CATALOG OF ELECTIVE DISCIPLINES

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)

set of 2023

Semey 2023

Developed
By the Academic Committee of the EP
The head of the AC Nurymkhan G. N.
EP Manager Orazzhanova L.K.

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Chairman of the Commission on Quality Assurance Abdilova G.

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at the meeting of the Academic Council of the University
Protocol №5 "21" April 2023
Chairman of the Academic Council Oralkanova I.A.

Polymer composites and materials

Discipline cycle	Profiling discipline
Course	1
Credits count	5
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.

Learning outcomes by discipline

1) Design new types of polymer materials
2) Describe the structure and properties of polymer matrices and prepregs
3) Propose methods for modifying polymer materials

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

Fundamental and applied aspects of polymer hydrogels and cryogels

Discipline cycle	Profiling discipline
Course	1
Credits count	5
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.

Learning outcomes by discipline

1) Use polymer gels for applied purposes
2) Describe the structure and properties of hydro- and cryogels
3) Synthesize new types of polymer gels

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

Polymer Destruction Chemistry

Discipline cycle	Profiling discipline
Course	1
Credits count	5
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.
Learning outcomes by discipline
1) Describe the mechanism of polymer destruction
2) Classify the types of destruction and its consequences
3) To carry out the selection of stabilizers that prevent destruction
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

Supramolecular structure of polymers

Discipline cycle	Profiling discipline
Course	1
Credits count	5
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
Learning outcomes by discipline
1) Apply modern research methods to study the supramolecular structure of polymers
2) Demonstrate knowledge of the supramolecular organization of polymers
3) describe the physico-chemical basis of phase transitions of polymer bodies
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
Course	1
Credits count	5
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
Learning outcomes by discipline
1) To reveal modern problems of polymer chemistry
2) Use the principles of polymer materials science to create structural materials
3) Create mechanically improved composite materials
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

Chemistry of biologically active substances

Discipline cycle	Profiling discipline
Course	1
Credits count	5
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

Learning outcomes by discipline

1) Describe the properties of biologically active substances
2) Carry out modification of biologically active substances
3) Determine the structure of BAS

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