Non-Profit Joint Stock Company
«Kazakh national research technical university named after K.I. Satbayev»
Institute of Chemical and Biological Technologies

CURRICULUM PROGRAM

«COMPUTATION IN CHEMICAL AND BIOCHEMICAL ENGINEERING»

Master of technical sciences by education program of the 7M07116 - "Computation in chemical and biochemical engineering"

2nd edition
in accordance with the SES of higher education in 2018

Almaty 2020

The program compiled and signed by the parties:

From KazNRTU named after K.Satbayev:

1. The Head of the Ch&BChI Department — G.Zh.Yeligbayeva

3. Director of the Ch&BT Institute — Z.K. Tuiebakhova

From employer:

1. Lokshin V.N. President of the International Academy of Reproductology, Corresponding Member of the National Academy of Sciences of the Republic of Kazakhstan, General Director of the ICRC "PERSONA", Professor

Approved at the meeting of the Academic Board of the Kazakh National Research Technical University named after KI. Satbayev. Protocol number 17 of 26/12/2020

Qualification:

Level 7 National Qualifications Framework
7M07 – Engineering, manufacturing and construction industries
7M071 – Engineering and Engineering (Master)
7M05 – Natural Sciences, Mathematics and Statistics
7M051 – Biological and related sciences (Master)
7M052 – Environment (Master)

Professional competence:

- data analysis and machine learning in chemical and biochemical engineering;
- the ability to apply promising methods of research and solving professional problems based on knowledge of world trends in the development of mathematics, computer technology and information technology in chemical and biochemical engineering;

- ability to develop conceptual and theoretical models of solvable scientific problems and applied problems in chemical and biochemical engineering;
- ability to plan research activities, analyze risks, manage projects in chemical and biochemical engineering.

BRIEF DESCRIPTION OF THE PROGRAM

The direction of the specialty program relates to engineering and engineering.

The purpose of the educational program is to train undergraduates in basic and specialized disciplines with the achievement of relevant competencies.

The purpose of the creation of the specialty - in the great mass of specialists in the chemical and biochemical sciences, information technology and computer science is to focus specialists with valuable knowledge of the technologies of the future - artificial intelligence technologies that will distinguish them favorably on the international market of the chemical and biochemical industry, as well as in the field of IT services.

They will study the basic methods of artificial intelligence on simple, "tangible" examples and the mathematical basis of machine learning and artificial intelligence applicable in the chemical and biochemical direction. The main objective of this direction is the modeling of intellectual activity in chemical and biochemical engineering with the help of computers. At the end of the course, graduates will recognize working machine learning algorithms in order to apply them in their tasks (theoretical or applied). In case of successful completion of the full master's degree course, the graduate is awarded an academic degree of "Master of Technical Sciences".

Training involves active research work, participation in research projects under the guidance of leading experts in priority areas of science, practice, and cooperation with leading foreign organizations of education and science. Invited foreign professors (USA, Turkey, Malaysia, etc.) can give lectures to undergraduates.

The educational program involves the development of fundamental ZUN in chemistry, biochemistry, mathematics and artificial intelligence. Graduates will have the opportunity to master almost all the skills needed in the field of Data Science, Data Engineering, Quantitative Analysis (in Python languages) and mathematics, and apply them in chemical and biochemical engineering.

The program focused on the following areas of professional activity:

- Data analysis in chemical and biochemical engineering
- Machine learning in chemical and biochemical engineering
- Artificial intelligence in chemical and biochemical engineering

Content of the educational program:

- Educational complex of disciplines
- Disciplines of chemical and biochemical engineering
- Data analysis disciplines
- Machine learning disciplines
- Artificial Intelligence Disciplines
- Disciplines of project management software development

EDUCATIONAL PROGRAM PASSPORT

1 Volume and content of the program

The volume of mastered academic credits determines the term of study in the magistracy. When mastering a set amount of academic credits and achieving the expected learning outcomes for a master's degree, the master's educational program is considered fully mastered. In the scientific and pedagogical magistracy at least 120 academic credits for the entire period of study, including all types of educational and scientific activities of the student.

Planning the content of education, the method of organizing and conducting the educational process is carried out by the university and the scientific organization independently based on the credit technology of education.

Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education in the preparation of scientific and scientific-pedagogical personnel for universities and scientific organizations with in-depth scientific, educational and research training.

The content of the magistracy educational program consists of:

1) theoretical training, including the study of cycles of basic and major 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 the scientific and pedagogical magistracy

4) final certification.

Regulatory documents for the development of educational programs

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 autonomy and autonomy of universities of July 4, 1998 No. 171-VI.

- The Law of the Republic of Kazakhstan "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on the Expansion of Academic and Managerial Independence of Higher Educational Institutions" No. 171-VI of July 4, 1998;

- Order of the Minister of Education and Science of the Republic of Kazakhstan of 30.10.18, No. 595 "On Approval of the Model Rules for the Activities of Educational Organizations of Corresponding Types";

- State obligatory standard of postgraduate education (Annex 8 to the order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 188, No. 604;

- Order of the Minister of Education and Science of the Republic of Kazakhstan of January 20, 2015 No. 19 On Approval of the Rules for Transfer and Reinstatement of Students by Types of Educational Organizations with changes and additions by Order No. 601 of October 31, 188;

- The working curriculum of the educational program "Computational processes in chemical and biochemical engineering (Computation in Chemical and Biochemical Engineering)" for 2019-2020, approved by the Rector of the Kazakh National Research Technical University named after K.I. Satbayev;

- Documents of the QMS system (Quality Management System) on the organization of the educational process in the Kazakh National Research Technical University named after K.I. Satbayev.

