NJSC SHAKARIM UNIVERSITY OF SEMEY

EDUCATIONAL PROGRAM

8D05 - Natural Sciences, Mathematics and Statistics
(Code and classification of the field of education)

8D053 - Physical and chemical sciences
(Code and classification of the direction of training)

0530
(Code in the International Standard Classification of Education)

D089 Chemistry
(Code and classification of the educational program group)

8D05301 - Chemistry
(Code and name of the educational program)

Doctor of philosophy (PhD)
(Level of preparation)

Semey

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Semey 2023

PREFACE

Developed

The educational program 8D05301 - Chemistry in the direction of preparation 8D053 - Physical and chemical sciences on the basis of the State Compulsory Standards of Higher and Postgraduate Education approved by the Order of the Ministry of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No 2 (as amended by the order) was developed by the Academic Committee dated 20.02.2023 No 66).

Members of the Academic Committee	Full name	Academic degree, academic title, position	Signature
Head of the Academic Committee	Nurymkhan Gulnur	Dean of the Faculty of Engineering and Technology, PhD	
Educational program manager	Orazzhanova Lyazzat	Associate Professor of the Department of Chemical Technology and Ecology, candidate of chemical sciences	
Member of the AC	Sabitova Alfira	Head of the Department of Chemical Technology and Ecology, PhD	
Member of the AC	Kassymova Zhanar	Associate Professor of the Department of Chemical Technology and Ecology, Candidate of Biological Sciences	
Member of the AC	Shakhvorostov Alexey	Researcher at the Institute of Polymer Materials and Technologies, PhD	
Member of the AC	Kabdyrakova Alua	Head of the Department of Budget Programs and Personnel Training of RSE "National Nuclear Center"	
Member of the AC	Elemesova Gulnur	1st year doctoral student OP 8D05301-Chemistry	
Member of the AC	Abdrakhmanova Azhar	1st year doctoral student OP 8D05301-Chemistry	

Reviewing

Full name of the reviewer	Position, place of work	Signature
Svidersky Alexander	Director of the Institute of Engineering and Additional Education of the Innovative Eurasian University, Doctor of Economics, Professor	

Reviewed

at the meeting of the Quality Assurance Commission of the Faculty of Engineering and Technology
Recommended for approval by the Academic Council of the University
Protocol № 4.6 "10" April 2023
Chairman of the Commission on Quality Assurance Abdilova G.

Approved at the meeting of the Academic Council of the University Protocol No. 8 "25" April 2023.

Approved

at the meeting of the Academic Council of the University
Protocol № 1 "01" of September 2023
Chairman of the Academic Council of the University Orynbekov D.R.

Content

1.Introduction

1.1.General data

Preparation for the educational program "8D05301-Chemistry" is carried out by the Department of "Chemical technology and ecology" of the faculty of engineering and technology. The educational programme of Shakarim University of Semey tailored to the needs of the regional labour market, the requirements of normative documents of MSHE of RK and is a system of documents for organization of educational process.

1.2.Completion criteria

The main criterion for the completion of the educational process for the preparation of PhD students is the development of at least 45 academic credits of the educational component, including 20 credits of practice, at least 123 academic credits of research work, at least 12 credits of final certification, namely writing and defending a doctoral dissertation. The cycle of basic disciplines (DB) includes 25 academic credits, including 15 DB credits of the University component and 10 credits of pedagogical practice.

The cycle of core disciplines (PD) includes 20 academic credits, 10 elective component credits, and 10 research practice credits. A total of 180 credits.

