research and management activities in the field of production of new inorganic substances and materials

BRIEF PROGRAM DESCRIPTION

The purpose of the program: training of highly qualified specialists with fundamental educational, methodological and research training in the field of chemical technology of inorganic substances, competitive both domestically and on the international labor market.

Types of work. Doctor of Philosophy PhD in Engineering can carry out the following professional activities: educational (teaching); educational and training; educational and technological; socio-pedagogical; scientific research; organizational and managerial.

The objects of professional activity of doctoral graduates are the most advanced positions in higher and specialized educational institutions of the state and non-state sector, research institutes and research and production corporations for the production of inorganic substances and materials, domestic and foreign chemical enterprises.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

The educational program of preparation of the 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 the relevant areas of science for the system of higher and postgraduate education and the scientific sphere.

Educational programs of doctoral studies in terms of professional training are developed based on studying the experience of foreign universities and research centers that implement accredited training programs for PhD doctors or doctors in the profile.

The content of the educational program of the profile doctoral program is determined 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 profile) is the development of a doctoral student of 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. Upon completion of the set amount of academic credits and achievement of the expected learning outcomes for obtaining the degree of Doctor of Philosophy (PhD) or by profile, the educational program of the doctoral program is considered fully mastered.

Training in doctoral studies is carried out based on master's degree programs in two areas:

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

2) profile with a training period of at least three years.

The content of the educational program involves in-depth study of the English language, disciplines of specialization that provide a high level of professional training of specialists, in-depth training on the topic of dissertation research, interdisciplinary training, and the formation of teaching skills in higher education. the program also includes a mandatory component of pedagogical practice, the implementation of research work of a doctoral student. to master a part of the educational component of the doctoral program and/or conduct research, the doctoral student conducts field internships in foreign educational and scientific institutions.

Objectives of the educational program:

The objectives are: harmonization of technologies for the preparation of scientific-pedagogical personnel of high qualification with world standards, as well as advancing the solution to the issues of their scientific, methodological, legal, financial-economic, personnel and logistical support; implementation of the educational process by the principles of international practice of training of scientific-pedagogical personnel, ensuring the implementation of independent original research, which have great relevance and practical significance.

2 Requirements for applicants

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

Admission to the number of doctoral students is carried out by the admission committees of universities and scientific organizations based on the results of the entrance exam for groups of educational programs of doctoral studies and a certificate confirming foreign language proficiency by the pan-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 and the corresponding specialization.

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

The procedure for admission of citizens to doctoral studies is established by the "Standard Rules for Admission to Training in Educational organizations that implement educational programs of postgraduate education".

Formation of a contingent of doctoral students is carried out by placing the state educational order for the training of scientific and pedagogical staff, as well as tuition fees at their own expense of citizens and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive, on a competitive basis, by the state educational order, free postgraduate education, if they receive education of this level 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 completing studies and obtaining a diploma

Persons who mastered the educational program of doctoral studies and defended his doctoral thesis at the positive decision of the dissertation councils of the university with special status or of the Committee for control in education and science, Ministry of education and science of the Republic of Kazakhstan on the results of the examination are awarded the degree of doctor of philosophy (Ph.D.) or professional doctorate, and the diploma of the state sample with the Appendix (transcript).

Persons who have received a Ph.D. degree, to deepen scientific knowledge, solve scientifically and applied problems on a specialized topic, perform a postdoctoral program or conduct scientific research under the guidance of a leading scientist chosen by the university.

3.1 Requirements for key competencies of doctoral graduates:

1) *to have an idea*:

- about the main stages of development and change of paradigms in the evolution of science;
- on 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 domestic science in the context of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of the 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;

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 their 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 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 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 scientific-pedagogical activities;
- 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;

5) *to be competent*:
- in the field of scientific and scientific-pedagogical activity 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;
- in matters of interpersonal communication and human resource management;
- in matters of university training of specialists;
- in carrying out the expertise of scientific projects and research;
- in ensuring continuous professional growth.

3.2 Requirements for R & D of a student in the Doctor of Philosophy (PhD) program):

1) compliance with the main problems of the educational program of doctoral studies, on which the doctoral dissertation is defended;
2) relevance, scientific novelty and practical significance of R & D;
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) performed 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 to form practical skills of 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.

Practice doctoral research is to study the latest theoretical, methodological, and technological advances in domestic and foreign science and consolidate practical skills of application of modern methods of scientific research, processing, and interpretation of experimental data in this thesis.