The content of the Educational Program: “Computation in Chemical and Biochemical Engineering” is implemented by KazNRTU named after K.I. Satbayev in the areas of training 7M071 – Engineering and Engineering (Master) and 7M051 – Biological and related sciences, and presents a documentation system that regulates the objectives, expected results, content and implementation of the educational process in the field of artificial intelligence in chemical and biochemical engineering.

EP provides the ability to obtain in-depth knowledge, key skills and abilities of the graduate and their further development in the field of artificial intelligence in chemical and biochemical engineering. This EP is based on the possibility of providing the undergraduate with the choice of an appropriate educational trajectory or a specific specialization based on the main educational program, but containing its own individual competencies reflecting the specifics of a particular specialization within the framework of a single educational direction 7M071 – Engineering and Engineering (Master).

The purpose and objectives of the educational program

To provide practice-oriented training of specialists in scientific activities and production in the field of data analysis, machine learning and artificial intelligence in chemical and biochemical engineering.

Create conditions for continuous professional self-improvement, development of social and personal competencies (broad cultural outlook, active citizenship, dedication, organization, hard work, sociability, ability to argue and make organizational and management decisions, knowledge of modern information technologies, fluency in several languages, aspiration self-development and commitment to ethical values and a healthy lifestyle, ability to work in a team e, responsibility for the end result of their professional activities, civil liability, tolerance), social mobility and competitiveness in the labor market.

The objective of the program is to study the fundamentals of building artificial intelligence systems, the characteristics of their organization, functioning, life cycle, the directions of development of artificial intelligence, the development of students'

competences in designing and using modern intelligent systems in chemical and biochemical engineering.

The master in areas of training 7M071 – Engineering and Engineering and 7M051 – Biological and related sciences should be prepared to solve the following professional tasks in accordance with the direction of the study program "Computational Processes in Chemical and Biochemical Engineering" and types of professional activities:

- design;
- production and technology;
- experimental research;
- organizational and managerial;
- operational;
- scientific.

Objects of professional activity:

• Computers, systems, systems and networks in chemical and biochemical engineering;

• Computer systems for information processing and management in chemical and biochemical engineering;

• Automated control systems in chemical and biochemical engineering;

• Computer software in chemical and biochemical engineering.

2 Entry Requirements

The previous level of education of applicants (first cycle) - higher professional education (bachelor degree). The applicant must have a diploma of a fixed pattern and confirm the level of knowledge of English with a certificate or diplomas of a fixed pattern.

The procedure for admission of citizens to the magistracy is established in accordance with the "Model rules for admission to study at educational organizations that implement educational programs of post-graduate education."

The formation of a contingent of undergraduates is carried out through the placement of the state educational order for the training of scientific and pedagogical personnel, as well as tuition fees at their own expense of citizens and other sources. Citizens of the Republic of Kazakhstan shall be granted the state the right to receive on a competitive basis in accordance with the state educational order free postgraduate education, if they receive education at this level for the first time.

At the "entrance" the undergraduate student should have all the prerequisites necessary for mastering the corresponding educational program of the magistracy. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a fee basis.

3 Requirements to complete the course and receive a diploma

Awarded degree / qualifications: The graduate of this educational program is awarded an academic degree of Master of Technical Sciences.

A graduate who has mastered the master's program should have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use in professional activities new knowledge and skills, to develop their innovative abilities;
- the ability to independently formulate research goals, establish the sequence of solving professional tasks;
- the ability to put into practice the knowledge of fundamental and applied sections of the disciplines that determine the direction (profile) of the graduate program;
- the ability to professionally choose and creatively use modern scientific and technical equipment to solve scientific and practical problems;
- the ability to critically analyze, represent, protect, discuss and disseminate the results of their professional activities;
- possession of skills for the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;
- readiness to lead the team in their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;
- readiness for communication in oral and written forms in a foreign language for solving problems of professional activity.

A graduate who has mastered the master's program must have professional competencies corresponding to the types of professional activity to which the master's program is oriented:

research activities:

- the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of science and specialized knowledge gained in mastering the master's program;
- the ability to independently conduct scientific experiments and research in the professional field, summarize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- the ability to create and explore models of objects based on the use of in-depth theoretical and practical knowledge in the field of software development;

research and production activities:

- the ability to independently carry out production and research and production of field, laboratory and interpretation work in solving practical problems;
- ability to professional exploitation of modern field and laboratory equipment and devices in the field of mastered master programs;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;

project activity:

- the ability to independently draw up and submit research and development projects;
- readiness to design complex research and production works in solving professional problems;

organizational and management activities:

- readiness to use the practical skills of organizing and managing research and scientific-production work in solving professional problems;
- readiness for practical use of regulatory documents in the planning and organization of research and production work;
- scientific and educational activities:
- ability to conduct seminars, laboratory and practical classes;
- ability to participate in the management of scientific and educational work of students in the field of software development.

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

4 Work curriculum of the educational program

WORKING CURRICULUM
Education program 7M07116 Computation in chemical and biochemical engineering
Group of Educational Programs M097 "Chemical Engineering and Process"
enrolment for 2020 - 2021 academic year

