Mining and Metallurgical Institute named after O.A. Baikonurov
Department of Chemical Processes and Industrial Ecology

EDUCATIONAL PROGRAM
7M07110 Chemical processes and production of chemical materials

Code and name of educational program

Code and classification of the field of education: **7M07 Engineering, manufacturing and construction industries**
Code and classification of training directions: **7M071 Engiheering and engineering affairs**
Group of educational programs: **M097 Chemical Engineering and Processes**
Level based on NQF: **7**
Level based on IQF: **7**
Study period: **2**
Amount of credits: **120**

Almaty 2025

Educational program «7M07110 Chemical processes and production of chemical materials» was approved at the meeting of K.I. Satbayev KazNRTU Academic Council
Minutes # 10 dated «06» March 2025.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council
Minutes # 3 dated «20» December 2025.

Educational program «7M07110 Chemical processes and production of chemical materials» was developed by Academic committee based on direction «7M071 Engineering and engineering affairs»

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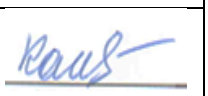
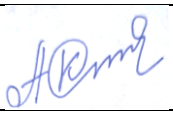
Kapralova Victoria	Doctor of Technical Sciences, Associate Professor	Professor	NPJSC "K.I. Satbayev KazNRTU", +77718526879	
Kalenova Aizhan	Candidate of Chemistry	Associate Professor	NPJSC "K.I. Satbayev KazNRTU", +77766973311	
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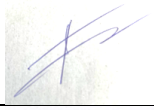
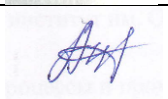
Arynov Kazhmukhan	Doctor of Technical Sciences, Professor	Director	LLP Innovative Research and Technology, +77028238721	
Kenzhebayeva Akmaral	-	Chief Quality Manager	Mineral fertilizer plant Kazphosphate LLP, +77078869014	
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List of abbreviations and designations

EP – educational program
BC – basic competencies
PC – professional competencies
TR – training results
MOOC – mass open online courses
NQF – National Qualifications Framework
IQF – Industry Qualifications Framework

1. Description of educational program

The EP "7M07110 Chemical Processes and Production of Chemical Materials" is implemented by KazNTRU named after K.I. Satbayev in the direction of 7M071 training – Engiheering and engineering affairs (Master) and presents a system of documentation regulating the goals, expected results, content and implementation of the educational process in the field of chemical engineering and the production of chemical materials.

The EP provides an opportunity to gain in-depth knowledge, key skills and abilities of the graduate and their further development in the field of chemical engineering and the production of chemical materials. This EP is built taking into account the possibility of providing the master with the choice of the appropriate educational trajectory for modules based on the main educational program, within the framework of a single educational direction of the 7M071 - Engiheering and engineering affairs (Master).

The duration of the master's degree is determined by the amount of academic credits mastered. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the Master's degree program is considered fully mastered. The scientific and pedagogical Master's degree program has at least 120 academic credits for the entire period of study, including all types of educational and scientific activities of a graduate student.

Planning of the content of education, the way of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of credit technology of training. The Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education for the training of scientific and scientific-pedagogical personnel for universities and scientific organizations with in-depth scientific-pedagogical and research training.

The content of the Master's degree program consists of:

1) theoretical training, including the study of cycles of basic and core disciplines;

2) practical training of undergraduates: various types of practices, scientific or professional internships;

3) research work, including the implementation of a master's thesis – for a scientific and pedagogical master's degree;

4) final certification.

Requirements for applicants. The previous level of education of applicants (first cycle) is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admission of citizens to the magistracy is established in accordance with the "Standard rules for admission to training in educational organizations implementing educational programs of postgraduate education."

The formation of a contingent of undergraduates is carried out by placing a state

educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary to master the relevant master's degree program. The list of necessary prerequisites is determined by the higher educational institution independently. In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a paid basis.

Requirements for completing studies and obtaining a diploma.

Degree/qualifications awarded: The graduate of the educational program "7M07110 Chemical processes and production of chemical materials" is awarded the academic degree "Master of Technical Sciences".

A graduate of the educational program "7M07110 Chemical processes and production of chemical materials" in the scientific and pedagogical direction of training 7M071 - Engineering and Engineering is preparing for the following types of professional activity:

- research;
- research and production;
- design and process;
- organizational and management;
- scientific and pedagogical.

A graduate who has mastered the master's program must have general cultural, general professional and professional competencies.

General cultural competencies:

• improve and develop their intellectual and general cultural level, readiness for communication in oral and written forms in a foreign language to solve the tasks of professional activities;

• ability to navigate the information flow: the ability to find and systematize various sources of information, as well as use rational ways to obtain, transform, systematize and store information when operating modern equipment and devices;

• willingness to lead the team in the field of their professional activities, tolerating social, ethnic, confessional and cultural differences;

• the ability to be proactive and critically assess situations, including risks and take full responsibility;

• own new information and multimedia technologies in the field of chemical engineering.

