Geology and Oil-gas Business Institute named after K. Turyssov
Department of Chemical and Biochemical Engineering

Education Program

7M07142 - "Chemical Technology of Organic substances"

Code and classification of the field of education: 7M07 Engineering, manufacturing and construction areas

Code and classification of areas of study: 7M071 Engineering

Code in the International Standard Classification of Education: 0710

Group of educational programs: M097 - " Chemical engineering and processes "

Уровень по НРК: 7
Уровень по ОРК: 7

Time of study: 2
Volume of credits: 120

Almaty, 2023

Educational Program 7M07142 - Chemical Technology of Organic Substances Approved at meeting of the Academic Council of KazNITU named after. K.I. Satbayev.
Minutes No. _13_ dated "_28_" _04_ 2022

Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNITU named after. K.I. Satbayev.
Minutes No. _7_ dated "_26_" _04_ 2022

Educational program
7M07142 - Chemical technology of organic substances
code and name of the educational program
developed by the academic committee for the direction
7M071 Engineering and Engineering

Name	Academic degree/ academic title	Job title	Place of work	sign
Chairman of the academic committee:				
Amitova Aigul Amantayevna	PhD	Head of the Department	KazNRTU	
Teaching staff:				
Selenova Bagdat Samatovn	Doctor of Chemical Sciences, Professor	Professor	KazNRTU	
Kerimkulova Aigul Zhadyraevna	Candidate of Chemical Sciences	Assistant Professor	KazNRTU	
Nauryzova Saule Zinagievna	PhD	Associate Professor	KazNRTU	
Chugunova Nina Ivanovna	Candidate of Chemical Sciences	Associate Professor		
Nakan Ulantai	PhD	Associate Professor		
Ilyin Alexander Ivanovich		Chairman of the Management Board	JSC "Scientific Center of Anti-infectious Drugs"	
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Tolkimbayev Gambit Ajdarovich		General manager	Oil and Gas Chemical Association	

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List of abbreviations and symbols

1. Description of the educational program

The educational program (hereinafter EP) is a set of documents developed by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan. The EP takes into account the needs of the regional labor market, the requirements of government agencies and relevant industry requirements.

The production of the main organic and petrochemical synthesis is based on fossil organic raw materials: oil, natural gas, coal. Using modern processes of their processing (cracking, pyrolysis, reforming, rectification, conversion, coking and semi-coking) and various methods of separation of starting materials, the most important compounds are obtained, which are direct raw materials for organic synthesis.

The formation of such a complex of technologically related industries will allow the production of high-tech and science-intensive types of products, which, in turn, will cause the accelerated development of other sectors of the real sector of the economy of the Republic of Kazakhstan. Kazakhstan, within the framework of its innovation and industrial policy, covers a wide range of petrochemical development, which will undoubtedly accelerate the accelerated development of the economy of the Republic of Kazakhstan in the future.

The EP is based on the state educational standard for higher professional education in the relevant field.

The EP defines the program educational goals, the learning outcomes of undergraduates, the necessary conditions, content and technologies for the implementation of the educational process, the assessment and analysis of the quality of students during training and after graduation.
The EP includes the curriculum, the content of disciplines, learning outcomes and other materials to ensure quality education for undergraduates.

2. Purpose and objectives of the educational program

EP goals:
- formation on the basis of the scientific school of the national research university of general cultural, professional and special competencies that allow the graduate to successfully work in the field of organic and petrochemical synthesis enterprises and be competitive in the labor market;
- development of undergraduates' personal qualities such as creativity, responsibility, tolerance, the desire for self-development and disclosure of their creative potential;

- development of research qualities, the ability to plan, set up, perform and generalize experimental research according to the chosen program, the formation of a critical understanding of the existing fundamental scientific theories and concepts, and the explanation of the results obtained from the standpoint of modern chemical science and technology;

- development and implementation of active learning methods for the formation of a creative, innovative approach to understanding professional activities, the development of independent thinking and the ability to make optimal decisions in a particular situation;

- development of educational and methodological documentation, methods for monitoring the knowledge of students and multimedia materials for the educational process.

Tasks of the OP:

· improvement and implementation of the educational process using advanced teaching methods;

· involvement in the educational process of high-class scientific personnel of international level and specialists in the production sector;

· use of modern equipment and instruments to improve the efficiency and level of scientific research;
· development of international cooperation for the implementation of joint scientific projects and master's programs for double-diploma education.