Academic degree: Magister
Term of study: 2 years

year of study	Code	Name of course	Component	Academic credits	lecture/ laboratory/ practice/MSIW	Prerequisites	Code	Name of course	Component	Academic credits	lecture/ laboratory/ practice/IWS	Prerequisites
1	**1 semester**						**2 semester**					
	LNG202	Foreign language (professional)	BD IC	6	0/0/3/ 3		AAP24 4	Pedagogical practice	BD IC	4	0/0/2/ 2	
	HUM20 1	History and philosophy of science	BD IC	4	1/0/1/ 2			Optional component BD	BD OC	6		
	HUM20 7	Higher school pedagogy	BD IC	4	1/0/1/ 2			Optional component BD	BD OC	6		
	HUM20 4	Management psychology	BD IC	4	1/0/1/ 2			Institutional component PS	PS IC	6		
		Optional component BD	BD OC	6				Institutional component PS	PS IC	6		
		Institutional component PS	PS IC	6			AAP24 2	Master's student scientific research, including an internship and a master's thesis.	MSS R	6		
	AAP242	Master's student scientific research, including an internship and a master's thesis.	MSS R	6								
		In total		**36**				**In total**		**34**		
2	**3 semester**						**4 semester**					
		Optional component PS	PS OC	6			AAP24 2	Master's student scientific research, including an internship and a master's thesis.	MSS R	6		
		Optional component PS	PS OC	6			AAP23 6	Research scientific training	PS	7		
		Optional component PS	PS OC	6			ECA20 5	Registration and defense of the master's thesis (RaDMT)	FA	12		
		Optional component PS	PS OC	6								
	AAP242	Master's student scientific research, including an internship and a master's thesis.	MSS R	6								
		In total		**30**				**In total**		**25**		
								In all		**125**		

4.1 Catalog of elective disciplines

Сэтбаев Университеті

ELECTIVE DISCIPLINES for 2020-2021 academic year admission

Group of Educational Programs M097 "Chemical Engineering and Processes"

Study duration: 2 years

№	Code	Name of discipline	Credits ECTS	lec/lb/prac/MSIW	semester
BD Components of choice - 18 credits					
Advanced basic module					
1	BIO 704	Chemical reagents in the processes of oil refining and oil production	6	2/0/1/3	1
2	CHE299	System analysis of chemical and technological processes*	6	2/0/1/3	2
	CHE709	CAD Chemical engineering*		1/2/0/3	2
3	CHE298	The bases of the modern technologies of the processing of mineral raw materials*	6	2/0/1/3	2
4	CHE224	Industrial organic chemistry	6	2/0/1/3	2
	CHE708	Modern technologies for the processing of organic substances			
PD Components of choice - 42 credits					
Module of technologies of the main production					
5	CHE272	Industrial reactors for large-scale chemical production*	6	2/0/1/3	1
6	CHE292	Biofuel technology*	6	2/0/1/3	3
7	CHE747	Industrial safety in production*	6	2/0/1/3	2
Module of Computation in chemical and biochemical engineering					
8	CSE713	Machine Learning & Deep Learning	4	1/0/1/2	1
	BIO272	Computational Chemistry and Modeling	6	2/0/1/3	1
9	BIO273	Computational Genetics	6	2/0/1/3	2
	BIO274	Computational Biology	6	2/0/1/3	2
	BIO275	Systems biology	6	2/0/1/3	2
10	BIO276	Introduction to Genomic Technologies	6	2/0/1/3	2
	CSE702	Python for Genomic Data Science	6	2/0/1/3	3
	CSE703	Biopython	6	2/0/1/3	3
11	CSE704	Algorithms for DNA Sequencing	6	2/0/1/3	3
12	CSE705	Ecosystem Dynamics	6	2/0/1/3	3
	CSE706	Ecosystem Modeling	6	2/0/1/3	3
13	BIO277	Cellular Biology	6	2/1/0/3	3
14	BIO278	Computational chemistry in drug delivery	6	2/1/0/3	3

* - disciplines of an interdisciplinary nature

4.2 Modular curriculum

MODULAR CURRICULUM

Education program: **7M07116 - Computation in chemical and biochemical engineering**

Form of study: full Duration of training: 2 years *Academic degree: Master of technical sciences*

The cycle	code	Name of disciplines	Semester	Acad. credits	lec.	lab.	prac	IWS	Type of control	Chair
Profile training module										
Basic disciplines (BD) (40 credits)										
University component (18 credits)										
BD 1.2.1	HUM201	History and philosophy of science	1	4	1	0	1	2	Exam	SD
BD 1.3.1	HUM207	Higher school pedagogy	1	4	1	0	1	2	Exam	SD
BD 1.1.1	LNG202	Foreign language (professional)	2	6	0	0	3	3	Exam	EL
BD 1.4.1	HUM204	Management psychology	2	4	1	0	1	2	Exam	SECPM
Practice-oriented module										
BD	AAP244	Pedagogical practice	2	4					Report	Ch&BCI ChP&IE
Choice component (18 credits)										
Advanced basic module										
BD 1.5.1	BIO 704	Chemical reagents in the processes of oil refining and oil production	1	6	2	0	1	3	Емтихан	Ch&BCI
BD 1.5.2.1	CHE299	System analysis of chemical and technological processes *	1	6	2	0	1	3	Емтихан	ChP&IE
BD 1.5.2.2	CHE709	CAD Chemical engineering *			1	2	0	3		
BD 1.6.2.2	CHE298	The bases of the modern technologies of the processing of mineral raw materials*	2	6	2	0	1	3	Емтихан	ChP&IE
BD 1.6.1.2	CHE224	Industrial organic chemistry	2	6	2	0	1	3	Емтихан	Ch&BCI
	CHE708	Modern technologies for the processing of organic substances								
Major disciplines (MD) (49 credits)										
Choice component (CC)										
Module of technologies of the main production										
MD 2.1.1	CHE272	Industrial reactors for large-scale chemical production*	1	6	2	0	1	3	Exam	Ch&BChE
MD 2.5.1.1	CHE747	Industrial safety in the production*	1	6	2	1	0	3	Exam	ChP&IE
MD 2.5.2.3	CHE292	Biofuel technology*	3	6	2	0	1	3	Exam	Ch&BChE
Module of Computation in chemical and biochemical engineering										
MD 2.4.2	CSE713	Machine Learning & Deep Learning	2	6	2	0	1	3	Exam	PI
MD 2.5.3.3	BIO272	Computational Chemistry and Modeling	3	6	2	0	1	3	Exam	Ch&BCI
	BIO273	Computational Genetics							Exam	Ch&BCI
MD 2.6.2.3	BIO274	Computational Biology	3	6	2	0	1	3	Exam	Ch&BCI
	BIO275	Systems biology			2	1	0	3	Exam	Ch&BCI
MD 2.6.2.3	BIO276	Introduction to Genomic Technologies	3	6	2	0	1	3	Exam	Ch&BCI
	CSE702	Python for Genomic Data Science							Exam	PI
	CSE703	Biopython	3	6	2	0	1	3	Exam	PI
MD 2.6.2.1.3	CSE704	Algorithms for DNA Sequencing	3	6	2	0	1	3	Exam	PI

