

**Kazakh National Research Technical University named after K.I. Satpayev**  
**K. Turysov Institute of Geology and Oil-Gas Business**  
**Department of Chemical and Biochemical Engineering**

**EDUCATION PROGRAM**

**"«CHEMICAL PROCESSES AND PRODUCTION OF CHEMICAL  
MATERIALS»"**

**Master of technical sciences by education program of the  
7M07110 - "Chemical processes and production of chemical materials"**

1st Edition

in accordance with the State Educational Standard of Higher Education, 2018

**Almaty 2021**

The program is drawn up and signed by the parties:

From KazNRTU named after K.I. Satbayev:

1. Head of the Department of C&BT

A. Amitova

2. Head of the Department of ChP&IE

Sh. Kubekova

3. Director of IGOM named after K.Turysov

A. Syzdykov



From employers:

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

2. LLP "Independent Center "Organic" for Expertise of Petroleum Products, Director Kalmuratova A.A.

Approved at the meeting of the Academic Council of the Kazakh National Research Technical University named after KI Satbayev. Protocol №3 from 25.06.2021

**Qualification:**

Level 7 National Qualifications Framework

7M07 – Engineering, manufacturing and construction industries

7M071 – Engineering and Engineering (Master)

**Professional competence:**

knowledge of modern scientific methods research, statement and formulation of scientific research tasks based on the results of search, processing and analysis of scientific and technical information, development of new technical and technological solutions when creating chemical products, taking into account technical, economic and environmental requirements, organization of the work of the team of performers, acceptance management decisions in the context of different opinions, application interactive forms and innovative teaching methods in a modern university.

## BRIEF DESCRIPTION OF THE PROGRAM

### 1 The goal of the program:

- 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 petrochemical technology 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.

**2 Types of employment.** A graduate of the educational program "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:

- production and technological;
- organizational and managerial;
- scientific research;
- design and engineering;
- pedagogical.

**3 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 petrochemical 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.

## EDUCATIONAL PROGRAM PASSPORT

### 1. Volume and content of the program

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.

### **Regulatory documents for the development of an educational program**

The regulatory legal framework for the development of this educational program consists of:

- The Law of the Republic of Kazakhstan "On Education" with amendments and additions within the framework of legislative changes to increase the independence and autonomy of universities dated 04.07.18 No. 171-VI.
- The Law of the Republic of Kazakhstan "On Amendments and Additions to Some Legislative Acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher educational institutions" dated 04.07.18 No. 171-VI;
- Order of the Minister of Education and Science of the Republic of Kazakhstan dated 30.10.18 No. 595 "On approval of Standard rules for the activities of educational organizations of appropriate types";
- State mandatory standard of postgraduate education (Annex 8 to the Order of the Minister of Education and Science of the Republic of Kazakhstan dated 31.10.18, No. 604;
- Order of the Minister of Education and Science of the Republic of Kazakhstan dated 20.01.15 No. 19 On Approval of the Rules for the Transfer and restoration of

Students by Types of Educational Organizations with Amendments and Additions by Order No. 601 dated 31.10.18.;

- Working curriculum of the educational program " Chemical processes and production of chemical materials " for 2020-2021, approved by the Rector of the K.I. Satpayev Kazakh National Research Technical University;

- Documents of the QMS system (Quality Management System) on the organization of the educational process at the K.I. Satpayev Kazakh National Research Technical University.

**The content of the EP:** The EP "Chemical Engineering of hydrocarbon compounds" is implemented by K.I. Satpayev KazNITU in the field of training 7M071 - Engineering and Engineering (Master's degree) 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 production of chemical materials.

The EP provides an opportunity to obtain in-depth knowledge, key skills and abilities of the graduate and their further development in the field of petrochemical engineering and production of chemical materials. This EP is built taking into account the possibility of providing a master's student with a choice of an appropriate educational trajectory or a specific specialization based on the main educational program, but containing their own individual competencies reflecting the specifics of a particular specialization within the framework of the unified educational direction 7M071 – Engineering and Engineering (Master).

