Institute of Automation and Information Technology
Department of Higher Mathematics and Modeling

EDUCATIONAL PROGRAM

7M06110 - Digital modeling

code and name of the educational program

Code and Classification of Education Area: 7M06
Information and Communication Technology
Code and classification of areas of training: 7M061
Information and Communication Technologies
Group of educational programs: M094
Information Technology
NRC level: 7M
OPC level: 7
Study period: 2 years
Credit volume: 120

Almaty 2025

NAO "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY
K.I. SATPAYEV

Educational program 7M06110 – «Digital modeling» approved at the meeting of the Academic Council of KazNRTU named after K.I. Satpayev.
Protocol No.10 of «06» March 2025 year.

Considered and recommended for approval at the meeting of the Educational-Methodical Council of KazNRTU named after K.I. Satpayev.
Protocol No. 3 of «20» December 2024 year.

Educational program 7M06110 – «Digital modeling» developed by the academic committee for the direction 7M061 «Information and communication technologies».

Name and surname	Degree/ academic title	Position	Place of work	Sign
Chairman of the Academic Committee:				
Tulesheva Gulnara Alipovna	Candidate of Physical and Mathematical Sciences, associate professor	Head of Department	KazNRTU named after K.I. Satpayev	
Academic Committee members:				
Sakabekov Auzhan Sakabekovich	Doctor of Physical and Mathematical Sciences, professor	Professor	KazNRTU named after K.I. Satpayev	
Alimzhanova Zhanna Muratbekovna	Candidate of Physical and Mathematical Sciences	Associate Professor	KazNRTU named after K.I. Satpayev	
Lukpanova Lazzat Khamitovna		Senior Lecturer	KazNRTU named after K.I. Satpayev	
Azhibekova Aliya Saparbekovna		Senior Lecturer	KazNRTU named after K.I. Satpayev	
Employers:				
Viktor Valerievich Verbovskiy	Doctor of Physical and Mathematical Sciences, professor	Deputy General Director for Science	Institute of Mathematics and Mathematical Modeling	
Students				
Zharykov Malik Nurlanovich		Master's student	KazNRTU named after K.I. Satpayev	

F KazNITU 703-05 Educational program

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List of abbreviations and designations

EP - educational program,
LO - learning outcomes,
DG - Digital modeling,
IEP - individual educational plan

1. Description of the educational program

The educational program 7M06110 – «Digital modeling» is aimed at training masters who can independently solve a wide range of engineering problems using modern analytical, numerical and experimental methods and methods of mathematical and computer modeling.

The educational program is designed to train specialists in mathematical and computer modeling of various processes and complex systems, to master competitive knowledge and the ability to apply them to create new methods and knowledge in mathematical and computer modeling of three-dimensional objects, and to solve applied problems arising in physics, chemistry, biology, economics, etc. The specialists will also be able to model various problems arising in theoretical computer science.

The program aims to train highly qualified specialists in mathematical computer modeling with innovative problem-solving skills in their area of expertise. Graduate students will also apply their knowledge to the analysis of various problems arising in physics, economics, finance, biology, computer science, and engineering.

The curriculum of the educational program 7M06110 – «Digital modeling» was developed taking into account the curricula of the educational program "Computational and mathematical engineering" of the master's degree program of famous research and engineering universities of the world, such as *Stanford University,* Universitat Obertade Catalunya and the educational program "Mathematical Modeling, Programming and Artificial Intelligence" of the master's degree program at St Petersburg State University. The curriculum is fully consistent with modern trends in the development of mathematical and computer modeling, information technology and the needs of the economy and science of Kazakhstan.

The educational program consists of core courses in mathematical modeling and coursework in programming algorithm design and construction, extensive and in-depth electives, and seminars. The core courses provide instruction in mathematical and computational tools applicable to a wide range of scientific, industrial, and engineering disciplines, and expand and deepen elective courses. The computer modeling requirement ensures mastery of scientific methods and professional skills. Seminars highlight new research in engineering and science.

The program is notable for the fact that it combines information and technological fundamentals with practical modeling capabilities. In the process of training, special attention is paid to the acquisition by graduates of profound knowledge in relevant areas, the ability to develop mathematical, physical and computer models of engineering problems and mastering the skills of independent research. The acquired knowledge and experience in computer modeling and research using modern computational and information technologies will allow graduates to quickly integrate into the work process, quite easily master a wide range of new technologies.