3. Requirements for evaluating the learning outcomes of an educational program

Formed learning outcomes:

PO1 present conceptual knowledge in the field of scientific methods for studying the properties of a system, interpret the mechanisms of ongoing reactions, know the chemistry and physics of polymeric materials and methods for their synthesis depending on the scope of application, as well as knowledge in the field of planning, organization and control of chemical and technological processes;

RO2 be able to apply the knowledge of the physico-chemical foundations of hydrodynamic, thermal, mass transfer, thermal and catalytic processes for their modeling, in the development and application of ideas in the field of research in the chemical technology of production and processing of polymers, oil and gas processing and their relationship with related industries;

PO3 know the classification of chemical-technological processes and describe the instrumentation, calculate typical chemical production apparatuses and justify the choice of standard equipment;

PO4 be able to interpret information to form judgments, taking into account social, ethical and scientific considerations, have communication skills, work in a team; be able to manage projects and processes; multilingualism;

PO5 analyze and explain the principles of constructing technological schemes for the production and processing of organic substances and the choice of technological equipment for oil refineries and petrochemical enterprises;

RO6 to apply the principles and fundamentals of chemical engineering in the development of technological lines of new enterprises with the justification of the conditions and mode of operation of technological equipment;

PO7 plan and organize the setting up of scientific experiments and research in the field of production and processing of oil and gas, polymers, process, interpret, critically analyze the results obtained and have the learning skills necessary to independently continue further education in the field under study;

RO8 to develop functional schemes for the automation of chemical and technological processes, to have an idea about the modeling of production and technological processes, the transfer of information about the digital model for further processing and decision making;

PO9 based on the use of in-depth theoretical and practical knowledge in the field of production of chemical materials, chemical engineering and engineering, professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems;

PO10 assess the environmental risks of technological installations for the production of products of basic organic and petrochemical synthesis with the proposal of measures to reduce the harmful effects on the environment and the recommendation of methods for treating wastewater from the enterprise;
PO11 the ability to participate in the development of interactive teaching methods, educational and methodological documentation, multimedia materials and methods for monitoring learning, as well as in managing the scientific and educational work of students in the field of organic and petrochemical synthesis.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	7M07 Engineering, manufacturing and construction areas
2	Code and classification of areas of study	7M071 Engineering and Engineering
3	Group of educational programs	M097 - "Chemical Engineering and Processes"
4	Name of the educational program	Chemical technology of organic substances
5	Brief description of the educational program	The EP regulates the educational process of training specialists in the field of chemical engineering in the field of organic and petrochemical synthesis enterprises. The program is built taking into account the possibility of providing the undergraduate with the choice of the appropriate educational trajectory, containing their own individual competencies, reflecting

		the specifics of a particular specialization within the framework of a single educational direction 7M071 - Engineering and Engineering.
6	Purpose of the OP	The purpose of the EP is to train highly qualified and competitive specialists in the labor market, focused on solving the problems of innovative development of the most important areas in the field of organic and petrochemical industries, with creativity, formed critical understanding of fundamental scientific theories and concepts and the ability to interpret the results obtained from the standpoint of modern chemical science and technology .
7	OP type new	OP type new
8	Уровень по НРК	7
9	Уровень по ОРК	7
10	Distinctive features of the OP	The EP was developed taking into account the Atlas of new professions and competencies of Kazakhstan in the field of oil refining and petrochemistry.
11	List of competencies of the educational program:	Professional competencies: P1 - Independence: the ability to independently analyze the available information, set goals and objectives of experimental research using modern instrumental methods and computing tools; management activities involving the creation of a strategy for the functioning and development of industry structures P2 - Complexity: an activity that involves solving problems that involve the choice and variety of solutions. Expansion and modernization of production, introduction of new technologies, development and use of new approaches and methods; the ability to generate new ideas and methodological solutions; P3 - Responsibility: for resolving issues in the field of organic synthesis technology and petrochemistry, organizing work on the operation of the production in accordance with the requirements of regulatory documents and technical documentation; be responsible for the quality of research and the scientific validity of the results obtained. Personal competencies L1 - Leadership, organizational qualities, determination. Communication skills with authorities. P2 - General understanding of business processes, computer literacy, accuracy in completing tasks, independence, stress resistance.
12	Learning outcomes of the educational program:	PO1 present conceptual knowledge in the field of scientific methods for studying the properties of a system, interpret the mechanisms of ongoing reactions, know the chemistry and physics of polymeric materials and methods for their synthesis depending on the scope of application, as well as knowledge in the field of planning, organization and control of chemical and technological processes; RO2 be able to apply the knowledge of the physico-chemical foundations of hydrodynamic, thermal, mass transfer, thermal and catalytic processes for their modeling, in the development and application of ideas in the field of research in the chemical technology of production and processing of polymers, oil and gas processing and their relationship with related industries; PO3 know the classification of chemical-technological processes and describe the instrumentation, calculate typical chemical production apparatuses and justify the choice of standard equipment; PO4 be able to interpret information to form judgments, taking into account social, ethical and scientific considerations, have communication skills, work in a team; be able to manage projects and processes; multilingualism; PO5 analyze and explain the principles of constructing technological schemes for the production and processing of organic substances and the choice of technological equipment for oil refineries and petrochemical enterprises; RO6 to apply the principles and fundamentals of chemical engineering in the development of technological lines of new enterprises with the justification of