### **Objectives of the educational program:**

A master's degree in the field of training 7M071 - Engineering and Engineering should be prepared to solve the following professional tasks in accordance with the direction of the EP "Chemical engineering of hydrocarbon compounds" and types of professional activities:

#### *1. Design and engineering 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.

#### *2. 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.

### *3. 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.

### *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. 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.

## **2 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.

## **3 Requirements for completing studies and obtaining a diploma**

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

A graduate who has mastered master's degree programs must have the following general professional competencies:

- \* the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- \* the ability to formulate research goals independently, establish the sequence of solving professional tasks;
- \* the ability to put into practice knowledge of fundamental and applied sections of disciplines that determine the orientation (profile) of the master's degree program;
- \* the ability to professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems;

\* the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;

\* proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

\* willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;

\* willingness to communicate orally and in writing in a foreign language to solve the tasks of professional activity.

A graduate who has mastered the master's degree program must have professional competencies corresponding to the types of professional activities that the master's degree program is focused on:

*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;

*scientific 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 petrochemical 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.



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

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.

Learning outcomes are formulated both at the level of the entire master's degree program, 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.

## **6. Competencies upon completion of training**

### **6.1 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.

*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.

*O - Universal, social and ethical competencies*

O1 - knowledge of modern social and political problems;

O2 - the ability to perceive cross-cultural differences, the ability to observe and maintain ethical norms and rules;

O3 - communication skills in a foreign language, ability to work in an international context;

*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.

### **6.2 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.

### **6.3 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.

## **7 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.

## **ENGLISH LANGUAGE (PROFESSIONAL)**

### **Professional English for Project Managers**

**COD– LNG210**

**CREDIT – 5**

**PREREQUISITE** –Academic English, Business English, IELTS 5.0-5.5

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### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The aim of the course is to form a foreign-language professionally oriented competence among undergraduates. Course objectives:

to develop the ability to realize communicative intention in various situations of professionally oriented oral and written communication based on four types of speech activity:

Listening, Speaking, Reading and Writing. To teach to use a foreign language as a means of accumulating information for professional and academic communication. Prepare undergraduates for passing certified tests

### **BRIEF DESCRIPTION OF THE COURSE**

The course is designed for master students of technical specialties for improvement and development of foreign language communication skills in the professional and academic spheres. The course introduces students the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally oriented cases, projecting).

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

Upon completion of the course, undergraduates will know:

- language means of professionally oriented and academic foreign language communication;
- a system of rules for constructing meaningful statements in a foreign language; be able to use a foreign language as a means of oral and written communication for professional and academic purposes; communicate and request information, express their own opinion / judgment, using argumentation, and evaluative language means;
- logically and consistently build an oral / written statement (in connection with what they heard / read), expressing personal attitude to the subject of speech;
- use a foreign language as a means of professional and academic interaction

## **HISTORY AND PHILOSOPHY OF SCIENCE**

**COD – HUM210**

**CREDIT – 4**

**PREREQUISITE – HUM124**

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### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

– to reveal the connection between philosophy and science, to highlight the philosophical problems of science and scientific cognition, the main stages of the history of science, the leading concepts of philosophy of science, modern problems of the development of scientific and technical reality

**BRIEF DESCRIPTION OF THE COURSE** – subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical 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

**KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**– to know and understand the philosophical issues of science, the main historical stages of the development of science, the leading concepts of the philosophy of science, to be able to critically evaluate and analyze scientific and philosophical problems, to understand the specifics of engineering science, to possess the skills of analytical thinking and philosophical reflection, to be able to justify and defend their position, to master the techniques of discussion and dialogue, to possess the skills of communicativeness and creativity in their professional activities

## **PEDAGOGY OF HIGHER EDUCATION**

**COD – HUM209**

**CREDIT – 4**

**PREREQUISITE: LNG102**

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**THE PURPOSE AND OBJECTIVES OF THE COURSE.** The course is aimed at studying the psychological and pedagogical essence of the educational process of higher education; forming ideas about the main trends in the development of higher education at the present stage, considering the methodological foundations of the learning process in higher education, as well as psychological mechanisms affecting the success of learning, interaction, management of subjects of the educational process. Development of psychological and pedagogical thinking of undergraduates.