1.3.Typical study duration: 3 years

2.PASSPORT OF THE EDUCATIONAL PROGRAM

2.1.EP purpose	The purpose of the educational program is to prepare highly qualified specialists for higher, postgraduate education, research and production, with in-depth fundamental educational, methodological and research training
2.2.Map of the training profile within the educational program	
Code and classification of the field of education	8D05 - Natural Sciences, Mathematics and Statistics
Code and classification of the direction of training	8D053 - Physical and chemical sciences
Code in the International Standard Classification of Education	0530
Code and classification of the educational program group	D089 - Chemistry
Code and name of the educational program	8D05301 - Chemistry
2.3.Qualification characteristics of the graduate	
Degree awarded / qualification	Doctor of philosophy PhD in the educational program 8D05301 - Chemistry
Name of the profession / list of positions of a specialist	High school chemistry teacher; Research fellow; Chemical engineer; process chemist and others
OQF qualification level (industry qualification framework)	8
Area of professional activity	Graduate program – Ph.D. can work in the field of science, technology and chemical education encompassing a combination of theoretical and applied problems of chemistry and related scientific disciplines, industry of new materials, including nanostructured materials, new energy sources, synthetic composites and fibers, other materials with desired properties
Object of professional activity	The objects of professional activity are chemical, physical, physico-chemical, thermal processes, macro-, micro-and nanosystems and materials, devices and automated systems of production and research, innovative projects
Types of professional activity	*educational (pedagogical) activities in the field of chemistry and related Sciences; • research activities in the field of chemistry and related Sciences; *production and technological activities in the field of chemistry and related Sciences; * organizational and management activities; • project activity.
Graduate Model	1 EP Description The uniqueness of 8D05301 – "Chemistry" is the synthesis of knowledge from theoretical and modern applied courses, developed taking into account the scientific potential, experience of cooperation with foreign chemical scientists and the material and technical resources of a special department. The graduate model of the educational program 8D05301 – "Chemistry" is developed on the basis of the following regulatory documents: 1. The Law of the Republic of Kazakhstan dated July 27, 2007 No. 319-III "On Education" (with amendments

	and additions as of 02/21/2019); 2. The State mandatory standard of higher and postgraduate education. Appendix 8 to the Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 2. 3. Rules of the organization of the educational process on credit technology of training. Order of the Ministry of Education and Science of the Republic of Kazakhstan dated 20.04.2011 No. 152 4. Standard rules of activity of educational organizations implementing educational programs of higher and (or) postgraduate education. Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595 5. Strategic Development Plan of the NAO "Shakarim Semey University" for 2021-2025 2 Objectives of the educational program - in-depth study of chemical education disciplines for the postgraduate education system and the scientific sphere. - mastering modern information and computer technologies; - involvement of doctoral students in research and innovative activities of the scientific and pedagogical direction, involving fundamental educational, methodological and research training. - instilling the skills of independent scientific research, expertise and analysis of a scientific problem, determining ways to solve it; - mastering techniques and studying the features of university teaching work; - consolidation of self-education skills in the scientific field; - selection of an individual education program by doctoral students; - obtaining fundamental, high-quality, professional education, deep specialized knowledge in the chosen field of chemistry, which will allow the successful development of science. 3 Objectives of the educational program - in-depth study of chemical education disciplines for the postgraduate education system and the scientific sphere. - mastering modern information and computer technologies; - involvement of doctoral students in research and innovative activities of the scientific and pedagogical direction, involving fundamental educational, methodological and research training. - instilling the skills of independent scientific research, expertise and analysis of a scientific problem, determining ways to solve it; - mastering techniques and studying the features of university teaching work; - consolidation of self-education skills in the scientific field; - selection of an individual education program by doctoral students; - obtaining fundamental, high-quality, professional education, deep specialized knowledge in the chosen

	field of chemistry, which will allow the successful development of science. 3 The results of the PhD student`s training in OP 8D05301 – "Chemistry" (8th qualification level of the NQF) in accordance with the Dublin descriptors of the third level suggest the ability to: - Demonstrate in-depth knowledge of modern aspects of the development of chemical science to solve research and applied problems; - Analyze the latest achievements of modern chemical science, non-standard approaches, apply them to solve professional problems; - Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies for organizing higher education, communication technologies; - Be motivated to develop and create new materials and composites with specified properties for different applications; - Possess the theory and skills of chemical scientific experiment, professional operation of modern equipment and devices; - To demonstrate the skills of independently drawing up a research plan, collecting, processing and discussing new scientific and applied results; - Have the ability to present the results obtained in research in the form of reports and scientific publications; - Demonstrate the ability to participate in public scientific discussions and speeches, including in English; - To analyze, systematize, generalize the results of scientific research and present the results obtained in the form of a doctoral dissertation; - Possess the methodology, basic methods and techniques of scientific analysis in the field of chemistry for solving research and applied problems in the chemical industry; - It is reasoned to identify new areas of research, new problems in the field of chemical science; - Apply innovative ideas and technologies in the professional field 4.1 Acquired competencies expressed in the achieved learning outcomes Competencies are acquired by students based on the results of training and practical experience. As a result of mastering the educational program , the graduate must have the following competencies: - To represent the main stages of development and paradigm shift in the evolution of science; - Demonstrate knowledge about scientific chemical schools, their theoretical and practical developments; - Demonstrate knowledge about scientific concepts of world and Kazakh science in the field of chemistry; - Demonstrate knowledge about the mechanism of implementation of scientific developments in practical activities; - Demonstrate knowledge about the norms of