		the conditions and mode of operation of technological equipment; PO7 plan and organize the setting up of scientific experiments and research in the field of production and processing of oil and gas, polymers, process, interpret, critically analyze the results obtained and have the learning skills necessary to independently continue further education in the field under study; RO8 to develop functional schemes for the automation of chemical and technological processes, to have an idea about the modeling of production and technological processes, the transfer of information about the digital model for further processing and decision making; PO9 based on the use of in-depth theoretical and practical knowledge in the field of production of chemical materials, chemical engineering and engineering, professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems; PO10 assess the environmental risks of technological installations for the production of products of basic organic and petrochemical synthesis with the proposal of measures to reduce the harmful effects on the environment and the recommendation of methods for treating wastewater from the enterprise; PO11 the ability to participate in the development of interactive teaching methods, educational and methodological documentation, multimedia materials and methods for monitoring learning, as well as in managing the scientific and educational work of students in the field of organic and petrochemical synthesis.
13	Form of study	full-time
14	Training period	2 years
15	Volume of loans	120
16	Languages of instruction	Kazakh, Russian, English
17	Awarded Academic Degree	Master of Engineering
18	Developer(s) and authors:	1. Head of the department Amitova A.A. 2. Director of the Institute Syzdykov A.Kh. 3. Assistant Professor, PhD Nauryzova S.Z.

4.2. The relationship between the achievability of the formed learning outcomes in the educational program and academic disciplines

№	Name of discipline	Brief description of discipline	Number of credits	Formed learning outcomes (codes)									
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Cycle of basic disciplines University component													
1	English (professional)	In the process of learning, students acquire knowledge of a foreign language, including the possession of specialized vocabulary, necessary for the implementation of effective oral and written communications in a foreign language in their professional activities. Practical tasks and methods for developing the required language skills in the learning process include: case method and role-playing games, dialogues, discussions, presentations, listening tasks, work in pairs or groups, various written tasks, grammar tasks and explanations.	5				V						
2	Psychology of management	The course is designed to provide a balanced coverage of all the key elements that make up the discipline. It will briefly review the origins and development of the theory and practice of organizational behavior and then review the main roles, skills and functions of management with a focus on management effectiveness, illustrated with real life examples and case studies.	3				V			V		V	
3	History and philosophy of science	The subject of philosophy of science, the dynamics of science, the specifics of science, science and prescience, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-non-classical science, the philosophy of mathematics, physics, engineering and technology, the specificity of engineering sciences, the ethics of science , social and moral responsibility of a scientist and engineer.	3				V			V	V	V	V
4	Pedagogy of higher education	In the course of studying the course, undergraduates get acquainted with the didactics of higher education, the forms and methods of organizing education in higher education, the psychological factors of successful learning, the	3				V			V		V	

		characteristics of psychological influence, the mechanisms of educational influence, pedagogical technologies, the characteristics of pedagogical communication, the mechanisms for managing the learning process. They analyze organizational conflicts and ways to resolve them, psychological destruction and deformation of the teacher's personality.											
5	Teaching practice	In the course of teaching practice, undergraduates are involved in undergraduate studies at the discretion of the university. At the same time, undergraduates apply the knowledge of pedagogy and psychology of students' cognitive activity in the learning process, undergraduates form an idea of the professional competence of a teacher of higher education.	6				V	V					
Cycle of basic disciplines Optional component													
1	Modern methods for studying the properties of oil and oil products	The content of the discipline assumes consideration of modern methods of scientific research in petrochemistry and oil refining: chemical (gravimetric, titrimetric) and physico-chemical (optical, electrochemical, chromatographic) methods of analysis; consideration of modern means of scientific research, the principles of scientific knowledge. The assimilation of this course contributes to a deep understanding by undergraduates of the scientific foundations, terms and concepts when planning and conducting scientific research in petrochemistry and oil refining, the acquisition of theoretical knowledge necessary for the development of research skills and the implementation of research work.	5	V		V		V				V	
2	Modern aspects of the production of polymer products	The purpose of the course is to characterize plastics as highly efficient materials in technological, consumer and economic terms. Modern methods of polymer processing, features of molding methods, energy intensity of the processing process are considered. Particular attention is paid to the equipment used in the processing of plastics. Casting under pressure. extrusion plants. Calendering, casting, direct pressing, foaming, reinforcement, fiber production.											
3	Industrial reactors for large-scale chemical production	Within the framework of the course, a presentation of the sections is given: the basics of the theory of the process in a chemical reactor, mathematical modeling of reactors, the	5			V		V	V			V	