General professional competencies:

• the ability to independently acquire, comprehend, structure and use new knowledge and skills, including in areas not directly related to the field of activity;

• ability to independently formulate research goals, establish the sequence of solving professional tasks;

• ability to put into practice knowledge of fundamental and applied disciplines that determine the direction of the master's program;

• the ability to professionally choose and creatively use modern scientific and

technical equipment to solve scientific and practical problems;

• ability to critically analyze, present, protect, discuss and disseminate the results of their professional activities;

• have skills in compiling and drawing up scientific and technical documentation, scientific reports, reviews, reports and articles.

Professional competencies corresponding to the types of professional activities for which the master's program is focused:

1) research activities:

• the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of sciences and specialized knowledge acquired during the development of the master's degree program;

• the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;

• the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of chemical materials production, chemical engineering and engineering;

2) research and production activities:

• the ability to independently carry out production and scientific-production experimental, laboratory and interpretive work in solving practical problems;

• the ability to professionally operate modern industrial and laboratory equipment and devices in the field of the master's degree program;

• the ability to use modern methods of processing and interpreting complex information to solve production problems;

3) design and technological activities:

• the ability to independently draw up and submit projects of research and scientific-production works;

• readiness to design complex research and scientific-production works in solving professional tasks;

4) organizational and managerial activities:

• readiness to use practical skills in organizing and managing research and scientific-production work in solving professional tasks;

• readiness for the practical use of regulatory documents in the planning and organization of scientific and production work;

5) scientific and pedagogical activity:

• ability to conduct seminars, laboratory and practical classes;

• the ability to participate in the development of interactive teaching methods, educational and methodological documentation, multimedia materials and methods of monitoring learning;

• the ability to participate in the management of scientific and educational work of students in the field of chemical engineering.

When developing a master's degree program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results of mastering the master's program.

The objects of professional activity: chemicals and materials; methods and devices for determining and researching the composition and properties of substances and materials; technological processes and industrial systems for producing chemical products, as well as systems for managing and regulating them; interactive forms and innovative teaching methods in a modern university.

Subjects of professional activity: research and engineering companies, research and design industry institutes; research laboratories, higher and secondary technical educational institutions; chemical and petrochemical plants and enterprises.

A distinctive feature of this educational program is that a graduate who has successfully mastered the program "7M07110 Chemical Processes and Production of Chemical Materials" has the opportunity to receive a second diploma from an OHPE-partner: National Research Tomsk Polytechnic University, Russian Federation in the direction of training 18.04.01 Chemical Technology (orientation OP: Ceramics and Composites Technologies).

Appendix to the diploma according to the ECTS standard.

The application is developed according to the standards of the European Commission, the Council of Europe and UNESCO/SEPES. This document serves only for academic recognition and is not an official confirmation of the document of education. It is not valid without a higher education diploma. The purpose of filling out the European Application is to provide sufficient data about the diploma holder, the qualification he received, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model, according to which the estimates will be translated, uses the European Credit Transfer or Credit Transfer System (ECTS).

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

2. Purpose and objectives of educational program

Purpose of EP:

- formation on the basis of the scientific school of the National Research University of general cultural, professional and special competencies that allow graduates to work successfully in the field of chemical engineering and production of new chemical materials and be competitive in the labor market;
- development of such personal qualities as creativity, responsibility, tolerance, striving for self-development and disclosure of their creative potential among undergraduates;
- the development of research qualities, the ability to plan, formulate, perform and generalize experimental studies 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.

Tasks of EP:

A master's degree in the field of training 7M071 - Engiheering and engineering affairs should be prepared to solve the following professional tasks in accordance with the direction of the EP "7M07110 Chemical processes and production of chemical materials " and types of professional activities:

1. Research activities:

- conduct a literary and patent search, compile reports on patent research, informational reviews, conclusions, etc.;
- plan experimental research, choose research methods;
- to develop schemes and design of the experimental installation, to carry out installation and debugging;
- to carry out experimental work using modern instrumental methods of research and analysis of the composition, structure and quality of the resulting products and starting substances;
- process data using mathematical methods of experiment planning, regression and correlation analysis;
- develop and research mathematical models of chemical and technological processes;
- to analyze and summarize the results of the research, to publish the results in the form of scientific articles and abstracts, to issue pre-patents and patents for inventions.

2. Research and production activities:

- calculate the material and thermal balances of the chemical-technological process;
- to make the hardware and technological scheme of the process;
- calculate the main structural and technological parameters of the main and auxiliary equipment;
- develop or select drawings of equipment, buildings and structures;
- develop simulation models of chemical and technological processes.

3. Design and technological activities

- develop chemical and technological processes for obtaining new substances and materials;
- to improve the technological schemes of existing production facilities with justification of the main parameters and indicators of the process;
- to draw up a business plan for a chemical and technological project;
- develop energy- and resource-saving technologies in the field of oil and gas refining and production of chemical materials;
- develop environmental protection measures for petrochemical enterprises.

4. Organizational and managerial activities

- to provide information support for production, labor and management;
- to carry out measures for the organization of production in accordance with regulatory documents;

- develop and compile the necessary documentation;
- organize the activities of the team, make work plans and set production tasks;
- solve logistical issues, monitor the execution of tasks.