### **BRIEF DESCRIPTION OF THE COURSE**

In the course of studying the course, undergraduates get acquainted with the didactics of higher education, forms and methods of organizing education in higher school, psychological factors of successful learning, features of psychological impact, mechanisms of educational influence, pedagogical technologies, characteristics of pedagogical communication, mechanisms for managing the learning process. They analyze organizational conflicts and ways to resolve them, psychological destructions and deformations of the teacher's personality.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

at the end of the course, a master's student should know the features of the modern system of higher professional education, the organization of pedagogical research, the characteristics of the subjects of the educational process, the didactic foundations of the organization of the learning process in higher school, pedagogical technologies, the patterns of pedagogical communication, the features of educational influences on students, as well as the problems of pedagogical activity.

## **PSYCHOLOGY OF MANAGEMENT**

**COD - HUM208**

**CREDIT - 3**

**PREREQUISITE –**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The main purpose of the course is aimed at studying the characteristics of the behavior of individuals and groups of people within organizations; determining psychological and social factors influencing the behavior of employees. Also, much attention will be paid to the issues of internal and external motivation of people. The main goal of the course is to apply this knowledge to improve the efficiency of the organization.

### **BRIEF DESCRIPTION OF THE COURSE**

The course is designed to provide balanced coverage of all the key elements that make up the discipline. It will briefly examine the origin and development of the theory and practice of organizational behavior, and then will examine the main roles, skills and functions of management with an emphasis on management effectiveness, illustrated by real-life examples and case studies.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

At the end of the course, students will know: the basics of individual and group behavior; basic theories of motivation; basic theories of leadership; concepts of communication, conflict management and stress in the organization; will be able to identify various roles of managers in organizations; look at organizations from the point of view of managers; understand how effective management contributes to an effective organization.

## **PSYCHOLOGY OF MANAGEMENT**

**CODE - HUM208**

**CREDIT - 3**

**PREREQUISITE**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

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### **CHEMISTRY AND PHYSICS OF POLYMER COMPOSITE MATERIALS CODE – CHE 755**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The course is aimed at the practical use of knowledge about the physical and chemical properties of polymers for the development of composite systems based on them with specified properties. The basic knowledge and skills in the field of chemistry and physics of polymer materials and high-molecular compounds will be presented.

### **BRIEF DESCRIPTION OF THE COURSE**

The course is designed to understand the chemical and physical properties of polymer materials and their use to create composite polymer materials with specified properties.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- design polymer composite materials with specified properties;
- determine the compliance of a given substance with specific physico-chemical properties;
- correlate the constituent substances of composite materials with obtaining the specified properties of polymer materials;
- plan instrumental scientific research.

## **CALCULATION AND MODELING OF MASS TRANSFER PROCESSES AND APPARATUSES**

**CODE– CHE 777**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

In this course, skills and practical skills are formed that allow determining the main parameters of the technological regime and the main dimensions of the devices, as well as creating models of mass-exchange processes for solving problems of computational and technological design.

### **BRIEF DESCRIPTION OF THE COURSE**

Within the framework of the course, the methods of technological calculation and the basics of technological design of mass transfer process apparatuses are considered, which make it possible to master the basic approaches to modeling mass exchange processes.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- solve professional production tasks, including the choice of technological parameters of the process, materials and energy costs;
- analyze the influence of technological parameters on the process, calculate and optimize the process.
- the essence of the technology of the mass transfer process and methods of calculation and design of devices;
- the main directions of improving the work and improving the designs of mass transfer process apparatuses, to evaluate the technical and economic efficiency of the technological process;
- methods for determining the optimal operating modes of equipment, methods for calculating technological standards and parameters of the mass transfer process.

## **FUNDAMENTALS OF MODERN TECHNOLOGIES FOR PROCESSING MINERAL RAW MATERIALS**

**CODE – CHE 760**

**CREDIT-5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

As part of the course, the undergraduate will get acquainted with the main modern technologies of mineral enrichment and processing of the obtained concentrates, methods of isolation and separation of useful components of mineral raw materials. The basic knowledge and skills in the field of modern technologies of processing of mineral raw materials will be presented.