		design of modern chemical reactors, new trends in the development of the theory of processes and apparatuses; interactions between chemical transformation processes and transport phenomena at all scale levels, a method for choosing a reactor and calculating the process in it, optimizing chemical processes and reactors; structural elements of chemical reactors; schemes and designs of industrial chemical reactors.											
4	Industrial water treatment and wastewater treatment methods	The aim of the course is to provide an understanding of water consumption in the chemical industry. The characteristic of natural waters and indicators of their quality are given. The main technological operations of industrial water treatment are considered: coagulation plants, mechanical water filtration, filter materials. Basic structural elements and types of mechanical filters. Operation of mechanical filters. Water treatment by precipitation methods. Ion exchange water filtration. Water desalination. Water degassing. Schemes of water treatment plants are presented. Local and general schemes for wastewater treatment of industrial enterprises. Classification of chemical pollutants of industrial waters and their behavior in water. Wastewater treatment from heavy metals. Thermal-oxidative methods for the neutralization of organic impurities in wastewater. The role of microorganisms in wastewater treatment processes. Methods for biological wastewater treatment.											
5	Mechanisms of organic reactions	The aim of the course is to consider the mechanisms of various organic reactions. A general classification of mechanisms and the concept of a transition state are given. The stages of studying the reaction mechanism are considered: material balance, kinetics, stereochemical correlations, isotopic and structural labels, the influence of substituents, solvent, catalysts, and the search for unstable intermediates. Thermodynamic parameters of reactions. The value of the entropy of activation for reactions of different types. The concept of kinetic and thermodynamic control of reactions. Hammett's equation. steric effects. Taft equation. Linearity relation of free energies in the study of the transition state.	5	V									
6	Industrial organic chemistry	The course is devoted to the consideration of the characteristic features and characteristics of the industry of											

		basic organic synthesis (OOS). The relationship between basic organic synthesis and specialized (branch) synthesis is shown. The raw material base of industrial organic chemistry is given. Basic chemical processes of industrial organic chemistry. Review of the main directions of processing of methane and olefinic hydrocarbons, acetylene and carbon monoxide in the industry. Halogenation and dehalogenation of chlorine derivatives. Hydration of olefins and acetylene. Dehydration. Alkylation and hydroxyethylation. hydrogenation and dehydrogenation. Oxidation. Carbonylation and oxosynthesis.											
Цикл профилирующих дисциплин Вузовский компонент													
1	Chemistry and physics of polymer composite materials	The purpose of studying the course is to give an in-depth understanding of the principles of creating polymer composite materials (PCM) with an improved complex of physical and chemical properties. As a result of studying the course, the undergraduate should know the basic physical and mechanical properties of polymer composite materials; principles of creating new filled PCMs with a complex of valuable properties; basic technologies for obtaining PCM; be able to choose various factors leading to improvement of the complex of PCM properties.	5	V								V	
2	homogeneous catalysis	The discipline is intended for the acquisition by undergraduates of systematic knowledge about catalysts and catalytic synthesis methods used in organic synthesis, about the basics of the general theory of the mechanisms of catalytic reactions, about the features of the flow of homogeneous catalytic reactions catalyzed by metal complexes. The main problems of using metal complex homogeneous catalysis in technological processes in industrial and fine organic synthesis, the influence of the reaction medium on the properties of catalysts and the kinetics of the process are considered. The assimilation of this course contributes to a deep understanding by undergraduates of the mechanisms of the most important industrial reactions, the main features of homogeneous metal complex catalysts and the difference between homogeneous catalysis and heterogeneous catalysis.	5		V	V				V			
3	Calculation and	Within the framework of the course, the methods of	5		V	V					V		