MD 2.7.3	CSE705	Ecosystem Dynamics	3	6	2	0	1	3	Exam	PI
	CSE706	Ecosystem Modeling	3	6	2	0	1	3	Exam	PI
MD 2.7.3.1	BIO277	Cellular Biology	3	6	2	1	0	3	Exam	Ch&BCI
MD 2.7.3.2	BIO278	Computational chemistry in drug delivery	3	6	2	1	0	3	Exam	Ch&BCI
Practice-oriented module										
MD	AAP236	Research practice	4	7					Report	Ch&BCI ChP&IE
Research Module (24 credits)										
MSSR	AAP242	Master's student scientific research	1	6					Report	Ch&BCI ChP&IE
MSSR	AAP242	Master's student scientific research	2	6					Report	Ch&BCI ChP&IE
MSSR	AAP242	Master's student scientific research	3	6					Report	Ch&BCI ChP&IE
MSSR	AAP242	Master's student scientific research	4	6					Report	Ch&BCI ChP&IE
Module of final attestation (12 credits)										
FA	ECA205	Registration and defense of the master's thesis	4	12					Defense of dissertation	Ch&BCI ChP&IE
		Total		**125**						

* - disciplines of an interdisciplinary nature

5 Descriptors of the level and volume of knowledge, skills, abilities and competencies

Requirements for the level of training of a graduate student are determined on the basis of Dublin descriptors of the second level of higher education (magistracy) and reflect the acquired competencies expressed in the achieved learning results.

Learning outcomes are formulated both at the level of the entire master's educational program and at the level of individual modules or an academic discipline.

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

1) demonstrate developing knowledge and understanding in the field of computational processes and artificial intelligence in chemical and biochemical engineering, based on advanced knowledge of this field, in the development and (or) application of ideas in the context of research;

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

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

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

5) training skills necessary for independent continuation of further education in the studied area.

6 Competences to complete training

6.1 Requirements for key competencies of graduates of a *scientific and pedagogical magistracy* should:

1) *have an idea*:

- about the role of science and education in public life;
- about the current trends in the development of scientific knowledge;
- about current methodological and philosophical problems of natural (social, humanitarian, economic) sciences;
- about professional competence of a higher education teacher;
- about the contradictions and socio-economic consequences of globalization processes;

2) *know*:

- methodology of scientific knowledge;
- The principles and structure of the organization of scientific activity;
- psychology of students' cognitive activity in the learning process;
- psychological methods and means of improving the effectiveness and quality of education;

3) *be able to*:

- use the knowledge gained 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, 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;

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

- to think creatively and creatively to solve new problems and situations;

- be fluent in a foreign language at a professional level, allowing to conduct research and teach special subjects in universities;

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

4) *have skills*:

- research activities, solving standard scientific problems;

- implementation of educational and pedagogical activities on the credit technology of education;

- methods of teaching professional subjects;

- the use of modern information technology in the educational process;

- professional communication and intercultural communication;

- oratory, correct and logical design of their thoughts in oral and written form;

- Expansion and deepening of knowledge necessary for everyday professional activities and continuing education in doctoral studies.

5) *be competent*:

- in the field of research methodology;

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

- in matters of modern educational technologies;

- in the implementation of research projects and research in the professional field;

- in ways to ensure continuous updating of knowledge, expansion of professional skills and abilities.

B – Basic knowledge and skills.

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

B2 - the ability to apply knowledge of the methodology of computational processes and artificial intelligence in chemical and biochemical engineering to solve specific professional problems and assess technological risks;

B3 – the ability to use psychological methods and means to improve the effectiveness and quality of education.

P – Professional competencies:

P1 - the ability to independently analyze available information, set goals and objectives and carry out experimental studies using modern instrumental methods and computational tools, be responsible for the quality of research and scientific accuracy of the results obtained;

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

P3 - the ability to professionally draw up, submit and report the results of research and production and technological works in accordance with the approved forms;

P4 - the 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 computational processes and artificial intelligence in chemical and biochemical engineering;

P5 - the ability to plan and conduct activities to assess the state and protection of the environment, to organize activities for environmental management;

P6 - possession of skills for the formation and presentation of educational material in various forms, laboratory and practical classes, readiness for teaching in educational institutions and management of students' research work.

O - Universal, social and ethical competences

O1 - knowledge of modern social and political problems;

O2 - the ability to perceive intercultural differences, the ability to comply with 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 the work team and provide measures of industrial safety;

C2 - the ability to plan and organize professional events;

C3 - readiness 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 graduate student in the scientific and pedagogical magistracy:

1) corresponds to the profile of the educational program of the magistracy, on which the master's thesis is performed and defended;

2) relevant and contains scientific novelty and practical significance;

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

4) performed using modern research methods;

5) contains research (methodical, practical) sections on the main protected provisions;

6) is based on advanced international experience in the relevant field of knowledge.

6.3 Requirements for the organization of practices:

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

1) pedagogical in the cycle BD – in the university;
2) research in the cycle PD – at the place of the dissertation.

Pedagogical practice is conducted with the aim of developing practical skills in teaching and learning. In this case, undergraduates are attracted to conduct classes in undergraduate at the discretion of the university.