The practical training of a doctoral student is carried out in order to consolidate the theoretical knowledge gained 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 Working curriculum of the educational program

WORKING CURRICULUM
Education Program 8D07109 "Innovative technologies and new inorganic materials"
Group of Educational Programs D097 "Chemical Engineering and Processes"

enrolment for 2020 - 2021 academic year

Academic Degree: Doctor of Philosophy (PhD)

Term of study: 3 years

year of study	Code	Name of course	Component	Academic credits	lecture/ lab/ prac/DSIW	Prerequisites	Code	Name of course	Component	Academic credits	lecture/ laboratory/ practice	Prerequisites
1	1 semester						2 semester					
	ME321	Research methods	BD IC	6	2/0/1/3		AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24		
	LNG304	Academic writing	BD IC	6	2/0/1/3		AAP350	Pedagogical practice	BD	10		
		Elective	BD OC	6								
		Elective	PS OC	6								
		Elective	PS OC	6								
		In total		30				In total		34		
2	3 semester						4 semester					
	AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24			AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25		
	AAP349	Research scientific training	PS	10								
		In total		34				In total		25		
3	5 semester						6 semester					
	AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25			AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25		
							ECA303	Writing and defending doctoral dissertation	FA	12		
		In total		25				In total		37		
								In all		185		

4.1 CATALOG * DISCIPLINE OF CHOICE

Satbayev University

ELECTIVE DISCIPLINES for 2020-2021 academic year admission

Education Program 8D07109 "Innovative technologies and new inorganic materials"
Group of Educational Programs D097 "Chemical Engineering and Processes"

Study duration: 3 years

№	Code	Name of discipline	Credits ECTS	Credits RK	lec/lb/prac/DSRW	semester
BD Components of choice - 6 credits						
1	CHE302	Modern tool research methods*	6	3	2/1/0/3	1
	CHE308	Ecotechnologies and renewable resources*	6	3	2/0/1/3	1
PD Components of choice - 12 credits						
Module of a new inorganic materials						
2	CHE305	New types of catalysts and adsorbents in inorogical technology	6	3	2/1/0/3	1
	CHE306	Inorganic nanostructured materials	6	3	2/0/1/3	1
Module of ecotechnologies and modeling						
3	CHE304	Calculation and modeling of mass-exchange processes and apparatus	6	3	2/1/0/3	1
	CHE307	Scientific bases of waste-free technologies of the processing industries	6	3	2/0/1/3	1
	BIO314	Green chemistry in the production of chemical substances and materials*	6	3	2/0/1/3	1
		Total:	18			

* - disciplines of an interdisciplinary nature

4.2 Modular curriculum of education program

MODULAR CURRICULUM

Education program **"8D07109 - Innovative technologies and new inorganic materials"**

Form of education: Full-time Duration: 3 years Academic degree: Doctor of philosophy PhD
* - disciplines of an interdisciplinary nature

The cycle	code	Name of disciplines	Semester	Acad. credits	lec.	lab.	prac	IWS	ype of contr	Chair
Profile training module (45 credits)										
Basic disciplines (BD)										
University component										
BD 1.1.1	LNG304	Academic writing	1	6	2	0	1	3	Exam	EngL
BD 1.2.1	MET321	Research methods	1	6	2	0	1	3	Exam	MITTCM
Choice component 6										
Basic module										
BD 1.3.1	CHE302	Modern tool research methods*	1	6	2	1	0	3	Exam	CP&IE
	CHE308	Ecotechnologies and renewable resources*	1	6	2	0	1	3	Exam	CP&IE
Practice-oriented module										
BD	AAP350	Pedagogical practice	2	10					Report	CP&IE
Major disciplines (MD)										
Choice component 12										
Module of a new inorganic materials										
MD 2.1.1	CHE305	New types of catalysts and adsorbents in inorogical technology	1	6	2	1	0	3	Exam	CP&IE
	CHE306	Inorganic nanostructured materials	1	6	2	0	1	3	Exam	CP&IE
Module of ecotechnologies and modeling										
MD 2.2.1	CHE304	Calculation and modeling of mass-exchange processes and apparatus	1	6	2	1	0	3	Exam	Ch&BChE
	CHE307	Scientific bases of waste-free technologies of the processing industries	1	6	2	0	1	3	Exam	Ch&BChE
	BIO314	Green chemistry in the production of chemical substances and materials*	1	6	2	0	1	3	Exam	Ch&BChE
Practice-oriented module										
MD	AAP349	Research scientific training	3	10					Report	Ch&BChE
Research Module										
DSRW	AAP345	Doctoral student research work, including internships and doctoral dissertations	2	24					Report	Ch&BChE
DSRW	AAP345	Doctoral student research work, including internships and doctoral dissertations	3	24					Report	Ch&BChE
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	4	25					Report	Ch&BChE
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	5	25					Report	Ch&BChE
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	6	25					Report	Ch&BChE
Final attestation module										
FA	ECA303	Writing and defending doctoral dissertation	6	12						Ch&BChE
		Total		**185**						