	modeling of mass transfer processes and apparatuses	technological calculation and the basics of designing devices for mass transfer processes are considered, which make it possible to master the main approaches to modeling mass transfer processes using mathematical models, modeling systems and modern application programs. Skills and practical skills will be formed to determine the main parameters of the technological regime and the main dimensions of the apparatus, as well as to create models of mass transfer processes for solving problems of computational and technological design.											
4	Ionic liquids, methods for their synthesis and their applications	During the course, attention was paid to the study of the structural features of ionic liquids, which explain their peculiar physical and chemical properties, which led to their prospects in various fields of application and the creation of environmentally and economically acceptable technologies based on them; methods for the synthesis of ionic liquids are considered: an exchange reaction using halogen-containing compounds, a quaternization reaction, and a reaction exchange on ion-exchange resins.	5							V		V	
5	Medical grade polymers	The course is devoted to the study of the impact of polymers on the human body. The origin and danger to health of low-molecular compounds migrating from polymers are considered; polymers and static electrification; toxicology of polymeric materials. The biomedical characteristics of the most important polymeric materials are given: biocompatibility, functionality, chemical composition, hemocompatibility, cytotoxicity. The use of polymeric materials in the treatment of humans. Polymer materials introduced into the body: prostheses, fillings, artificial organs, polymer implants. Polymeric suture and dressing materials. Polymer medical adhesives. Polymer plasma and blood substitutes, detoxifiers, interferonogens, antidotes; drugs made on the basis of polymers. Bases for ointments and suppositories. Solvents for injectable dosage forms, aerosols, drops. Fillers (diluents) for tablets, granules and pills. Binders for tablets, granules and pills. Protective covers for tablets, granules, pills, capsules and suppositories.	5						V	V		V	
6	Chemistry of natural compounds	The purpose of the discipline is to study the structure, chemical transformations of natural organic compounds, which are the main components of the cells of living	5	V					V	V			

		organisms; the formation of knowledge and skills among undergraduates, allowing planning the synthesis of various classes of natural compounds and predicting their possible biological activity. The key roles of amino acids, peptides and proteins, nucleosides, nucleotides and nucleic acids in the functioning of a living cell are considered; basic biological functions of amino acids, peptides and proteins, nucleosides, nucleotides and nucleic acids. The interrelation of different levels of structural organization of amino acids, peptides and proteins, nucleosides, nucleotides and nucleic acids with their biochemical and biological properties has been established. Topical trends in modern chemistry of natural compounds are presented.											
7	DATA Science	As part of the study of the Data Science discipline, students master theoretical and practical knowledge, acquire skills in the field of search, critical analysis and synthesis of information using the Python programming language. The discipline provides knowledge about the capabilities of modern information systems in various subject areas and to form skills in working with the most common application programs, knowledge of intelligent information systems (IIS), the structure of IIS, components and types, and logical programming.	5								V	V	
8	Environmental aspects of the production of organic substances	The purpose of the course is to review and analyze the main environmental problems associated with the production of organic substances. The course covers the main ways to control and reduce the level of environmental hazards. The production of hydrocarbon systems with improved environmental characteristics, technological processes for the processing of hydrocarbon systems that improve the environmental quality of gasoline are presented. The assimilation of this course allows you to expand your understanding of the features of technology, dangers and risks in the processes of organic and petrochemical synthesis..	5										V
9	Automation and control systems for organic production	Study of methods for constructing effective systems for automatic and automated control of technological processes using SCADA software and hardware systems. The main task	5						V		V		

		is to acquire professional skills by a master student in building automatic and automated control systems and the means necessary for their implementation, to master and study the principles of operation of SCADA systems, controllers and actuators operating under the control of SCADA systems.											
10	Research practice	During the research practice, undergraduates get acquainted with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data. At the same time, undergraduates, performing experimental research on the topic of a master's thesis using modern instrumental methods and computing tools, learn to be responsible for the quality of research and the scientific reliability of the results obtained, professionally draw up, present and report the results of research work.	4				V			V			