The research practice of the undergraduate is carried out in order to familiarize with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

7ECTS Diploma Supplement

The application is developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and does not constitute official proof of education. Without a diploma of higher education is not valid. The purpose of completing the European application is to provide sufficient data on the diploma holder, the qualifications obtained by him, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, and information about the national education system. In the application model, which will be used for the transfer of estimates, the European system of transfer or credit transfer (ECTS) is used.

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 for professional recognition will require additional legalization of the diploma of education. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

8 Discipline description

Foreign language (professional)
CODE - LNG202
CREDIT - 6 (0/0/3/3)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE

Prepare students for effective study of academic English at the university graduate level.

BRIEF DESCRIPTION OF THE COURSE

The course combines four basic skills and academic language. Students are encouraged to independently learn and acquire knowledge of the course content.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

The student will be able to listen to the main points in listening assignments, take notes while listening, extract key information from the text, predict the content of the text, determine the topic, purpose and basic idea of the paragraph, analyze the paragraph structure, systematize the information logically, plan and write essays, develop critical skills thinking and commenting, participate in the discussion.

History & philosophy of science
CODE - HUM201
CREDIT - 4 (1/0/1/2)
PRE-REQUISIT - no

GOALS AND TASKS OF THE COURSE

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

BRIEF DESCRIPTION OF THE COURSE

The subject of philosophy of science, the dynamics of science, the 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, engineering engineering, ethics of science , social and moral responsibility of a scientist and engineer

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

Know and understand the philosophical questions of science, the main historical stages of the development of science, the leading concepts of the philosophy of science, be able to critically evaluate and analyze scientific and philosophical problems, understand the specifics of engineering science, have the skills of analytical thinking and philosophical reflection, know how to justify and defend their position, own methods conducting discussion and dialogue, possess skills of communication and creativity in their professional activities.

Pedagogy of Higher education
CODE - HUM207
CREDIT - 4 (1/0/1/2)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE

The course is aimed at studying the psychological and pedagogical essence of the educational process of higher education; formation of ideas about the main trends in the development of higher education at the present stage, consideration of the methodological foundations of the learning process in higher education, as well as psychological mechanisms affecting the success of training, interaction, management of subjects of the educational process. The development of psychological and pedagogical thinking of undergraduates.

BRIEF DESCRIPTION OF THE COURSE in the course undergraduates familiarize themselves with the didactics of higher education, the forms and methods of organizing studies in higher education, the psychological factors of successful learning, the peculiarities of psychological influence, the mechanisms of educational influence, pedagogical technologies, the characteristics of pedagogical communication, the mechanisms for managing the learning process. Analyze organizational conflicts and ways to resolve them, psychological destruction and deformation of the personality of the teacher.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE - at the end of the course the undergraduate must know the features of the modern system of higher professional education, organization of pedagogical research, characteristics of subjects of the educational process, didactic basics of organizing the learning process in higher education, pedagogical technologies, patterns of pedagogical communication, features of educational influences on students, and also problems of pedagogical activity.

Psychology of management
CODE - HUM204
CREDIT-4 (1/0/1/2)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE

The main goal of the course is to study the behavior of individuals and groups of people within organizations; defining psychological and social factors influencing the behavior of workers. Also, much attention will be paid to issues of internal and external motivation of people.

The main goal of the course is the application of this knowledge to improve the effectiveness of the organization.

BRIEF DESCRIPTION OF THE COURSE

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

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

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

Introduction to Python Programming language
CODE - CSE297
CREDIT - 6 (1/1/1/3)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE:

The purpose of studying this discipline is an introduction to programming. The concept of algorithm, construction of linear, branching, and cyclic processes is revealed. Basics of working with operators, arithmetic and logical operations. Data I / O, functions and procedures, recursion and introduction to data structures and collections. The Python language is becoming the de facto standard for further study of the fundamentals of interdisciplinary computing and digital technologies, is a prerequisite for many disciplines related to mathematical statistics and machine learning.

BRIEF DESCRIPTION OF THE COURSE

Currently, Python is recognized as the most common programming language in data processing tasks. This is due to its simplicity and intuitive syntax, in which communication with the hardware of the computer is abstracted, with a pronounced emphasis on creating small efficient algorithms. The course provides a quick insight into the syntactic features of the language and strengths.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

As a result of the course, students will gain the necessary knowledge of the Python language. Gain basic knowledge of algorithms and programming techniques. They will learn to use the design features of the language for writing programs, build processes with complex logic of branching and cyclic computational operations. Get the basic knowledge of logical and binary operations. Can write programs using the console input-output data. They will learn how to install the appropriate development and execution environment for the program code, learn how to debug the program code, fix errors, test and verify the results of the program code execution.

Mathematical Programming (optimization) and Control Theory
CODE - MAT229
CREDIT - 6 (1/1/1/3)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE

This course introduces undergraduates with the subject and methods of solving optimization problems. The purpose of this course is to teach undergraduates to formulate various optimization problems and master the methods for solving them.

BRIEF DESCRIPTION OF THE COURSE

Optimization is the art and science of distributing limited resources with the best possible effect. Optimization methods are used every day in matters of industrial planning, resource allocation, planning, decision-making, etc. This is an integral part of the mathematical background needed by mathematicians, economists, engineers, physicists and other scientists. It is difficult to overestimate the importance of optimization theory for engineering students. This requirement reflects the importance and widespread use of the subject.

The course is intended for undergraduates. It describes basic optimization techniques, including linear programming, dynamic programming, networks, and game theory.

Advanced biochemistry
CODE - BIO279
CREDIT - 6 (1/0/1/3)
PRE-REQUISIT - no

PURPOSE AND TASKS OF THE COURSE

Biological chemistry has made great strides in studying the chemical composition of living organisms (including humans) and the nature of the chemical processes taking place in living systems at the cellular, subcellular and molecular levels. The last few decades have been marked by a number of significant discoveries in biological chemistry and in some of its sections: Enzymology, Biochemical Genetics, Molecular Biology, Bioenergy, etc., which advanced it to the category of fundamental scientific disciplines and made biochemistry a powerful tool for solving many important problems of biology and medicine.