	interaction in the scientific community; - Demonstrate knowledge about the pedagogical and scientific ethics of a research scientist - Apply modern trends, trends and patterns of development of domestic science in the context of globalization and internationalization; - Understand the methodology of scientific knowledge; - Apply the achievements of world and Kazakh science in the field of chemistry; - Understand the importance of a foreign language for scientific communication and international cooperation - To realize and accept the social responsibility of science and education; - 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; - To choose and effectively use modern research methodology; - Plan and predict your further professional development; - Critically analyze, evaluate and compare various scientific theories and ideas; - Plan and predict the results of the study; -Demonstrate the quality and effectiveness of the selected scientific methods; - Conduct patent search and transfer scientific information using modern information and innovative technologies 3.2 Personal qualities of the graduate the ability to analyze the patterns of formation and development of professional knowledge, the desire to develop intellectual, moral, communicative, organizational and managerial skills.

3.Modules and content of the educational program

Scientific aspects of chemistry

Academic writing

Discipline cycle	Basic disciplines
Discipline component	University component
SubjectID	32110 (3010317)
Course	1
Term	1
Credits count	5
Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline examines the basics of oral and written scientific communication in professional activity. The principles of constructing a scientific text in accordance with the topic of the dissertation and the direction of research, the rules of analytical review, general requirements for scientific work are studied. Outlines the basics of the formation of oral speech, scientific abstracting and presentation of research results; introduces scientific databases, domestic and foreign standards

Purpose of studying of the discipline

expansion of the communicative competence connected with analytical text activity; formation of linguistic and pragmatic thinking skills in students

Learning Outcomes

ON1 To demonstrate in-depth knowledge and skills in priority areas of chemistry for solving research and applied problems.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.

Prerequisites

Masters degree course

Postrequisites

Final examination Doctoral student research work, including internship and doctoral dissertation II Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Actual theoretical and applied aspects of chemistry

Discipline cycle	Basic disciplines
Discipline component	University component
SubjectID	32112 (3012256)
Course	1
Term	1
Credits count	5
Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The course introduces problematic issues, tasks, achievements and development trends of modern fundamental chemistry. The principles of "green chemistry", directions of organic synthesis technology, nanotechnology, fluid technologies in the chemistry of natural compounds are considered. Methods for modeling molecules and chemical reactions are discussed. Scientific, applied and technical aspects of organic, analytical and macromolecular chemistry are studied.

Purpose of studying of the discipline

deepening the knowledge of doctoral students about current issues, achievements and directions of fundamental chemistry

Learning Outcomes

ON2 Analyze the latest achievements of modern chemical science, non-standard approaches, apply them to solve professional problems.
ON10 Own methodology, basic methods and techniques of scientific analysis in the field of chemistry for solving research and applied problems in the chemical industry
ON11 Definition of new branches of research, new problems in the field of chemical science
ON12 Apply innovative ideas and technologies in the professional field

Prerequisites

Masters degree course

Postrequisites
Final examination Research practice Doctoral student research work, including internship and doctoral dissertation II Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Research methods

Discipline cycle	Basic disciplines
Discipline component	University component
SubjectID	32111 (3010318)
Course	1
Term	1
Credits count	5
Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline
This course introduces the methods and direction of scientific research in the field of chemical science. The discipline considers tasks, methods, types, stages of theoretical and experimental research, studies structural components and forms of scientific activity. Mathematical, analytical means of cognition, metrological support are highlighted. The planning of the experiment, the stages of its organization, graphical processing, analysis and interpretation of the data obtained are studied.

Purpose of studying of the discipline
mastering knowledge about the laws, principles, concepts, terminology, content, and specific features of the organization and management of scientific research.