### **BRIEF DESCRIPTION OF THE COURSE**

General information about classical and modern theories of technological processes. The enrichment process as the first stage of ore processing. Products and technological indicators of the enrichment process. The main methods and schemes of enrichment. Special enrichment methods and their classification. Physico-chemical bases of the flotation process. Leaching and dissolution. Fundamentals of extraction and ion exchange processes in the technology of obtaining uranium, rare and scattered non-ferrous and precious metals. Ion exchange equipment. Environmental problems of mineral processing

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- to analyze the influence of the main technological parameters on various processes of enrichment and processing of mineral raw materials;
- be able to process experimental data and use these results in solving professional production tasks.
- features of the practical use of the processes of enrichment, leaching, separation and isolation of compounds of non-ferrous and rare metals in mineral processing technologies

### **INDUSTRIAL WATER TREATMENT AND WASTEWATER TREATMENT METHODS**

**CODE – CHE 759**

**CREDIT-5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

Familiarization with technological indicators of the quality of natural and wastewater; study of the main operations and stages of industrial water treatment; conditions and schemes for the formation of wastewater of chemical enterprises and the main methods of their purification.

### **BRIEF DESCRIPTION OF THE COURSE**

The course examines the rational use of water resources: fuller use and expanded reproduction of freshwater resources; development of new technological processes to prevent pollution of reservoirs and minimize the consumption of fresh water.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- basic technological operations of industrial water treatment, water clarification, water desalination;
- the concept of wastewater of chemical enterprises and the sources of their formation, mechanical and physical methods of wastewater treatment. Wastewater treatment from heavy metals.
- thermo-oxidizing methods of neutralization of organic impurities in wastewater.
- basic methods of wastewater treatment of chemical enterprises.
- methods of biological wastewater treatment. Wastewater treatment of power technological installations.

### **INDUSTRIAL ORGANIC CHEMISTRY**

**CODE - CHE 778**

**CREDIT-5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of organic synthesis is to obtain substances with valuable physical, chemical and biological properties or to test the predictions of theory. Modern organic synthesis is multifaceted and allows you to obtain almost any organic molecules.

### **BRIEF DESCRIPTION OF THE COURSE**

The course is a section of organic chemistry and technology that studies various aspects (methods, techniques, identification, equipment, etc.) of obtaining organic compounds, materials and products, as well as the process of obtaining substances.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- apply methods of theoretical and experimental research
- to use knowledge about the structure of matter, the nature of chemical bonds in various classes of chemical compounds to understand the properties of materials and the mechanism of chemical processes occurring in the surrounding world;
- use modern means of obtaining, storing, processing information, have computer skills as a means of information management;
- to use modern information technologies, to process information using business applications; to use network computer technologies and databases in your subject area.

## **MODERN METHODS OF ANTICORROSIVE PROTECTION OF TECHNOLOGICAL EQUIPMENT**

**CODE – CHE 763**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The choice of a method for protecting chemical devices and building structures from corrosion is determined by technical and economic calculations that take into account the technological and production conditions of operation of devices and structures, the cost of anti-corrosion work, durability and availability of a protective coating for subsequent repairs and a number of other factors.

### **BRIEF DESCRIPTION OF THE COURSE**

Classification of corrosion processes. The main indicators of metal corrosion. The influence of internal and external factors on the chemical and electrochemical corrosion of metals. The main methods of protection against chemical and electrochemical corrosion of metals. Atmospheric corrosion of metals and methods of combating it: application of various protective non-metallic and metallic coatings, alloying of steel with easily passivated metals or cathode additives. Corrosion of metals in molten salts and methods of protection: electrochemical cathodic protection, reduction of harmful impurities, etc.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

At the end of the course, the master's student will know:

- fundamentals of the theory of corrosion processes in gas and liquid electrically conductive media;
- the main sources of corrosion effects on materials used in the medical industry, their qualitative and quantitative characteristics;
- the concept of comprehensive protection of materials from corrosion.
- methods and methods for predicting the reliability of equipment and the consequences of corrosion;
- information about the condition and changes in the properties of structural materials under the influence of man-made and anthropogenic factors, demonstrate the ability and readiness to assess the nature of the influence of the environment or the production environment on the patterns of corrosion processes;
- choose a structural material; justify the design of the device and a set of measures to protect medical equipment and instruments from the corrosive effects of the environment.



## **MODERN PROBLEMS OF CHEMICAL AND POLYMER TECHNOLOGY**

**CODE-DREAM 770**

**Credit -5**

### **PURPOSE AND OBJECTIVES OF THE COURSE.**

Formation of modern ideas of undergraduates on the problems of Chemical Technology of polymer synthesis

### **BRIEF DESCRIPTION OF THE COURSE.**

Successful training of students in the discipline "modern problems of chemistry and polymer technology" is facilitated by the acquisition of fundamental and applied knowledge obtained during the study of general and inorganic chemistry, Organic Chemistry, Physical Chemistry, biopolymer chemistry, Monomer chemistry and technology, processes and apparatus of Chemical Technology, fundamentals and equipment of design of technological processes, General Chemical Technology of polymers. This course is important when performing a master's thesis, and the competencies acquired during its development are used in further professional activities.