BRIEF DESCRIPTION OF THE COURSE

The course of biological chemistry traditionally includes the study of static biochemistry (chemical composition of the body and the structure of the main classes of organic compounds that make up living objects), dynamic biochemistry (transformations of the main, chemical components of tissues and principles of regulation of vital processes) and functional biochemistry (features of metabolism in individual organs and tissues and its relationship with the functional activity of the organism as a whole). The content of the curriculum includes the following sections:

1. Molecular structure of living things - the structure of proteins, carbohydrates, lipids, nucleic acids, structural features and functions of enzymes.
2. Molecular basis of metabolism - general ideas about bioenergy, the metabolism of carbohydrates, lipids, amino acids and proteins and the relationship between the exchanges of these compounds.
3. The exchange of genetic information - the synthesis of nucleic acids and proteins.
4. Regulation of molecular processes of life, the mechanisms of action of hormones and other biological regulators.
5. Biochemistry of individual tissues, organs and biological fluids includes acquaintance with the peculiarities of metabolism in the liver, nervous, muscular, connective tissue; with the chemical composition and diagnostic value of biochemical examination of blood, urine and cerebrospinal fluid.
6. Nutrition biochemistry - the role of various food components in the normal formation and functioning of the organism.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

• A student should know:

• fundamental laws of chemistry, which allow to explain the chemical processes occurring in living organisms;

• the basic laws of the molecular organization of a living cell, metabolic processes occurring in it, the structural organization of biologically important molecules, methods of biochemical research;

• the most important physico-chemical methods for studying the structure, properties and contents of chemicals in the body and the environment;

• molecular basis of vital processes: the metabolism of proteins, lipids and carbohydrates, the effect of irreplaceable nutrition factors on the state of human health;

• basics of the regulation of vital processes: the molecular mechanisms of action of hormones, mediators and other regulatory molecules at the level of enzymatic reactions, subcellular particles, cells, organs and the whole organism.

• A student should be able to:

• conduct simple chemical studies with analysis and presentation of results: qualitative analysis of simple and complex substances;

• determine the response of the medium in solutions and biological fluids;

• work with equipment used in clinical and physicochemical laboratories.

• A student must acquire skills:

• on the assessment of the molecular organization of living systems, physicochemical methods for studying the structure, properties and content of chemicals in the body;

• on the interpretation of biochemical processes in the implementation and consumption of basic vital functions of the human body.

Advanced Biology
CODE - BIO280
CREDIT - 6 (2/0/1/3)
PRE-REQUISIT - Biology

PURPOSE AND TASKS OF THE COURSE:

The purpose of the course is to raise the level of knowledge so that the whole diversity of living nature is perceived by the listeners as a single system with general laws of origin, development, patterns of structure and life activity. Show the unity of nature of various biological systems at all levels of their organizations AI (from the cell to the ecosystem), despite the striking diversity of their structure and functions.

The objectives of the course are to develop the ability to analyze and summarize phenomena and facts, establish causal relationships in the structure and functioning of cells, tissues, organs and organisms in their relationships with each other and with environmental conditions.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

At the end of the course the student should know:

- basic data of modern biology;
- the basic laws, theories and hypotheses of the essence of life, its origin and evolution of living systems;
- prospects of development and continuous progress in biological sciences
- How to protect biological objects on the example of the Primorye flora and fauna.

Understand:

- The fundamental importance of biology;
- the consequences of human intervention on society and the biosphere;

Database Systems
CODE - CSE700
CREDIT - 6 (1/1/1/3)
SPECIFIC-CSE297

PURPOSE AND TASKS OF THE COURSE:

The goal of the course is to give basic concepts of data warehouses, types of storages. Define the physical and conceptual data model. Identify the differences between them and approaches in solving problems of building databases. Various types of data storage are considered, algorithms for organizing effective access to data, and differentiation of access rights to data are considered. The practical and theoretical part of the course focuses on the relational data model and the SQL language. The course is designed for all three areas of the educational program, knowledge of SQL, as the main tool for working with databases is a basic requirement in IT.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

Upon completion of the course, the student will know the basic data storage models. Be able to distinguish between physical and conceptual data model. To be able to work with file storages - text and binary. Explore the relational data model. Will know the data normalization processes. Will master the language of SQL.

As a result of studying the module, the student will be able to:

- Install, configure and interact with the relational database management system;
- Describe, define and apply the main components of the relational database model to the database design;
- apply a structured query language (SQL) to determine and manipulate the database;
- use database modeling method for one class of entities, one-to-one (1: 1) relationship between entity classes, one-to-many relationship (1: M) between entity classes, many-to-many (M: M) between entity classes and recursive relationships;
- identify, develop and process individual entities, tables 1: 1, 1: M and M: M;
- implement the principles and concepts of information integrity, security and confidentiality.
- understand the concept of atomicity of operations, integrity, sustainability. Be able to use data isolation models.

Data Processing Using Python I
Data Processing Using Python II
CODE - CSE298, CSE299
CREDIT - 6 (1/1/1/3)
SPECIFICATION- CSE297, CSE298

PURPOSE AND TASKS OF THE COURSE:

The purpose of studying this discipline is to further deepen the knowledge in the data processing tool - the Python language. The course aims to expand the knowledge of the design features of the language, and the development of libraries for working with data in various representations - pandas, numpy, matplotlib. Gaining knowledge, skills and competencies will allow students to prepare for the course - machine learning.