Learning Outcomes
ON3 Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies of higher school education, communication technologies.
ON5 To possess the theory and skills of chemical scientific experiment, professional operation of modern equipment and devices.
ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites
Masters degree course

Postrequisites
Final examination Research practice Doctoral student research work, including internship and doctoral dissertation II Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Doctoral student research work, including internship and doctoral dissertation I

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	32113 (3010328)
Course	1
Term	1
Credits count	15
Working practice	450hours
Total	450hours
Knowledge control form	Total mark on practice

Short description of discipline
The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline
The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science

Learning Outcomes
ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites
Academic writing Research methods Actual theoretical and applied aspects of chemistry
Postrequisites
Final examination

Teaching practice

Discipline cycle	Basic disciplines
Discipline component	University component
SubjectID	32121 (3010319)
Course	2
Term	1
Credits count	10
Pedagogical practics	300hours
Total	300hours
Knowledge control form	Total mark on practice

Short description of discipline
Teaching practice is essential and essential a component of the educational process of doctoral studies and is carried out in order to form professional pedagogical skills. Includes the study of the experience of pedagogical activity in the system of postgraduate education, the acquisition of practical teaching skills through the development of educational material, teaching disciplines in the chemical direction; participation in scientific activities, educational and methodological and educational work of the department.

Purpose of studying of the discipline
formation of professional and personal competencies necessary for the organization of the educational process in higher education.
Learning Outcomes
ON3 Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies of higher school education, communication technologies.
Prerequisites
Basic and profile disciplines of the EP
Postrequisites
Final examination

Modern aspects of the development of chemical science

Supramolecular structure of polymers

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32115 (3010322)
Course	1
Term	2
Credits count	5
Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline
The discipline forms idea of directions of research on supramolecular structure of polymers. The internal organization of polymer bodies studied. Models of SSP amorphous polymers discussed. The structure of cell of crystalline macromolecules, structural hierarchy, types common supramolecular organizations – lamellar, layered, fibrillar, dendritic, spherulites considered. Thermodynamics, kinetics of crystallization and melting described; factors influencing these processes; methods determining the structure.

Purpose of studying of the discipline
The study of the main directions of the study of the supramolecular structure of polymers
Learning Outcomes
ON1 To demonstrate in-depth knowledge and skills in priority areas of chemistry for solving research and applied problems.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.
ON12 Apply innovative ideas and technologies in the professional field
Prerequisites
Research methods Actual theoretical and applied aspects of chemistry
Postrequisites
Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Doctoral student research work, including internship and doctoral dissertation II

Discipline cycle	Profiling discipline

Discipline component	University component
SubjectID	32120 (3010329)
Course	1
Term	2
Credits count	20
Working practice	600hours
Total	600hours
Knowledge control form	Total mark on practice

Short description of discipline

The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline

The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science.

Learning Outcomes

ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites

Academic writing Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination

Polymer composites and materials

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32119 (3010326)
Course	1
Term	2
Credits count	5
Lections	30hours
Practical and seminar classes	15hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline forms knowledge in the field of polymer composite materials. The classification and characteristics of composites are considered. The structure and types of polymer matrices, types of fillers and intermediate semi-finished products, the technology of obtaining prepregs are studied. Methods of production and features of fiberglass, carbon fibers, textolites are discussed. The principles of creation, methods of improving the properties of PCM are described. Questions about heavy-duty, hybrid polymer composite materials and nanocomposites are covered.

Purpose of studying of the discipline

Mastering the knowledge in the field of polymer composite materials

Learning Outcomes

ON2 Analyze the latest achievements of modern chemical science, non-standard approaches, apply them to solve professional problems.
ON3 Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies of higher school education, communication technologies.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.

Prerequisites

Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Modern problems of polymer materials

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32116 (3010323)
Course	1

Term	2
Credits count	5
Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline studies problematic aspects of polymer materials science. Classification, ways of creation, properties of filled, unfilled PM are considered. The types, functions of fillers, principles of action of plasticizers, plasticizer, the value pigment, dye, antiprensa, stabilizers are studied. The problems destruction, deformation PCM, their strength, durability, difficulties in obtaining and processing them, ways to solve problematic issues are discussed.