4.4. Information about disciplines

№	Name of the discipline	Brief description of the discipline (30-50 words)	credits	codes
Цикл базовых дисциплин Вузовский компонент				
1	English (professional)	In the process of learning, students acquire knowledge of a foreign language, including the possession of specialized vocabulary, necessary for the implementation of effective oral and written communications in a foreign language in their professional activities. Practical tasks and methods for developing the required language skills in the learning process include: case method and role-playing games, dialogues, discussions, presentations, listening tasks, work in pairs or groups, various written tasks, grammar tasks and explanations.	5	П1,П2, П3, Л1,Л2
2	Psychology of management	The course is designed to provide a balanced coverage of all the key elements that make up the discipline. It will briefly review the origins and development of the theory and practice of organizational behavior and then review the main roles, skills and functions of management with a focus on management effectiveness, illustrated with real life examples and case studies.	3	П1,П2, П3, Л1,Л2
3	History and philosophy of science	The subject of the philosophy of science, the dynamics of science, the specifics of science, science and prescience, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-non-classical science, the philosophy of mathematics, physics, engineering and technology, the specificity of engineering sciences, the ethics of science , social and moral responsibility of a scientist and engineer.	3	П1,П2, П3, Л1,Л2
4	Pedagogy of higher education	In the course of studying the course, undergraduates get acquainted with the didactics of higher education, the forms and methods of organizing education in higher education, the psychological factors of successful learning, the characteristics of psychological influence, the mechanisms of educational influence, pedagogical technologies, the characteristics of pedagogical communication, the mechanisms for managing the learning process. They analyze organizational conflicts and ways to resolve them, psychological destruction and deformation of the teacher's personality.	3	П1,П2, П3, Л1,Л2
5	Teaching practice	In the course of teaching practice, undergraduates are involved in undergraduate studies at the discretion of the university. At the same time, undergraduates apply the knowledge of pedagogy and psychology of students' cognitive activity in the learning process, undergraduates form an idea of the professional competence of a teacher of higher education.	6	П1,П2, П3, Л1,Л2
Basic disciplines Selectable Component				
1	Modern methods for studying the properties of oil and oil products	The content of the discipline assumes consideration of modern methods of scientific research in petrochemistry and oil refining: chemical (gravimetric, titrimetric) and physico-chemical (optical, electrochemical, chromatographic) methods of analysis; consideration of modern means of scientific research, the principles of scientific knowledge. The assimilation of this course contributes to a deep understanding by undergraduates of the scientific foundations, terms and concepts when planning and conducting scientific research in petrochemistry and oil refining, the acquisition of theoretical knowledge necessary for the development of research skills and the implementation of research work.	5	П1,П2, П3
2	Modern aspects of the production of polymer products	Plastics as highly efficient materials in technological, consumer and economic terms. Modern methods of polymer processing. Manufacturability of plastics, features of molding methods, energy intensity of the processing process. The versatility of the equipment		

		used in the processing of plastics. Casting under pressure. extrusion plants. Calendering, casting, direct pressing, foaming, reinforcement, fiber production.		
3	Industrial reactors for large-scale chemical production	Within the framework of the course, a presentation of the sections is given: the basics of the theory of the process in a chemical reactor, mathematical modeling of reactors, the design of modern chemical reactors, new trends in the development of the theory of processes and apparatuses; interactions between chemical transformation processes and transport phenomena at all scale levels, a method for choosing a reactor and calculating the process in it, optimizing chemical processes and reactors; structural elements of chemical reactors; schemes and designs of industrial chemical reactors.	5	П1,П2, П3, Л1
4	Industrial water treatment and wastewater treatment methods	The aim of the course is to provide an understanding of water consumption in the chemical industry. The characteristic of natural waters and indicators of their quality are given. The main technological operations of industrial water treatment are considered: coagulation plants, mechanical water filtration, filter materials. Basic structural elements and types of mechanical filters. Operation of mechanical filters. Water treatment by precipitation methods. Ion exchange water filtration. Water desalination. Water degassing. Schemes of water treatment plants are presented. Local and general schemes for wastewater treatment of industrial enterprises. Classification of chemical pollutants of industrial waters and their behavior in water. Wastewater treatment from heavy metals. Thermal-oxidative methods for the neutralization of organic impurities in wastewater. The role of microorganisms in wastewater treatment processes. Methods for biological wastewater treatment.		
5	Mechanisms of organic reactions	General classification of mechanisms. The concept of a transitional state. Reaction mechanism study stages: material balance, kinetics, stereochemical correlations, isotopic and structural labels, influence of substituents, solvent, catalysts, search for unstable intermediates. Thermodynamic parameters of reactions. The value of the entropy of activation for reactions of different types. The concept of kinetic and thermodynamic control of reactions. Hammett's equation. steric effects. Taft equation. Linearity relation of free energies in the study of the transition state.	5	П1,П2, П3
6	Industrial organic chemistry	Characteristic features and features of the industry of basic organic synthesis (OOS). Relationship between basic organic synthesis and specialized (branch) synthesis. Raw material base of industrial organic chemistry. Basic chemical processes of industrial organic chemistry. Review of the main directions of processing of methane and olefinic hydrocarbons, acetylene and carbon monoxide in the industry. Halogenation and dehalogenation of chlorine derivatives. Hydration of olefins and acetylene. Dehydration. Alkylation and hydroxyethylation. hydrogenation and dehydrogenation. Oxidation. Carbonylation and oxosynthesis.		
Cycle of major disciplines University component				
1	Chemistry and physics of polymer composite materials	The purpose of studying the course is to give an in-depth understanding of the principles of creating polymer composite materials (PCM) with an improved complex of physical and chemical properties. As a result of studying the course, the undergraduate should know the basic physical and mechanical properties of polymer composite materials; principles of creating new filled PCMs with a complex of valuable properties; basic technologies for obtaining PCM; be able to choose various factors leading to improvement of the complex of PCM properties.	5	П1,П2, П3
2	homogeneous	The discipline is intended for the acquisition by undergraduates	5	П1,П2,