BRIEF DESCRIPTION OF THE COURSE

The course focuses on the mechanisms for working with data, such as: loading, filtering, transforming, analyzing and interpreting data. We study the basic methods of working with matrices and matrix operations based on the NumPy library. We study the data visualization tools MatPlotLib in the form of various types of graphs, allowing to analyze the performed operations, the results of calculations or to understand the nature of the data.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

According to the results of the course, undergraduates will know a wide range of data processing tools in the SciPy library. They will gain knowledge in the field of programming matrix operations and working with data. They will learn to use the tools of loading, filtering, processing, interpreting data. Learn to use effective approaches when writing Python code.

Advanced Heat & Mass Transfer
CODE - CHE719
CREDIT - 4 (1/0/1/2)
SPECIALTY

PURPOSE AND TASKS OF THE COURSE

The main goal of the course is to master the theoretical foundations of technological processes of heat and mass transfer, the general laws of their flow in chemical equipment, mastering generalized methods of modeling and calculating processes using modern IT programs, studying the most common designs of chemical devices and methods of their engineering calculation.

Course objectives: the study of the basics of the theory of heat transfer, industrial methods of supply and removal of heat in chemical equipment; mass transfer processes and devices in systems with a free boundary of the phase separation (absorption, distillation and rectification, extraction); mass transfer processes with a fixed surface contact of the phases (adsorption, drying, ion exchange, dissolution and crystallization); membrane processes chemical technology.

BRIEF DESCRIPTION OF THE COURSE

The course "Advanced Heat & Mass Transfer" provides a presentation of sections: thermal processes: the concept of a temperature field and a temperature gradient. The physical basis of heat transfer in the simplest ways: heat conduction, convection, heat radiation. Thermal Fourier law. Physical basis of convective heat transfer. Heat transfer. Driving force and heat transfer equation. The equation of convective heat transfer in a moving medium. The main criteria for thermal similarity. Heat transfer during forced and natural movement of the coolant, condensation and boiling. Physical basics of heat transfer. Driving force and heat transfer equation. Flow patterns of coolants. Heat balances. Characteristics of the main methods of heating. Designs of heat exchangers. The basic laws of static mass transfer. Balance diagrams. The basic laws of mass transfer kinetics, material balance. The driving force of mass transfer and its calculation. Mass transfer equation, additivity of phase resistances. Diffusion semblance. Determination of the main dimensions of mass transfer apparatus. Mathematical modeling of the main processes of heat and mass transfer in chemical engineering, interaction of chemical transformation processes and transport phenomena at all scale levels, optimization of chemical processes and reactors.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

As a result of studying the discipline, the undergraduate must know the basic laws of heat and mass transfer processes and the principles of their modeling, the basics of calculating devices for carrying out these processes, the theory of physical modeling of chemical technology processes; be able to carry out calculations using experimental and

reference data and modern computer programs; determine the parameters of the best organization of the process in a chemical reactor; possess methods for determining the optimal and rational technological modes of operation of chemical equipment.

Numerical Methods for Engineers and Scientists I
Numerical Methods for Engineers and Scientists I I
CODE - MAT230, MAT231
CREDIT - 4 (1/0/1/2)
SPECIAL MAT229, MAT230

PURPOSE AND TASKS OF THE COURSE

This course is an introduction to numerical methods for differential equations arising from the simulation of physical phenomena in the field of chemical engineering. The goal is to provide an understanding of how the subroutines work, to help the undergraduate to derive maximum benefit from them and provide sufficient background for the effective use of math software.

BRIEF DESCRIPTION OF THE COURSE

An engineer is usually not interested in complex theoretical methods, but rather in solving a model and in a physical understanding that a solution can give. A recent and important tool for achieving this goal is mathematically programmed, reliable computer subroutines for solving mathematical problems. To effectively use the software, you need to know about its capabilities and especially about the limitations. This implies that the user must at least have an intuitive understanding of how the software is designed and implemented. Within this course, numerical methods for differential equations are described, which either illustrate the computational property of interest, or are the basic methods of a computer software package. It is assumed that the master has a basic knowledge of mathematics.

The tasks considered in the course of the course are aimed at imitating industrial mathematics projects.

The course is annual and is designed for two semesters. In the first semester, ordinary differential equations are considered, in the second sect, partial differential equations.

Bioinformatics
CODE - BIO271
CREDIT - 6 (1/1/1/3)
SPECIAL BIO279

PURPOSE AND TASKS OF THE COURSE:

The purpose of the course: the formation of fundamental knowledge and links between molecular biology, the fundamental principles of general chemistry, bioorganic and biological chemistry, genetics and computer science. The study of existing principles, tools and models for the analysis of biological and biochemical data.

Teach how to organize data in such a way that researchers have access to current information and can use it, modify and supplement it. Teach to use software tools for analyzing, interpreting and visualizing data so that they have chemical and biological meaning.

Teach detecting genes in the DNA sequences of various organisms, develop methods for studying the structure and function of new decoded sequences and corresponding structural RNA regions, identify families of related sequences and build models, align similar sequences and reconstruct phylogenetic trees in order to identify evolutionary relationships.

BRIEF DESCRIPTION OF THE COURSE

Bioinformatics is the science of storing, retrieving, organizing, analyzing, interpreting and using biological and biochemical information.

The subject of the discipline are computer-oriented methods for solving information problems in the field of biochemical engineering / technology. It consists of four sections: an introduction to bioinformatics, methods of bioinformatic analysis, information principles in biotechnology and biochemistry, bioinformational Internet resources. The scientific basis of the course consists of molecular biophysics, molecular biology, basic chemistry, bio-organic chemistry and biochemistry, genetics.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

According to the results of the study of this discipline, undergraduates will gain knowledge of the types and formats of biological and biochemical data, the existing international databases of molecular biology and genetics. Learn how to work with existing free distribution software products to process such data. They will be able to apply correct methods and data processing models in solving problems of molecular biology and genetics.