Purpose of studying of the discipline

The study of the main aspects of the development of polymer materials

Learning Outcomes

ON1 To demonstrate in-depth knowledge and skills in priority areas of chemistry for solving research and applied problems.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.
ON12 Apply innovative ideas and technologies in the professional field

Prerequisites

Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation VI

Fundamental and applied aspects of polymer hydrogels and cryogels

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32117 (3010324)
Course	1
Term	2
Credits count	5
Lections	30hours
Practical and seminar classes	15hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline studies the features of the gel-like state of a substance and the scope of their application. The structure, properties and methods of obtaining reversible and irreversible, physical and chemical polymer gels are considered. The structure of xerogels, lyogels, hydrogels and organogels, the principles of swelling of hydrogels are highlighted. Gel-forming materials and types of crosslinking agents are discussed. The nature, types and mechanisms of cryogel formation, research methods are studied.

Purpose of studying of the discipline

The study of the main features of the gel state of matter and areas of their application

Learning Outcomes

ON2 Analyze the latest achievements of modern chemical science, non-standard approaches, apply them to solve professional problems.
ON3 Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies of higher school education, communication technologies.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.

Prerequisites

Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Chemistry of biologically active substances

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32114 (3010320)
Course	1
Term	2
Credits count	5

Lections	15hours
Practical and seminar classes	30hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline examines the general patterns of chemical behavior of biologically active substances in the body, methods of studying their structure and metabolism. The specific chemical and biological properties, structural organization, methods of isolation and establishment of the structure of BAS are studied. Biologically active derivatives of hydrocarbons, carbohydrates, heterocyclic compounds, proteins, nucleic acids, lipids, alkaloids, terpenes are considered. The fields of application of bioactive compounds are described.

Purpose of studying of the discipline

Deepening the knowledge of doctoral students in the field of reactivity, biological activity and the value of various natural and synthetic compounds, establishing the relationship between the structure and the biological activity of substances

Learning Outcomes

ON1 To demonstrate in-depth knowledge and skills in priority areas of chemistry for solving research and applied problems.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.
ON12 Apply innovative ideas and technologies in the professional field

Prerequisites

Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Polymer Destruction Chemistry

Discipline cycle	Profiling discipline
Discipline component	Electives
SubjectID	32118 (3010325)
Course	1
Term	2
Credits count	5
Lections	30hours
Practical and seminar classes	15hours
Independent work of a student under the guidance of a teacher	35hours
Independent work of the student	70hours
Total	150hours
Knowledge control form	Examination

Short description of discipline

The discipline considers the theoretical foundations of polymer degradation processes. The main ways of destruction of high-molecular compounds, the scope of their decomposition products are described. Destructive phenomena under the influence of UV rays, thermal, thermo-oxidative, chemical, mechanical destruction of polymer compounds, its negative consequences are studied. The mechanism, chemistry and kinetics of macromolecule decay, ways to reduce the destruction of hydrocarbons are considered. The types of stabilizers and the principles of their operation are described.

Purpose of studying of the discipline

The study of the main ways of degradation of polymers and areas of application of their decomposition products

Learning Outcomes

ON2 Analyze the latest achievements of modern chemical science, non-standard approaches, apply them to solve professional problems.
ON3 Demonstrate the ability to solve scientific and educational problems in the field of chemistry, possess modern technologies of higher school education, communication technologies.
ON4 Be motivated to develop and create new materials and composites with desired properties for different applications.

Prerequisites

Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination Research practice Doctoral student research work, including internship and doctoral dissertation III Doctoral student research work, including internship and doctoral dissertation IV Doctoral student research work, including internship and doctoral dissertation V Doctoral student research work, including internship and doctoral dissertation VI

Doctoral student research work, including internship and doctoral dissertation III

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	32122 (3010330)
Course	2
Term	1
Credits count	20

Working practice	600hours
Total	600hours
Knowledge control form	Total mark on practice

Short description of discipline
The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline
The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science.

Learning Outcomes
ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites
Basic and profile disciplines of the EP

Postrequisites
Final examination

Doctoral student research work, including internship and doctoral dissertation IV

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	32123 (3010331)
Course	2
Term	2
Credits count	30
Working practice	900hours
Total	900hours
Knowledge control form	Total mark on practice

Short description of discipline
The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline
The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science

Learning Outcomes
ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites
Basic and profile disciplines of the EP

Postrequisites
Final examination

Research practice

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	32124 (3010327)
Course	3
Term	1
Credits count	10
Working practice	300hours
Total	300hours
Knowledge control form	Total mark on practice

Short description of discipline
Research practice consists in studying advanced general scientific, methodological, scientific and technical achievements of chemical domestic and foreign science, improving experimental, research skills, conducting experiments in accordance with the topic of the dissertation, improving information processing skills and interpreting the data obtained. This type of activity contributes to the

consolidation, deepening and systematization of knowledge gained in the study of fundamental chemical disciplines.