	catalysis	of systematic knowledge about catalysts and catalytic synthesis methods used in organic synthesis, about the basics of the general theory of the mechanisms of catalytic reactions, about the features of the flow of homogeneous catalytic reactions catalyzed by metal complexes. The main problems of using metal complex homogeneous catalysis in technological processes in industrial and fine organic synthesis, the influence of the reaction medium on the properties of catalysts and the kinetics of the process are considered. The assimilation of this course contributes to a deep understanding by undergraduates of the mechanisms of the most important industrial reactions, the main features of homogeneous metal complex catalysts and the difference between homogeneous catalysis and heterogeneous catalysis.		П3, Л2
3	Calculation and modeling of mass transfer processes and apparatuses	The role of mass transfer processes and apparatuses, their classification. Material balance of the mass transfer process. Methods of technological calculation and the basics of designing devices for mass transfer processes. General principles of modeling. Classification of models. Methodology for constructing mathematical models of chemical-technological processes. Physical description of the nature of the modeled object. Mathematical modeling of mass transfer processes. Mathematical description of equilibrium in the "liquid-vapor" and "liquid-liquid" systems. Simulation of the mass transfer process. Modeling of the separation process. Modeling of the rectification process. Simulation of the absorption process. Simulation of the adsorption process.	5	П1,П2, П3, Л2
4	Ionic liquids, methods for their synthesis and their applications	During the course, attention was paid to the study of the structural features of ionic liquids, which explain their peculiar physical and chemical properties, which led to their prospects in various fields of application and the creation of environmentally and economically acceptable technologies based on them; methods for the synthesis of ionic liquids are considered: an exchange reaction using halogen-containing compounds, a quaternization reaction, and a reaction exchange on ion-exchange resins.	5	П2,П3, Л2
5	Medical grade polymers	The course is devoted to the study of the impact of polymers on the human body. The origin and danger to health of low-molecular compounds migrating from polymers are considered; polymers and static electrification; toxicology of polymeric materials. The biomedical characteristics of the most important polymeric materials are given: biocompatibility, functionality, chemical composition, hemocompatibility, cytotoxicity. The use of polymeric materials in the treatment of humans. Polymer materials introduced into the body: prostheses, fillings, artificial organs, polymer implants. Polymeric suture and dressing materials. Polymer medical adhesives. Polymer plasma and blood substitutes, detoxifiers, interferonogens, antidotes; drugs made on the basis of polymers. Bases for ointments and suppositories. Solvents for injectable dosage forms, aerosols, drops. Fillers (diluents) for tablets, granules and pills. Binders for tablets, granules and pills. Protective covers for tablets, granules, pills, capsules and suppositories.	5	П1,П2, П3, Л2
6	Chemistry of natural compounds	The purpose of the discipline is to study the structure, chemical transformations of natural organic compounds, which are the main components of the cells of living organisms; the formation of knowledge and skills among undergraduates, allowing planning the synthesis of various classes of natural compounds and predicting their possible biological activity. The key roles of amino acids, peptides and proteins, nucleosides, nucleotides and nucleic acids in the functioning of a living cell are considered; basic biological functions of amino acids, peptides and proteins, nucleosides, nucleotides and nucleic acids. The interrelation of different levels of structural organization of amino acids, peptides and proteins,	5	П1,П2, П3, Л2