5. Scientific and pedagogical activity:

- develop and implement active teaching methods that help to form a creative, innovative approach to understanding professional activity, develop independent thinking and the ability to make optimal decisions in a certain situation;
- develop educational and methodological documentation, methods for monitoring students' knowledge and multimedia materials for the educational process;
- conduct laboratory and practical classes.

3. Requirements for evaluating the educational program learning outcomes

The requirements for the master's degree level are determined on the basis of the Dublin descriptors of the second level of higher education (Master's degree) and reflect the acquired competencies expressed in the achieved learning outcomes.

The results of training include knowledge, skills and competencies and are formulated both at the level of the entire educational program of the magistracy, and at the level of individual modules or academic discipline.

Descriptors reflect learning outcomes that characterize the student's abilities:

1) demonstrate developing knowledge and understanding in the field of chemical processes and production of organic and inorganic substances and materials, based on advanced knowledge of chemical science and engineering in the development and (or) application of ideas in the context of research;

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

3) to collect and interpret information for the formation of judgments taking into account social, ethical and scientific considerations;

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

5) to show the learning skills necessary for independent continuation of further education in the field of chemical engineering and engineering affairs.

Selection of training results evaluation tools. The main task at this stage is to select methods and assessment tools (criteria) for all types of control, with the help of which it is possible to most effectively assess the achievement of the planned results of training at the discipline level.

Evaluation rating and possible final versions of assessments according to criteria

Letter grade	GPA	scores	Criteria
A	4	95-100	Shows the highest standards of knowledge, skills and competencies exceeding the volume of the course taught
A-	3,67	90-94	Meets the highest standards of knowledge, skills and competencies

B+	3,33	85-89	Very good and meets high standards of knowledge, skills and competencies
B	3	80-84	Good and meets most high standards of knowledge, skills and competencies
B-	2,67	75-79	More than sufficient knowledge, skills and competencies approaching high standards
C+	2,33	70-74	Sufficient knowledge, skills and competencies that meets the general standards
C	2	65-69	Satisfies and conforms to most common knowledge, skills and competencies standards
C-	1,67	60-64	Satisfies, but according to some knowledge, skills and competencies does not meet the standards
D+	1,33	55-59	Minimally satisfying, but does not meet the standards for a large range of knowledge, skills and competencies
D	1	50-54	Minimally satisfactory passing score with questionable compliance with standards
FX	0,5	25-49	Temporary assessment: Unsatisfactory low indicators, retake of the exam is required
F	0	0-24	Didn't try to master the discipline. It is also exposed when a student tries to get a grade on the exam by cheating

Requirements for the key competencies of graduates of the scientific and pedagogical Master's degree. The graduate must:

1) have an idea:

• about the role of science and education in public life;

• about current trends in the development of scientific knowledge;

• about current methodological and philosophical problems of natural (social, humanitarian, economic) sciences;

• about the professional competence of a high school teacher;

• contradictions and socio-economic consequences of globalization processes;

2) know:

• methodology of scientific knowledge;

• principles and structure of the organization of scientific activity;

• psychology of cognitive activity of students in the learning process;

• psychological methods and means of improving the effectiveness and quality of training;

3) be able to:

• use the acquired knowledge for the original development and application of ideas in the context of scientific research;

• critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;

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

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

• apply the knowledge of pedagogy and psychology of higher education in their teaching activities;

• apply interactive teaching methods;

• carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;

• think creatively and be creative in solving new problems and situations;

• be fluent in a foreign language at a professional level, which allows conducting scientific research and teaching special disciplines in universities;

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

4) have skills:

• research activities, solutions of standard scientific tasks;

• implementation of educational and pedagogical activities on credit technology of training;

• methods of teaching professional disciplines;

• the use of modern information technologies in the educational process;

• professional communication and intercultural communication;

• oratory, correct and logical formalization of their thoughts in oral and written form;

• expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies;

5) be competent:

• in the field of research methodology;

• in the field of scientific and scientific-pedagogical activity in higher educational institutions;

• in matters of modern educational technologies;

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

• in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

A - Universal, social and ethical competencies

A1 - knowledge of modern social and political problems;

A2 - the ability to perceive cross-cultural differences, the ability to observe and maintain ethical norms and rules;

A3 - communication skills in a foreign language, ability to work in an international context;

B - Basic knowledge, skills and abilities

B1 - the ability to use philosophical concepts of natural science to form a scientific worldview;

B2 - the ability to apply knowledge of the methodology of chemical sciences and chemical engineering to solve specific professional tasks and assess technological risks;

B3 - the ability to use psychological methods and means to improve the effectiveness and quality of training.

P - Professional competencies

P1 – the ability to independently analyze the available information, set goals

and objectives and perform experimental research using modern instrumental methods and computing tools, be responsible for the quality of research and the scientific reliability of the results obtained;

P2 - the ability to generate new ideas and methodological solutions;

P3 - the ability to professionally design, present and report the results of research and production and technological work according to approved forms;

P4 - willingness to creatively apply modern computer technologies in the collection, storage, processing, analysis and transmission of information to solve professional problems in the field of chemical engineering and production of chemical materials;

P5 - the ability to plan and carry out measures to assess the state and protection of the environment, to organize measures for rational use of natural resources;

P6 - proficiency in the formation and presentation of educational material in various forms, conducting laboratory and practical classes, readiness to teach in educational institutions and leadership of students' research work.