Purpose of studying of the discipline

familiarization with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data

Learning Outcomes

ON5 To possess the theory and skills of chemical scientific experiment, professional operation of modern equipment and devices.
ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.

Prerequisites

Basic and profile disciplines of the EP

Postrequisites

Doctoral student research work, including internship and doctoral dissertation VI

Doctoral student research work, including internship and doctoral dissertation V

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	32125 (3010332)
Course	3
Term	1
Credits count	20
Working practice	600hours
Total	600hours
Knowledge control form	Total mark on practice

Short description of discipline

The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline

The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science.

Learning Outcomes

ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.
ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites

Academic writing Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination

Doctoral student research work, including internship and doctoral dissertation VI

Discipline cycle	Profiling discipline
Discipline component	University component
SubjectID	26442 (3010333)
Course	3
Term	2
Credits count	18
Working practice	540hours
Total	540hours
Knowledge control form	Total mark on practice

Short description of discipline

The research work of a doctoral student is carried out to prepare a doctoral student who knows the methodology of scientific knowledge of chemical processes and is able to apply scientific methods in the study of problems in the field of chemistry. In accordance with the topic of the dissertation, it includes the following stages: the study and selection of scientific resources, the design of bibliographic data, the choice of analysis methods, the implementation of experimental research, the passage of a foreign internship, the processing and publication of the results, the defense of the dissertation

Purpose of studying of the discipline

The goal is to prepare a doctoral student who knows the methodology of research knowledge of chemical processes and is able to apply scientific methods in the study of problems of modern chemical science.

Learning Outcomes

ON6 To show skills of self-preparation of the plan of scientific research, collection, processing and discussion of new scientific and applied results.
ON7 Have the ability to present the results obtained in research in the form of reports and scientific publications.
ON8 Demonstrate the ability to participate in public scientific discussions and speeches, including in English.

ON9 To analyze, systematize, summarize the results of scientific research and present the results in the form of a doctoral dissertation

Prerequisites

Academic writing Research methods Actual theoretical and applied aspects of chemistry

Postrequisites

Final examination

Final certification

Doctoral dissertation

Credits count	12

4.Summary table on the scope of the educational program

«8D05301 - Chemistry»

Name of discipline	Cycle/ Component	Term	Number of credits	Total hours	Lec	SPL	LC	IWST	IWS	Knowledge control form
Scientific aspects of chemistry										
Academic writing	BS/US	1	5	150	15	30		35	70	Examination
Actual theoretical and applied aspects of chemistry	BS/US	1	5	150	15	30		35	70	Examination
Research methods	BS/US	1	5	150	15	30		35	70	Examination
Doctoral student research work, including internship and doctoral dissertation I	AS/US	1	15	450						Total mark on practice
Teaching practice	BS/US	3	10	300						Total mark on practice
Modern aspects of the development of chemical science										
Supramolecular structure of polymers	AS/CCh	2	5	150	15	30		35	70	Examination
Doctoral student research work, including internship and doctoral dissertation II	AS/US	2	20	600						Total mark on practice
Polymer composites and materials	AS/CCh	2	5	150	30	15		35	70	Examination
Modern problems of polymer materials	AS/CCh	2	5	150	15	30		35	70	Examination
Fundamental and applied aspects of polymer hydrogels and cryogels	AS/CCh	2	5	150	30	15		35	70	Examination
Chemistry of biologically active substances	AS/CCh	2	5	150	15	30		35	70	Examination
Polymer Destruction Chemistry	AS/CCh	2	5	150	30	15		35	70	Examination
Doctoral student research work, including internship and doctoral dissertation III	AS/US	3	20	600						Total mark on practice
Doctoral student research work, including internship and doctoral dissertation IV	AS/US	4	30	900						Total mark on practice
Research practice	AS/US	5	10	300						Total mark on practice
Doctoral student research work, including internship and doctoral dissertation V	AS/US	5	20	600						Total mark on practice
Doctoral student research work, including internship and doctoral dissertation VI	AS/US	6	18	540						Total mark on practice
Final certification										
Doctoral dissertation		10	12	360						