### **KNOWLEDGE, SKILLS AND ABILITIES TO COMPLETE THE COURSE**

- mastering the skills of problem analysis in the field of Chemical Technology of polymer synthesis;
- mastering new methods of theoretical and experimental work in the field of chemistry of high-molecular compounds and polymer materials;
- mastering competencies;

## **TECHNOLOGIES FOR OBTAINING CHEMICAL CONCENTRATES OF NATURAL URANIUM**

**CODE – CHE 762**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

In this course, a master's student will acquire the skills of practical calculations of technological parameters of the main processes of concentration of uranium compounds. The basic knowledge and skills in the field of technology for obtaining chemical concentrates of natural uranium will be presented.

### **BRIEF DESCRIPTION OF THE COURSE**

Modern methods of processing uranium-containing solutions. Hardware and technological schemes of sorption and desorption processes. ED-process, ID-process. Extraction methods for processing uranium-containing solutions. Types of extractants, the influence of the structure of extractants on their extractive properties. The effect of diluents on the extraction process. Methods of deposition of chemical concentrates of natural uranium. Technological schemes for obtaining chemical concentrates of natural uranium

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

- an idea of the methods of mining uranium deposits;
- skills of conducting experimental research of technological processes of concentration of uranium compounds, processing experimental data and using their results for a reasonable choice of optimal technological parameters of processes.
- basic physico-chemical and technological properties of the most important uranium compounds used in the production of CCNU;
- fundamentals of processes, technological operations and schemes of the main methods of concentration of uranium compounds.

### **DESIGN OF EQUIPMENT FOR THE PRODUCTION AND PROCESSING OF POLYMER MATERIALS**

**CODE – CHE 756**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

Mastering the skills of selecting and evaluating technological equipment when designing polymer chemical production.

### **BRIEF DESCRIPTION OF THE COURSE**

Analysis of technical documentation, selection of equipment, preparation of applications for the purchase and repair of equipment; the ability to use the latest achievements of Science and technology in the design of technological processes for the production of polymers and polymer materials with a given set of properties, familiarization with the design features of reactors for the production of plastic masses, depending on the types,

structure, method of obtaining the main and auxiliary equipment of polymer chemical plants,

### **KNOWLEDGE, SKILLS AND ABILITIES TO COMPLETE THE COURSE**

- selection of the necessary equipment for the technological operation;
- development and execution of the necessary calculations on production technology and technological part of polymer production projects, development and training of drawings and technological, kinematic, hydraulic and other schemes;
- application of methods of modeling and optimization of technological processes;
- management of the production site in order to ensure maximum productivity of the installed equipment;
- identify the reasons for stopping the equipment due to malfunctions, instruct the relevant service to eliminate them;
- organization and implementation of measures to prevent industrial injuries and harmful effects of the consequences of the technological process on the environment.

## **CHEMISTRY AND TECHNOLOGY OF NATURAL HETEROCYCLIC COMPOUNDS**

**CODE – CHE 758**

**CREDIT – 5**

### **PURPOSE AND OBJECTIVES OF THE COURSE**

"Chemistry and technology of natural heterocyclic compounds" - mastering the basic technological principles of catalytic processes of oil refining and providing scientific foundations.

Course objectives:

- creation of the basics of theoretical training of undergraduates for solving practical tasks;
- formation of scientific foundations of chemistry, kinetics and technology of the hydrocarbon processing process;
- formation of practical skills for saving energy and materials in environmentally friendly technological industries;
- mastering the skills of technological and structural calculation of equipment of oil refining and petrochemical industries.

### **BRIEF DESCRIPTION OF THE COURSE**

In the discipline "chemistry and technology of natural heterocyclic compounds", undergraduates study the theoretical foundations, scientific foundations of chemistry,

methods and technology of obtaining heterocyclic compounds to solve practical problems, and develop scientific thinking.