C - Special and managerial competencies

C1 - the ability to lead a work team and ensure industrial safety measures;

C2 - ability to plan and organize professional events;

C3 - willingness to act in non-standard situations, to bear social and ethical responsibility for the decisions made.

Requirements for the research work of a master's student in the scientific and pedagogical magistracy.

The research work of a master's student should:

1) correspond to the profile of the master's degree program, according to which the master's thesis is being performed and defended;

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

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

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

5) contain research (methodological, practical) sections on the main protected provisions;

6) be based on the best international experience in the field of chemical science and engineering.

Requirements for the organization of practices.

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

1) pedagogical in the cycle of BD – at the university;

2) research in the PD cycle – at the place of the dissertation.

Pedagogical practice is conducted in order to form practical skills of teaching and learning methods. At the same time, undergraduates are involved in conducting undergraduate classes at the discretion of the university.

The research practice of the undergraduate is conducted in order to familiarize himself with the latest theoretical, methodological and technological achievements

of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

Final attestation. The purpose of the final certification is to assess the results of training achieved upon completion of the study of the educational program of the magistracy. The final certification is at least 8 academic credits in the total amount of the educational program of the master's degree in the scientific and pedagogical direction and is carried out in the form of defending a master's thesis.

A master's thesis is a final qualifying scientific work, which is a generalization of the results of an independent research by a graduate student of one of the actual problems of a specific specialty of the relevant branch of science, having an internal unity and reflecting the progress and results of the development of the chosen topic. The master's thesis must be checked for plagiarism, the rules and procedure for which are determined by the university.

The Master's thesis is the result of the research/experimental research work of the undergraduate conducted during the entire period of the undergraduate's studies.

The defense of a master's thesis is the final stage of master's degree preparation.

The master's thesis must meet the following requirements:

- the work must conduct research or solve current problems in the field of chemical technology of inorganic substances;
- the work should be based on the identification of important scientific problems and their solution;
- decisions must be scientifically sound and reliable, have internal unity;
- the dissertation work should be written alone.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	7M07 Engineering, manufacturing and construction industries
2	Code and classification of training directions	7M071 Engiheering and engineering affairs
3	Educational program group	M097 Chemical Engineering and Processes
4	Educational program name	7M07110 Chemical processes and production of chemical materials
5	Short description of educational program	The EP "7M07110 Chemical Processes and Production of Chemical Materials" is implemented by KazNTRU named after K.I. Satbayev in the direction of 7M071 training - Engiheering and engineering affairs (Master) and presents a system of documentation regulating the goals, expected results, content and implementation of the educational process in the field of chemical engineering and the production of chemical materials.
6	Purpose of EP	Training of highly qualified, competitive specialists who are able to engage in pedagogical activities using modern educational methods, conduct and generalize experimental research and develop a scientific approach in the

		implementation of professional tasks from the standpoint of modern technical solutions in the field of environmentally friendly processes for the production of new chemical materials.
7	Type of EP	New EP
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	Double diploma EP. Foreign OHPE: National Research Tomsk Polytechnic University, Russian Federation
11	List of competencies of educational program	*Research activities:* • the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of sciences and specialized knowledge acquired during the development of the master's degree program; • the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations; • the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of chemical materials production, chemical engineering and engineering; *Research and production activities:* • the ability to independently carry out production and scientific-production experimental, laboratory and interpretive work in solving practical problems; • the ability to professionally operate modern industrial and laboratory equipment and devices in the field of the master's degree program; • the ability to use modern methods of processing and interpreting complex information to solve production problems; *Design and technological activities:* • the ability to independently draw up and submit projects of research and scientific-production works; • readiness to design complex research and scientific-production works in solving professional tasks; *Organizational and managerial activities:* • readiness to use practical skills in organizing and managing research and scientific-production work in solving professional tasks; • readiness for the practical use of regulatory documents in the planning and organization of scientific and production work; *Scientific and pedagogical activity:* • ability to conduct seminars, laboratory and practical classes; • the ability to participate in the development of interactive teaching methods, educational and methodological documentation, multimedia materials and methods of monitoring learning; • the ability to participate in the management of scientific and educational work of students in the field of chemical