Machine learning for engineers
CODE-CSE296
CREDIT - 4 (1/0/1/2)
SPECIAL

PURPOSE AND TASKS OF THE COURSE

The goal of the course is the development of the necessary theoretical and practical knowledge as well as the acquisition of skills in the application of machine learning in data processing tasks.

The main objectives of the course:

• Consider the main types of machine learning and their tasks
• Learn the theoretical foundations of machine learning
• Examine data classification and clustering methods.
• Acquire practical skills in machine learning.
• Get information on current trends in machine learning

BRIEF DESCRIPTION OF THE COURSE

The course focuses on artificial intelligence, in particular what is known as weak artificial intelligence, or methods and techniques that can help make software smarter and more useful. While early AI focused on creating intelligent machines that mimic human behavior (otherwise known as Strong AI), much of the research and practice of AI today focuses on practical purposes. They include embedding algorithms and AI methods in software to enable them to learn, optimize, and reason.

The first part of the course is focused on the basics of machine learning. Mathematical and algorithmic foundations of controlled (by example or with a teacher) and uncontrolled (without a teacher) training are considered. Some knowledge of linear algebra is necessary to understand this part of the discipline.

The second part examines in detail a number of machine learning algorithms and methods for solving classification problems based on them, these include the nearest neighbors algorithm (kNN or K nearest neighbors), Support Vector Machines machines, Decision Trees, neural networks and etc.

KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

Understand

What are machine learning methods and algorithms and in which cases they should be used?

Know

The main features of machine learning in data processing tasks and the software used for this

Be able to

Use methods of machine learning in practical data processing tasks.

The educational program of scientific and pedagogical magistracy includes - research practice:

The research practice of the undergraduate is conducted in order to familiarize with the latest theoretical, methodological and technological achievements of domestic and foreign science, with modern methods of scientific research, processing and interpretation of experimental data.

Master's research work

Research work in scientific and pedagogical magistracy should:

- Comply with the main issues of the specialty for which the master's thesis is defended;
- be relevant, contain scientific novelty and practical significance;
- be based on modern theoretical, methodical and technological achievements of science and practice;
- be carried out using modern research methods;
- contain research (methodical, practical) sections on the main protected provisions;
- based on international best practices in the relevant field of knowledge.
- be performed using advanced information technologies;
- contain experimental research (methodical, practical) sections on the main protected provisions.

Registration and protection of the master's thesis
CODE – ECA205
Credit – 12

The purpose of the master's thesis is:

Demonstration of the level of scientific / research qualification of a graduate student, the ability to independently conduct a scientific search, testing the ability to solve specific scientific and practical problems, knowledge of the most common methods and techniques for their solution.

SHORT DESCRIPTION

Master's thesis is a final qualifying scientific work, which is a synthesis of the results of an independent study by a graduate student of one of the urgent problems of a particular specialty of the relevant branch of science, which has an internal unity and reflects the progress and results of the development of the chosen topic.

The master thesis is the result of the research / experimental research work of the undergraduate carried out during the entire period of the undergraduate's studies.

The defense of the master's thesis is the final stage of the master's training. The master thesis must meet the following requirements:

- the work should conduct research or solve actual problems in the field of software development;
- the work should be based in identifying important scientific problems and solving them;
- decisions must be scientifically grounded and reliable, have internal unity;
- The dissertation must be written alone;

Application 1

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РЕЦЕНЗИЯ

на образовательную программу Магистратуры
(Профильная магистратура, срок обучения 2 года
Магистр технических наук

« Вычислительные процессы в химической и биохимической инженерии» (Computation in Chemical and Biochemical Engineering)

на базе нижеследующих специальностей утратившего силу Классификатора специальностей:

6M070100 - Биотехнология

6M060800 - Экология

6M072000 - ХТНВ

6M072100 - ХТОВ

Рецензируемая образовательная программа (ОП) «Вычислительные процессы в химической и биохимической инженерии» направления подготовки «7М071 - Инженерия и инженерное дело» (Магистр технических наук) Национальной рамки квалификации представляет собой описание образовательной подготовки специалистов в области образовательной программы «Вычислительные процессы в химической и биохимической инженерии», разработанной на основе Государственного общеобязательного стандарта высшего образования Республики Казахстан (Магистратура).

Содержание и структура ОП по направлению подготовки «7М071 — Инженерия и инженерное дело» (Профильная 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 и умений, навыков, полный перечень общечеловеческих, социально-этических, базовых, профессиональных и специальных компетенций.

Структура Учебного плана ОП «Вычислительные процессы в химической и биохимической инженерии» логична и последовательна. Дисциплины учебного плана раскрывают сущность актуальных на сегодняшний день проблем. Общая трудоёмкость программы составляет 120 академических кредитов при сроке обучения 2 года.

Сильными сторонами рецензируемой ОП являются:

- приобретение выпускниками профессионально-ориентированных навыков и умений, что позволит удовлетворить потребности промышленности и науки в химической и биохимической инженерии с использованием искусственного интеллекта;
- возможность обучающимися химического и биохимического направлений подготовки освоить фундаментальные основы машинного обучения и программирования, что научит организовывать огромный объем данных таким образом, чтобы исследователи имели доступ к текущей информации, могли ее

использовать и модифицировать. Элементы машинного обучения для биохимических инженерных задач помогут сделать программное обеспечение умнее и полезнее для правильной интерпретации массива данных, способствуя и повышая востребованность выпускников программы на рынке труда.

На основании вышесказанного считаю, что образовательная программа «Вычислительные процессы в химической и биохимической инженерии» направленияподготовки «7М071 — Инженерия и инженерное дело» (Профильная Магистратура, срок обучения 2 года) может быть рекомендована для внедрения в учебный процесс.

Президент Международной Академии
Репродуктологии, член-корр. НАН РК;
Ген.директор МКЦР «PERSONA»
Проф. **В.Н.Локшин**

Content