* - disciplines of an interdisciplinary nature

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

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

1) demonstrate a systematic understanding of the field of study, mastering the skills and research methods used in the field of organic chemistry;

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

3) contribute your own original research to the expansion of the boundaries of the scientific field, which deserves publication at the national or international level;

4) critically analyze, evaluate and synthesize new and complex ideas;

5) communicate their knowledge and achievements to colleagues, the scientific community and the general public;

6) promote, in the academic and professional context, the technological, social or cultural development of a knowledge-based society.

6 Appendix to the diploma according to the standard ECTS

The application is developed according to the standards of the European Commission, the Council of Europe and UNESCO/CEPES. This document serves only for academic recognition and is not an official confirmation of the document of education. Without a higher education diploma, it is invalid. The purpose of filling out the European Application is to provide sufficient data on the holder of the diploma, the qualification obtained, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. In the application model, which will be used for the transfer of estimates, the European system of transfers or credit transfer is used (ECTS).

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

MODERN INSTRUMENTAL METHODS OF RESEARCH
CODE – CHE302
CREDIT – 6 (2/1/0/3)
PREREQUISITES – Physical and chemical methods of analysis

PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the course – systematize knowledge on the use of modern instrumental methods for the study of inorganic substances and materials.

Course objectives: formation of basic knowledge and ideas about the fundamental laws and basic methods of studying the physical and chemical properties and structure of substances; acquisition of skills and abilities to work with the main types of devices used in the study of the composition and structure of inorganic substances and materials; formation of competencies that allow for the experimental determination of patterns of changes in the physical and chemical properties of the studied substances and materials.

BRIEF DESCRIPTION OF THE COURSE

The course "Modern instrumental research methods" presents the following sections: the current state of ideas underlying physical and physico-chemical methods of research of inorganic substances; methodology for applying modern instrumental methods of research of physical and chemical properties and structure of inorganic substances; establishing the details of the chemical structure of the resulting compound based on the results of quantitative and qualitative analysis using appropriate instrumental methods; practical application of tools that allow solving problems of studying the molecular composition and structure of inorganic substances; the principles of interpretation of the results obtained on the basis of data obtained by a complex of physical and chemical research methods are considered.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

the study of this discipline will allow you to gain knowledge and develop the skills and abilities necessary for solving research problems, to find optimal methods, tools and methodology of research sufficient to study the composition, physical and chemical properties and structure of new inorganic substances and materials.

GREEN CHEMISTRY IN THE PRODUCTION OF CHEMICALS AND MATERIALS

CODE – BIO314

CREDIT – 6 (2/0/1/3)

PREREQUISITES – Geoecology

PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the course – to form knowledge and ideas about the fundamental principles of research on the principles of sustainable development of chemical and technological systems based on the rational use of natural resources.

BRIEF DESCRIPTION OF THE COURSE

The course "Green Chemistry in the production of chemicals and materials" contains the following sections: Principles of sustainable development of systems. General concepts and definitions. Factors that determine the stability of the chemical-technological system. Basic principles of green chemistry. The criteria for the evaluation of chemical production. Characteristics of the main processes of chemical production accompanied by environmental pollution. Analysis of the main sources of pollution of technological waters of chemical enterprises. Ways to reduce the volume of waste water. rational schemes of water supply and sewerage at chemical enterprises. resource-saving technologies in the chemical industry of inorganic substances.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Know: current trends in the development of chemical engineering; the main factors that determine the environmental friendliness of chemical processes, ways to prevent and / or reduce their harmful effects on the environment and humans.

Be able to: search for physical and chemical characteristics of compounds, calculate criteria for chemical reactions and processes, conduct a comprehensive analysis of the environmental friendliness of plants for the production of inorganic substances and materials.

Own: methods of criteria-based assessment of industrial processes, and their application in solving practical problems.

CALCULATION AND MODELING OF MASS TRANSFER PROCESSES AND DEVICES

CODE – CHE 304

CREDIT – 6 (2/1/0/3)

PREREQUISITES - Processes and apparatuses of chemical and biochemical technology, general chemical technology

PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the course - acquisition of skills and abilities of calculation of material and thermal balances of mass transfer devices, basic dimensions, equipment parameters, selection of equipment for solving practical problems of modeling skills of mass transfer devices and processes.