		engineering.
12	Learning outcomes of educational program	ON1 Implement environmental monitoring using innovative methods and controls: ON2 Solve professional problems and assess technological and environmental risks in the field of chemical engineering and production of chemical materials, using the acquired knowledge, skills and abilities; ON3 Apply knowledge of the theoretical foundations of the methodology of scientific knowledge and pedagogical science, as well as the rules of academic writing in professional activities; ON4 Be fluent in a foreign language at a professional level, which allows conducting scientific research and teaching special disciplines in universities; ON5 Conduct scientific research of undergraduate students, carry out scientific and methodological work using modern and innovative (including digital) teaching technologies, substantiate and prove research results when discussing with specialists and a wider audience in the domestic and international scientific community; ON6 Demonstrate the ability to find organizational and managerial solutions in production situations; ON7 Optimize the parameters of technological processes, industrial reactors and equipment to increase the efficiency of raw material processing methods in the production of chemical products and carry out inspection control over certified products, processes; ON8 Carry out technical management, control of chemical engineering processes, quality management of obtained substances and materials, project management, risk management, assessment of the enterprise's performance during inspection; ON9 To carry out the teaching of special disciplines in universities on the basis of modern teaching methods and the requirements of pedagogy and psychology of higher education taking into account the principles of student-centered learning and assessment; as well as develop strategies and programs for managing the production of new chemical materials based on strategic, innovative, managerial and project management; ON10 Develop new methods and technologies for processing mineral raw materials and obtaining new substances and materials in innovative and priority areas of industry in Kazakhstan in accordance with development trends of global and Kazakh industry, GOST ISO/IEC 17020.
13	Education form	Full-time
14	Period of training	2 year
15	Amount of credits	120 credits
16	Languages of instruction	Russian, Kazakh, English
17	Academic degree awarded	Master of Technical Sciences
18	Developer(s) and authors	Kubekova Sh.N., Kapralova V.I., Kalenova A.S., Raimbekova A.S.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)									
				ON1	ON2	ON3	ON4	ON5	ON6	ON7	ON8	ON9	ON10
Cycle of basic disciplines University component													
1	Foreign language (professional)	Mastering professional English at an advanced level (for non-linguistic areas). The study of grammatical characteristics of scientific style in its oral and written forms. Professional oral communication in monological and dialogical form according to the educational program. Ability to demonstrate the results of research in the form of reports, abstracts, publications and public discussions; interpret and present the results of scientific research in a foreign language.	3		v								
2	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3			v						v	
3	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select	3				v						

		the content of training sessions. Organize the educational process on the basis of credit technology of education.											
4	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.	3						v			v	
Cycle of basic disciplines Component of choice													
5	Innovative technologies in cement production	Purpose: to form the ability to optimize the parameters of processes and equipment to improve the efficiency of cement production. The course covers: new methods for improving the energy and environmental balance of cement production, modern trends in the modernization of cement production; production of cement in the mode of a single flow of rotary kilns and mills; replacement of classic fuels with alternative materials.	5					v			v		
6	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5		v			v					v
7	Industrial water treatment and methods of sewage treatment	The purpose of the course: the formation of a holistic view of the schemes of water treatment, industrial water treatment; modern technologies based on the latest achievements of science and technology in the field of water consumption.	5	v				v					

		Description: indicators of water quality; technological operations of industrial water treatment; advanced water treatment technologies, monitoring of water resources. Upon completion of the course, undergraduates will be able to: determine and control the optimal parameters of the water treatment process, justify the choice of equipment for effective treatment methods in order to provide clean and environmentally safe water.										
8	Modern methods of scientific research in chemical technology	The purpose of the course: the formation of in-depth knowledge, ideas about the main methods for studying the physical and chemical properties and structure of substances. Within the framework of the course, the practical use of modern methods of scientific research is studied in carrying out research work, in the analysis of the quality of raw materials and products. Upon completion of the course, undergraduates will be able to identify various compounds based on the data of the research results and present them to a wide audience, the choice of the appropriate physical and chemical research method, depending on the structure of the substance and the task.	5		v					v			
9	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5		v			v					v
10	Technologies of receiving nanocrystal inorganic materials	The purpose of the course: the study of the main methods for the synthesis of nanocrystalline inorganic materials from solutions and the gas phase, methods for their study, as well as areas of their practical application. Description: familiarization with the physical and chemical	5		v							v	

		properties of nanocrystalline inorganic materials; their production methods and areas of application. At the end of the course, undergraduates will be able to plan the optimal conduct of an experiment on the synthesis and analysis of nanocrystalline materials; predict their properties in order to create new environmentally friendly materials for the needs of the industry of Kazakhstan.										
11	Technology of silicate materials	The purpose of the course: the formation of a system of knowledge necessary for specialists to organize technological processes in the production of silicate materials, as well as skills and practical skills in solving professional problems. The course is aimed at studying the main technological processes, drawing up the calculation of raw mixtures, and creating new promising materials. Upon completion of the course, undergraduates will be able to develop environmentally friendly processes for the production of silicate materials, carry out scientific research and present the results of obtaining innovative materials as part of a qualifying work.	5		v					v			
12	Physico-chemical basis of technology for binders and products based on them	The purpose of the course: the formation of a set of skills, abilities and knowledge for undergraduates to solve practical problems of the production of mineral binders and materials based on them. Course description: basics of technology, technological processes for obtaining mineral binders, methods of engineering and technological calculations, design. Upon completion of the course, undergraduates will be able to: determine, optimize the parameters of technological processes, control the quality of products, justify the choice of equipment to improve the efficiency of raw materials processing methods, use modern methods of managing existing technological production.	5	v						v	v		
Cycle of profile disciplines University component													
13	The bases of the modern	To form the ability to evaluate traditional and	5							v	v		v