### **KNOWLEDGE, SKILLS AND ABILITIES TO COMPLETE THE COURSE**

The study of this discipline allows the master's student to solve practical problems, form scientific thinking, in particular, to correctly understand the boundaries of the application of knowledge about chemical nature, the composition and basic physical properties of organic compounds and methods of their processing, to understand the relationship between chemical nature, the composition and physical and chemical properties of various classes of compounds, to apply the acquired knowledge in solving problems of Economics, everyday life and Environmental Protection.

## **THEORETICAL FOUNDATIONS OF ELECTROCHEMISTRY**

**CODE – CHE 764**

**CREDIT – 5**

### **THE PURPOSE AND OBJECTIVES OF THE COURSE**

The course is designed to master the practical use of electrochemical and electrothermal production devices. The basic knowledge and skills in the field of electrochemical, electrothermal production, as well as methods of their implementation will be presented

### **BRIEF DESCRIPTION OF THE COURSE**

The discipline "Theoretical foundations of electrochemistry" studies the theoretical foundations of electrochemistry, as well as the development of the theory and practice of the modern scientific approach to processing technogenic raw materials by electrochemistry.

### **KNOWLEDGE AND SKILLS UPON COMPLETION OF THE COURSE**

Theoretical foundations of electrochemical processes;

- depending on the required performance, calculate the optimal variant of the electrochemical process;
- the essence and social significance of their profession;

- physico-chemical fundamentals of processes, theoretical foundations of plant equipment.

## **DEFENSE OF THE MASTER'S THESIS**

**COD – ECA205**

**KREDIT –12**

### **PURPOSE AND OBJECTIVES**

The purpose of the master's thesis is: to demonstrate the level of scientific / research qualifications of a graduate student, the ability to independently conduct a scientific search, to test the ability to solve specific scientific and practical problems, knowledge of the most general methods and techniques for solving them.

### **SHORT DESCRIPTION**

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 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

## Content

1	Scope and content of the program	4
2	Requirements for applicants	8
3	Requirements for completing studies and obtaining a diploma	8
4	Working curriculum of the educational program	11
5	Descriptors of the level and scope of knowledge, skills, skills and competencies	13
6	Competencies upon completion of training	12
7	Appendix to the diploma according to the ECTS standard	17
8	Review of the educational program	30



## РЕЦЕНЗИЯ

на образовательную программу  
«Химические процессы и производство химических материалов»  
в области инженерии и инженерного дела  
(научно-педагогическая магистратура, срок обучения 2 года)

Рецензируемая образовательная программа (ОП) «Химические процессы и производство химических материалов» квалификации «7М071 - Инженерия и инженерное дело» (магистр технических наук) Национальной рамки квалификации представляет собой описание образовательной подготовки, разработанной на основе Государственного общеобязательного стандарта высшего образования Республики Казахстан (магистратура).

Содержание и структура ОП по направлению подготовки «7М071 – Инженерия и инженерное дело» (научно-педагогическая магистратура) отвечает основным требованиям стандарта и содержит следующую информацию: цели и задачи ОП, характеристику профессиональной деятельности выпускника, академические требования к поступающим, требования для завершения обучения и получения диплома, рабочий учебный план, дескрипторы уровня и объема знаний, умений, навыков и полный перечень общечеловеческих, социально-этических, базовых, профессиональных и специальных компетенций.

Структура Учебного плана ОП «Химические процессы и производство химических материалов» логична и последовательна. Дисциплины учебного плана раскрывают сущность актуальных на сегодняшний день проблем. Общая трудоемкость программы составляет 120 академических кредитов при сроке обучения 2 года.

Сильными сторонами рецензируемой ОП являются:

- освоение выпускниками современных методов обучения в высших учебных заведениях, способствующих формированию творческого, инновационного подхода к пониманию профессиональной деятельности; развитию самостоятельности мышления и умению принимать оптимальные решения в определенных ситуациях;
- возможность выбора обучающимися различных видов профессиональной деятельности, что повышает их востребованность на рынке труда.

На основании вышесказанного считаю, что образовательная программа «Химические процессы и производство химических материалов» направления подготовки «7М071 – Инженерия и инженерное дело» (научно-педагогическая магистратура, срок обучения 2 года) может быть рекомендована для внедрения в учебный процесс.

Первый заместитель генерального директора  
АО «Институт химических наук  
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