Course objectives:

formation of doctoral students - professional competencies necessary for professional activity in the field of applied scientific research on the problems of calculating various parameters for equipment and processes; improvement and development of new methods for various parameters of equipment, selection of the type of equipment and modeling of chemical and technological processes;

BRIEF DESCRIPTION OF THE COURSE

Basic laws of the interphase mass transfer process. law of additivity of phase resistances to mass transfer. the average driving force of the mass transfer process. material balance of mass transfer processes. The equilibrium of the system. basic Design of rectification columns. Determination of the number of theoretical plates by the graphical method. Calculation of the number of plates at the working phlegm (steam) number. Determination of the phlegm (steam) number. features of calculating complex columns. Packing and poppet columns. The calculation of the main dimensions of the plate columns. Adsorption and desorption. Calculation of the number of theoretical plates in the absorber. Heat balance of the absorber. calculation of the desorption process. Heat balance of the absorber. extraction. The basis of the calculation of extractors. Triangular diagram and its main properties. The main types of extractors. Adsorption. Methods of implementation of the adsorption process. basic calculation of the adsorber.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

The doctoral student after mastering the program of this discipline must:

- know the basic concepts of mass transfer processes and apparatuses and its simulations;
- fundamentals of mass transfer theory,
- basic provisions of modeling.
- develop hardware and technological schemes;
- to make and calculate material and thermal balances of mass transfer processes and apparatuses,
- determine their geometric dimensions and model it.
- assess risks and determine measures to ensure the safety of technological processes;
- participate in the modeling of technological processes, improvement of technological equipment and reconstruction of production;
- draw up technological and technical documentation for operation.

NEW TYPES OF CATALYSTS AND ADSORBENTS IN INORGANIC TECHNOLOGY

CODE – CHE305

CREDIT – 6 (2/1/0/3)

PREREQUISITES – General chemistry, Physical chemistry, General chemical technology

PURPOSE AND OBJECTIVES OF THE COURSE:

The main goal of the course – formation of knowledge about modern types and types of catalysts and adsorbents, their main characteristics and methods of production; their use in inorganic technology to improve technological processes.

BRIEF DESCRIPTION OF THE COURSE: general patterns of selection of catalysts and adsorbents. requirements for industrial catalysts and adsorbents. The factors determining the catalytic activity. The ability to predict the catalytic action of chemical substances. Optimal porous structure of catalysts and adsorbents. Technology of precipitated catalysts, carriers and adsorbents. The main stages of the technology. Technology for obtaining catalysts by impregnation. Methods and modes of impregnation. Features of drying and calcining of impregnating catalysts. Technologies of mixed and fused catalysts. Basic technological schemes. production of catalysts for the synthesis of methanol, production of sulfuric acid and ammonia. Fundamentals of silica gel technology. Zeolites. Features of structural and physico-chemical properties. Fundamentals of synthetic zeolite technology. Equipment and equipment production of catalysts and adsorbents.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE:

The study of this discipline will allow you to gain knowledge and develop the skills and abilities necessary for solving research problems of creating new types of catalysts and adsorbents and searching for the possibility of their application in innovative processes of inorganic technology.

INORGANIC NANOSTRUCTURED MATERIALS
CODE – CHE306
CREDIT – 6 (2/0/1/3)
PREREQUISITES – chemistry, physics, mathematics

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of studying the discipline is to study the current state and some prospects in the field of innovative technologies and new materials, to master the fundamental foundations of key professional competencies in the field of nanomaterials and nanotechnologies based on the knowledge of nanoscience and nanoengineering; to acquire general skills and abilities in the development and production of inorganic nanostructured materials.

BRIEF DESCRIPTION OF THE COURSE

The history of the development of nanotechnology. priority areas of nanotechnology. basic scientific terms and definitions. Types of nanomaterials: consolidated nanomaterials, nanowires, nanopolymers, nanobiomaterials, fullerenes and tubular nanostructures, catalysts, nanoporous materials and supramolecular structures. nanoparticles (nanopowders). Creating nanoobjects based on the "top – down" and "bottom – up" principles. Solid-state chemical reactions. Mechanochemical transformations. Shock-wave synthesis. Nanostructuring under pressure with a shift. Nanostructuring by crystallization of amorphous structures. The compaction (consolidation) of nanoclusters

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

The study of this discipline will allow you to acquire knowledge about the history of nanotechnology, the classification of nanoworld objects, the main methods of their research, the methods used in the creation of nanoobjects, the unique properties of nanomaterials, their application and prospects for the development of this branch of science.