		nucleosides, nucleotides and nucleic acids with their biochemical and biological properties has been established. Topical trends in modern chemistry of natural compounds are presented.		
7	DATA Science	As part of the study of the Data Science discipline, students master theoretical and practical knowledge, acquire skills in the field of search, critical analysis and synthesis of information using the Python programming language. The discipline provides knowledge about the capabilities of modern information systems in various subject areas and to form skills in working with the most common application programs, knowledge of intelligent information systems (IIS), the structure of IIS, components and types, and logical programming.	5	П1,П2, П3, Л2
8	Environmental aspects of the production of organic substances	The purpose of the course is to review and analyze the main environmental problems associated with the production of organic substances. The course covers the main ways to control and reduce the level of environmental hazards. The production of hydrocarbon systems with improved environmental characteristics, technological processes for the processing of hydrocarbon systems that improve the environmental quality of gasoline are presented. The assimilation of this course allows you to expand your understanding of the features of technology, dangers and risks in the processes of organic and petrochemical synthesis.	5	П1,П2, П3, Л2
9	Automation and control systems for organic production	Study of methods for constructing effective systems for automatic and automated control of technological processes using SCADA software and hardware systems. The main task is to acquire professional skills by a master student in building automatic and automated control systems and the means necessary for their implementation, to master and study the principles of operation of SCADA systems, controllers and actuators operating under the control of SCADA systems.	5	П1,П2, П3, Л2
10	Research practice	During the research practice, undergraduates get acquainted with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data. At the same time, undergraduates, performing experimental research on the topic of a master's thesis using modern instrumental methods and computing tools, learn to be responsible for the quality of research and the scientific reliability of the results obtained, professionally draw up, present and report the results of research work.	4	П1,П2, П3,Л1, Л2
SRWM Component of choice				
	Research work of a master student, including an internship and a master's thesis	The research work of a master student is carried out throughout the entire course of study in the master's program. The graduate student is working on a dissertation topic that corresponds to the profile of the educational program of the magistracy. In the course of the work, the undergraduate fully substantiates the relevance, scientific novelty and practical significance of the work, based on modern theoretical, methodological and technological achievements of science and practice and using modern methods of scientific research.	24	
	final examination			
	Registration and defense of a master's thesis		12	

5. Curriculum of the educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazntu named after K.Satpayev
M.T. Bedenov
"28" 10 2022

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 7M07142 - "Chemical tecnology of organic substances"
Group of educational programs 7M097 - "Chemical engineering and processes"

Form of study: full-time **Duration of study: 2 year** **Academic degree:**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	5			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E		3		
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E	3			
component of choice											
щз	Modern methods of studying the properties of oil and petroleum products	BD CCH	5	150	2/0/1	105	Э	5			
CHE788	Modern aspects of production of plastic products										
HBI200	Industrial reactors for large-capacity chemical production	BD CCH	5	150	2/0/1	105	Э	5			
CHE759	Industrial water treatment and methods of sewage treatment				2/1/0*						
CHE779	Mechanisms of organic reactions	BD CCH	5	150	2/0/1	105	Э			5	
CHE778	Industrial Organic Chemistry										
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
CHE793	Chemistry and physics of polymer composite materials	PD UC	5	150	2/0/1	105	E	5			
CHE783	Homogeneous catalysis	PD UC	5	150	2/0/1	105	E	5			
CHE777	Calculation and modeling of mass transfer processes and devices	PD UC	5	150	2/0/1	105	E		5		
CHE784	Ionic liquids, synthesis methods and applications	PD UC	5	150	2/0/1	105	E			5	
CHE787	Polymers for medical purposes	PD UC	5	150	2/0/1	105	E			5	
CHE794	Chemistry of natural compounds	PD UC	5	150	2/0/1	105	E		5		
CHE782	DATA Science	PD UC	5	150	2/0/1	105	E		5		
CHE795	Ecological aspects of the petrochemical industry	PD UC	5	150	2/0/1	105	E			5	
HBI219	Bitumen production technology	PD UC	4	120	2/0/1	75	E			4	
CHE781	Automation and control systems of organic production	PD UC	5	150	2/0/1	105	E			5	
M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD, CCH	4								4
M-4. Experimental research module											
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	5							5	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	14								14
M-5. Module of final attestation											
ECA212	Preparation and defense of a master's thesis	FA	8								8
	Total based on UNIVERSITY:							30	30	34	26
								60		60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines		20	15	35
PD	Cycle of profile disciplines		53		53
	Total for theoretical training:	*0*	*73*	*15*	*88*
	RWMS		*24*		*24*
FA	Final attestation	8			8
	TOTAL:	8	97	15	120

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 3 27.10.2022 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 2 21.10.2022 y.

Decision of the Academic Council of the Institute GaOGB. Protocol № 2 от "14" 10 2022

Vice-Rector for Academic Affairs — Zhautikov B.A.

Institute Director of GaOGB — Syzdykov A.H.

Head of the Department of Chemical and Biochemical Engineering — Amitova A.A.

Specialty Council representative from employers — Kalmuratova A.A.

1. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of development additional educational programs (Minor)