	technologies of the processing of mineral raw materials	innovative technologies for processing mineral raw materials, taking into account the complexity of use, environmental and economic requirements; to develop new technologies in accordance with the development trends of the global and domestic chemical industry. Natural mineral raw materials; necessity and modern methods of its enrichment; methods of extraction of valuable components from mineral raw materials, main and auxiliary technological equipment; technogenic and secondary raw materials.											
14	Technology of fine and building ceramics	The purpose: formation of the ability to analyze and evaluate the production technology of fine and building ceramics. Description: composition, physico-chemical, technological properties of ceramics; raw materials, basic technological operations of production; factors affecting the technological and consumer properties of products. Upon completion of the course, undergraduates will have the skills to calculate the properties and design the composition of products based on mineral and technogenic raw materials; be able to develop new effective methods for their production and choose a rational production scheme; know the promising areas of application of fine and building ceramics.	5		**v**								**v**
15	Chemistry and technology of new flotation reagents and flocculants	Purpose: formation of the ability to select and calculate the main technological parameters of the use of flotation reagents and flocculants in the processes of flotation enrichment of mineral raw materials. Short description: General concepts and fundamentals of the flotation process. Classification of flotation reagents by general and particular characteristics. Types of collectors and their mechanism of action. Activators, depressors and flocculants: types and mechanism of action, application. pH regulators of the medium. Practical application of flotation reagents in flotation, settling and clarification processes.	5		**v**					**v**	**v**		
Cycle of profile disciplines													

Component of choice												
16	High-temperature processes in the processing of natural phosphates	The purpose of the course: formation of in-depth knowledge and practical skills in the field of processing natural phosphates. The course studies the process of electrothermal reduction of natural phosphates, the chemistry of the process, the main technological stages of the process of electrothermal reduction of natural phosphates, as well as the physical and chemical foundations of the process of processing low-quality natural phosphates into various phosphate materials. Upon completion of the course, undergraduates will be able to develop new effective methods for the processing of natural phosphates, be able and choose a rational scheme for their production; know the promising areas of application of new phosphate materials.	5		v						v		
17	Disperse systems and surface phenomena in chemical-technological processes	The purpose of the course: the formation of the ability to effectively control technological processes based on knowledge about the patterns of the flow of surface phenomena in dispersed systems of various types. Description: surface phenomena and dispersed systems in the processes of extraction, processing and transportation of hydrocarbon and mineral raw materials, as well as surfactants and macromolecular compounds (MC) - polymers for the intensification of various chemical and technological processes. Upon completion of the course, undergraduates will be able to solve professional problems, assess technological and environmental risks from the use of surfactants and MC.	5		v				v	v	v		
18	Green technologies and renewable resources	The purpose of the course: the formation of a complex of engineering, technical, scientific knowledge; management and monitoring skills when using modern green technologies in professional activities. Description: energy decarbonization, design of new energy saving and energy storage technologies. Upon completion of the course, undergraduates will be able to apply	5		v					v			

		the accumulated knowledge in the implementation of green technologies, analyze and analyze the risks of their implementation; be able to improve technological processes to improve the energy efficiency of production; carry out control of lean production and environmental monitoring, taking into account the latest achievements of science and technology.											
19	Innovative technologies for the processing of halurgical raw materials	The purpose of the course: the study and use in professional activities of new ways of processing galurgical raw materials. Description: innovative ways of processing galurgical raw materials; substantiation of optimal technological regimes for the production of new inorganic salts and materials, process equipment; environmental consequences of the method of underground leaching of galurgical raw materials. Upon completion of the course, undergraduates will be able to optimize the parameters of processes and equipment to improve the efficiency of halurgical raw materials processing technology, develop new technologies and processes for the production of new inorganic salts in accordance with global industry development trends.	5		v				v		v		v
20	Innovative technologies of receiving mineral fertilizers	The purpose of the course: the formation of a certain composition of competencies necessary for specialists to prepare for professional activities. Description: prospects and main directions of development of the mineral fertilizer industry; formulations of compositions of organo-mineral, microfertilizers; study of the properties of new fertilizers obtained by acid-free methods using ultrafine grinding. Upon completion of the course, undergraduates will be able to plan, conduct research on the synthesis of innovative types of fertilizers and present the results to a wide audience as part of qualifying works; make specific technical decisions in the development of technological processes for new types of fertilizers.	5		v			v		v			v
21	Fundamentals of primary	The purpose of the course: the formation of the	5							v			v

	processing of natural uranium compounds	ability to apply the acquired skills, abilities and knowledge in solving practical problems in professional activities. Description: environmental and economic analysis of methods for mining uranium deposits, methods for extracting uranium compounds from leaching solutions, the essence and types of processes for leaching uranium compounds from natural raw materials, environmental monitoring of uranium production. Upon completion of the course, undergraduates will be able to compare alternative technological solutions, optimize the modes of processes and reactors, draw up technological schemes, give a technical and economic assessment that ensures the safe production activities of people and compliance with environmental ecology.											
22	Fundamentals of recycling in the production of inorganic materials	The purpose of the course: formation of the ability to apply modern scientific concepts and theories in the field of recycling to create new materials and technologies. Description: definition of key concepts of waste recycling; waste classification and management; main sources of formation and types of industrial waste; basic technologies for industrial waste processing; areas of application of products from industrial waste, the concept of "zero waste". Upon completion of the course, the undergraduate will be able to carry out activities in the field of waste management, justify the choice of modern waste processing and disposal technologies, and demonstrate management decisions to ensure environmental safety.	5	v	v				v		v		
23	Fundamentals of technology of polymer composite materials	The course "Fundamentals of Technology of Polymer Composite Materials" provides an in-depth presentation of the principles of creating a technology of polymer composite materials (PCM) with an improved and specified set of physicochemical and operational properties. As a result of studying the course, the undergraduate should know the basics of the technology for obtaining polymer composite materials; principles	5		v								v