SCIENTIFIC BASIS OF WASTE-FREE TECHNOLOGIES OF PROCESSING INDUSTRIES

CODE – CHE307

CREDIT – 6 (2/0/1/3)

PREREQUISITES – inorganic chemistry, waste-free technologies

PURPOSE AND OBJECTIVES OF THE COURSE

the main purpose of studying the discipline is to study the possibilities of creating and implementing resource-and energy-saving low-waste and waste-free innovative technologies in the production of inorganic substances and materials.

BRIEF DESCRIPTION OF THE COURSE

Basic concepts, definitions and problems of energy and resource saving in chemical technology. indicators of resource saving of industrial chemical production at various hierarchical levels. The role of thermodynamic approach in solving problems of energy and resource saving in chemical production. the "black box" model as a thermodynamic model of the functioning of a chemical-technological system. The first beginning of thermodynamics. The total material stream, the flow of heat energy flow. Examples of models of a number of systems: apparatus, unit, industrial production, chemical and technological system. Theoretical and practical material balances. The role of the energy balance of the system in solving the issue of energy saving. Energy conversion coefficient and efficiency of the chemical-technological system. Use of optimization methods in the creation of energy-and resource-saving industries.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

upon completion of the course, students should know the existing energy-saving, low-waste and non-waste inorganic technologies, be able to optimize the consumption of material and energy resources, possess the skills of applying mathematical analysis methods to optimize and organize energy-and resource-saving chemical and technological systems.

DEFENSE OF THE DOCTORAL DISSERTATION
CODE – ECA303
CREDIT –12

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

SHORT DESCRIPTION

Doctoral dissertation - a scientific work of a doctoral student, which is an independent study, in which theoretical provisions are developed, the totality of which can be qualified as a new scientific achievement, or a scientific problem is solved, or scientifically based technical, economic or technological solutions are presented, the introduction of which makes a significant contribution to the development of the country's economy. Doctoral dissertation – the result of the research /experimental research work of the doctoral student, conducted during the entire period of study of the doctoral student. the defense of the doctoral dissertation is the final stage of the master's degree preparation. the doctoral dissertation 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.

CONTENT

1	Scope and content of the program	4
2	Requirements for applicants	5
3	Requirements for completing studies and obtaining a diploma	5
3.1	Requirements for key competencies of doctoral graduates	6
3.2	Requirements to the RWDS of a student in the doctor of philosophy program	7
3.3	Requirements for the organization of practices	7
4	Working curriculum of the educational program	9
4.1	Catalog discipline of choice	10
4.2	Modular curriculum	11
5	Descriptors of the level and scope of knowledge, skills, skills and competencies	12
6	Appendix to the diploma according to the ECTS standard	12

Attachment

Рецензия
на образовательную программу PhD докторантуры
«Инновационные технологии и новые неорганические материалы»

Образовательная программа «Инновационные технологии и новые неорганические материалы» PhD докторантуры предполагает фундаментальную исследовательскую, методологическую и образовательную подготовку высококвалифицированных специалистов, обладающих глубокими научными, профессиональными и педагогическими знаниями и умениями для химической промышленности неорганических веществ, сферы науки и образования.

ОП «Инновационные технологии и новые неорганические материалы» квалификации «8D071 – Инженерия и инженерное дело» Национальной рамки квалификации содержит следующую информацию: цели и задачи ОП, характеристику профессиональной деятельности выпускника, требования к поступающим и требования для завершения обучения, рабочий учебный план, дескрипторы уровня и объема знаний, умений, навыков.

Структура учебного плана ОП логична и последовательна. В программе предусмотрено углубленное изучение современных методов исследований, современного состояния и некоторых перспектив в области инновационных технологий и новых материалов, освоение основ ключевых профессиональных компетенций в области наноматериалов и нанотехнологий, а также ряда специальных дисциплин, способствующих формированию управленческих навыков в области организации безотходного производства, комплексной переработки минерального сырья с минимизацией вредного воздействия на окружающую среду, ориентироваться в больших объемах информации. Приобретенные знания, навыки и умения позволят выпускникам данной ОП PhD докторантуры быть конкурентоспособными в современных условиях развития экономики страны.

Считаю, что образовательная программа «Инновационные технологии и новые неорганические материалы» PhD докторантуры отвечает потребностям рынка труда, задачам индустриально-инновационного развития страны и может быть рекомендована к внедрению в учебный процесс.

Первый заместитель ген.директора
АО«Институт химических наук
им.А.Б.Бектурова»,
д.т.н., профессор, член-корр. НАН РК У.Ж.Джусипбеков