		of creating new filled polymer composite materials with a complex of valuable properties; basic technologies for obtaining PCM; be able to choose various factors and technologies leading to improvement of the complex of PCM properties.											
24	Surface-active reagents in chemical-technological processes	The course is aimed at studying the composition and properties of anionic, cationic, nonionic and amphoteric surfactants widely used in typical processes. The mechanism of the cleaning action of surfactants, methods of their preparation and the effect of surfactants on the environment are considered, a comparative assessment of sodium salts of carboxylic acids and alkyl sulfates is given. Upon completion of the course, undergraduates will conduct scientific research on the synthesis and study of the properties of new surface-active reagents; discuss and present to a wide audience the results of research as part of the qualifying work.	5		v			v					
25	Calculation and modeling of mass transfer processes and apparatuses	Goal: training competent specialists in the field of applied scientific research on the problems of calculating various parameters of technological equipment and processes. Contents: Practical methods for obtaining mathematical models of mass transfer processes and apparatuses and their analysis during the preparation of the production of new products. Calculations of the resulting models using software and computer technology and creation of innovative projects and products based on them. Improvement and development of new methods for creating highly efficient technological processes of modern production and their management.	5					v	v				v
26	System analysis of chemical and technological processes	The course studies methods of mathematical modeling, optimization of CTP and systems. Description: basic concepts characterizing the development and principles of functioning of chemical-technological systems; main methods of modeling and optimization of CTS. Upon completion of the course, undergraduates will be able to ensure the safe conduct of the	5	v					v		v		v

		technological process; use engineering knowledge and technical means to control the parameters of the technological process in order to determine the properties of raw materials and finished products; to optimize the parameters of the technological process at all stages of the design of the CTP and production management in order to increase its efficiency.											
27	Theoretical foundations of extraction and ion exchange processes	The purpose of the course: the formation of a complex of knowledge, skills and abilities in the field of extraction and ion-exchange technology. Description: basic concepts and definitions of extraction and ion exchange processes, technological indicators of processes; classification of extractants and ion exchangers, basic requirements for industrial extractants and ion exchangers, basic technological equipment. Upon completion of the course, the undergraduate will be able to master the methods for calculating the extraction and ion-exchange processes, methods for determining the technological indicators of these processes; be able to determine the optimal conditions for conducting technological processes and improve ion-exchange equipment in terms of their resource efficiency.	5	v					v	v			
28	Technological features of the production of rare metal compounds from natural and technogenic raw materials	The purpose of the course: the formation of a certain composition of competencies for undergraduates to prepare for professional activities. Description: the role of rare metals in the development of the latest branches of science and technology, the raw material base of Kazakhstan; the main stages of the processing of ore concentrates; technological equipment. Upon completion of the course, the undergraduate will be able to make technical and managerial decisions, taking into account industrial and environmental safety; organize activities to control the parameters of the technological process and the quality of rare metal products; to develop new processes for the processing of rare	5		v					v			

		metal raw materials.											
29	Advanced Study of Salt Systems	The purpose of the course: the formation of the ability to analyze and evaluate phase equilibria in multicomponent salt systems. Description: physical and chemical analysis of multicomponent water-salt systems in technological calculations for the production of inorganic salts, graphic representation of state diagrams, technological schemes of salt crystallization from brines. Upon completion of the course, undergraduates will be able to conduct applied scientific research, publicly present the results of completed scientific research as part of a qualifying work; be able to optimize the parameters of processes and equipment to improve the efficiency of brine processing technology, develop new technologies and processes for the production of inorganic salts for the needs of industry.	5		v					v			v
30	Advanced CAD Chemical Engineering	The purpose of the course: the formation of skills in computer design of chemical-technological processes and systems. The course studies modern methods of computer simulation of CTP, modeling and optimization of complex equilibrium (stationary) and dynamic chemical-technological processes involving organic and inorganic substances, as well as complex mixtures using ChemCad, Aspen Hysys programs. Upon completion of the course, the undergraduate will be able to solve professional engineering problems with the help of modern modeling programs; choose the optimal parameters for the operation of equipment; manage technological processes in order to obtain competitive products; predict technological and environmental risks.	5							v	v		v

5. Curriculum of educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	2025-2026 (Autumn, Spring)
Group of educational programs	M097 - "Chemical engineering and processes"
Educational program	7M07110 - "Chemical processes and production of chemical materials"
The awarded academic degree	Master of Technical Sciences
Form and duration of study	full time (scientific and pedagogical track) - 2 years

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters				Prerequisites
									1 course		2 course		
									1 sem	2 sem	3 sem	4 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)													
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
LNG213	Foreign language (professional)		BD, UC	3	90	0/0/30	60	E	3				
HUM214	Psychology of management		BD, UC	3	90	15/0/15	60	E	3				
HPP226	Modern methods of scientific research in chemical technology	1	BD, CCH	5	150	30/15/0	105	E	5				
HPP241	Technologies of receiving nanocrystal inorganic materials	1	BD, CCH	5	150	30/0/15	105	E	5				
MNG781	Intellectual property and research	1	BD, CCH	5	150	30/0/15	105	E	5				
HPP225	Physico-chemical basis of technology for binders and products based on them	2	BD, CCH	5	150	30/15/0	105	E	5				
HPP242	Technology of silicate materials	2	BD, CCH	5	150	30/0/15	105	E	5				
MNG782	Sustainable development strategies	2	BD, CCH	5	150	30/0/15	105	E	5				
HUM212	History and philosophy of science		BD, UC	3	90	15/0/15	60	E		3			
HUM213	Higher school pedagogy		BD, UC	3	90	15/0/15	60	E		3			
HPP243	Innovative technologies in cement production	1	BD, CCH	5	150	30/15/0	105	E			5		
CHE759	Industrial water treatment and methods of sewage treatment	1	BD, CCH	5	150	30/15/0	105	E			5		
M-3. Practice-oriented module													
AAP273	Pedagogical practice		BD, UC	8				R			8		
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (university component, component of choice)													
HPP232	The bases of the modern technologies of the processing of mineral raw materials		PD, UC	5	150	30/15/0	105	E	5				
HPP214	Green technologies and renewable resources	1	PD, CCH	5	150	30/0/15	105	E	5				
HBI216	Fundamentals of technology of polymer composite materials	1	PD, CCH	5	150	30/0/15	105	E	5				
CHE743	Technology of fine and building ceramics		PD, UC	5	150	30/15/0	105	E		5			
HPP215	System analysis of chemical and technological processes	1	PD, CCH	5	150	30/0/15	105	E		5			
HPP220	Advanced CAD Chemical Engineering	1	PD, CCH	5	150	30/15/0	105	E		5			
HPP230	Disperse systems and surface phenomena in chemical-technological processes	2	PD, CCH	5	150	30/15/0	105	E		5			

HPP236	Technological features of the production of rare metal compounds from natural and technogenic raw materials	2	PD, CCH	5	150	30/0/15	105	E		5			
HPP237	Advanced Study of Salt Systems	3	PD, CCH	5	150	15/30/0	105	E		5			
HPP231	Innovative technologies for the processing of halurgical raw materials	3	PD, CCH	5	150	30/15/0	105	E		5			
HPP221	Surface-active reagents in chemical-technological processes	1	PD, CCH	5	150	30/0/15	105	E			5		
HPP244	Innovative technologies of receiving mineral fertilizers	1	PD, CCH	5	150	30/15/0	105	E			5		
HPP229	Fundamentals of recycling in the production of inorganic materials	2	PD, CCH	5	150	30/0/15	105	E			5		
HPP223	Fundamentals of primary processing of natural uranium compounds	2	PD, CCH	5	150	30/0/15	105	E			5		
CHE703	Theoretical foundations of extraction and ion exchange processes	2	PD, CCH	5	150	30/0/15	105	E			5		
HPP224	High-temperature processes in the processing of natural phosphates	3	PD, CCH	5	150	30/0/15	105	E			5		
HPP238	Calculation and modeling of mass transfer processes and apparatuses	3	PD, CCH	5	150	15/0/30	105	E			5		
HPP235	Chemistry and technology of new flotation reagents and flocculants		PD, UC	4	120	30/15/0	75	E				4	
M-3. Practice-oriented module													
AAP256	Research practice		PD, UC	4				R				4	
M-4. Experimental research module													
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R	4				
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R		4			
AAP251	Research work of a master's student, including internship and completion of a master's thesis		RWMS	2				R			2		
AAP255	Research work of a master's student, including internship and completion of a master's thesis		RWMS	14				R				14	
M-5. Module of final attestation													
ECA212	Registration and protection of the master thesis		FA	8								8	
Total based on UNIVERSITY:									30	30	30	30	
									60		60		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	20	15	35
PD	Cycle of profile disciplines	0	18	35	53
Total for theoretical training:		**0**	**38**	**50**	**88**
RWMS	Research Work of Master's Student				24
ERWMS	Experimental Research Work of Master's Student				0
FA	Final attestation				8
TOTAL:					**120**

Dechion of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Dechion of the Academic Council of the Institute. Minutes № 3 dated 28.11.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs — Uskenbayeva R. K.

Approved:

Vice Provost on academic development — Kalpeyeva Z. B.

Head of Department - Department of Educational Program Management and Academic-Methodological Work — Zhumagaliyeva A. S.

Director - Mining and Metallurgical Institute named after O.A. Baikonurov — Ryshchkov K. .

Department Chair - Chemical Processes and Industrial Ecology — Kubekova S. .

Representative of the Academic Committee from Employers ____Acknowledged____ — Arynov K.

6. Additional educational programs (Minor)

None.

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