Graduates get practical training in such companies of Kazakhstan as JSC Kazatomprom, JSC KazMunayGas, JSC KazdorNII, the Institute of Mathematics and Mathematical Modeling, etc. Under the program of academic mobility, undergraduates have the opportunity to undertake internships in leading engineering universities in Europe and Russia.

All levels of training are taught by highly qualified faculty, including graduates of universities in Europe, Russia, and other countries.

Graduates may choose a variety of career paths. Some may go directly into industry as practicing engineers, while others may pursue doctoral studies in mathematical and computer modeling. Graduates may be employed by banks and insurance companies, consulting firms, educational and research institutions, and other companies that use mathematical modeling, computer modeling, and applied mathematics in their work.

The educational program of the master's degree "Digital Modeling" is the second level of qualification of the three-tier system of higher education, it lays the foundation for doctoral programs.

2. Goal and objectives of the educational program

Purpose of the EP: The purpose of the educational program "Digital Modeling" is to train highly qualified specialists with relevant competencies of masters in the field of mathematical and computer modeling, creation and use of new effective methods of information processing, mathematical models of complex processes and objects, development and application of modern mathematical methods and software. As a result of graduation, graduates will be able to work as specialists in the field of technology construction and research of mathematical models of a wide variety of systems and processes, allowing to predict the evolution of the studied systems, and thereby verify the correctness of the decisions taken.

EP Objectives: Objectives of the educational program:

- training a competitive generation of technical masters in mathematical and computer modeling for the labor market, proactive, able to work in a team, with high personal and professional competencies;
- integration of educational and scientific activities;
- establishing partnerships with leading universities in the near and far abroad in order to improve the quality of education;
- expansion of contacts with customers of educational services, employers in order to determine the requirements for the quality of training of masters, courses, seminars, workshops, internships, practical training.

The content of the educational program " Digital Modeling " is implemented in accordance with the credit technology of education and is carried out in the state, Russian and English languages. The educational program will allow the implementation of the principles of the Bologna Process. Based on the choice and independent planning of the sequence of disciplines by master students, they independently form the IEP for each semester according to the Working curriculum and the Catalogue of elective disciplines. The volume of mathematical, natural

science, basic and language disciplines is increased in the educational program.

Graduates undergo practical training in commercial, state and departmental structures. Under the program of academic mobility the best students have the opportunity to study at leading foreign universities in the relevant program.

3. Requirements for assessing the learning outcomes of the educational program

List of competencies

General competencies

- English language skills for: search for scientific and technical information; work with scientific and technical literature; oral and written communication with a native speaker on a professional topic and in real-life situations.
- Mastery of critical systems thinking, transdisciplinarity, and cross-functionality.
- ICT competencies, the ability to develop software using algorithmic languages.
- Possess the skills of: independent learning; deepening your knowledge; being open to new information; thinking systematically and exercising your own judgment.
- The ability to be tolerant of another nationality, race, religion, culture; the ability to engage in intercultural dialogue.
- Mastery of communication skills, ability to cooperate and work in a team.
- Ability to work in a mode of high uncertainty and rapidly changing task conditions; work with customer requests.
- The possession of a broad social, political and professional outlook; ability to use data from various sources and special literature, analyze and critically evaluate historical facts and events.
- Mastery of the basics of entrepreneurship and business economics, readiness for social mobility.

Professional competencies

- Mastery of fundamental knowledge of mathematics, physics, and scientific principles and the ability to use them in solving engineering problems.
- Ability to independently develop adequate physical and mathematical models, computer modeling algorithms.
- Ability to use mathematical and computer models of technological processes for independent research.
- Ability to develop new mathematical models of information technology.
- Ability to work with high-tech laboratory and research equipment.
- Mastery of algorithmic languages and programming technology using object-oriented programming of mathematical and numerical models of physical processes and engineering problems.

- Mastery of mathematical modeling and machine learning methods and computer modeling skills to work as a designer in mechanical engineering, energy, transportation, chemical production.
- Possession of methodology: system analysis; design and decision making in complex and professional situations; ways of communication and reconciliation of points of view; execution and presentation of analytical and project documentation.

Learning outcomes

LO 1 - Know the formulation of classification, clustering, forecasting problems; know algorithms and methods of deep learning. Be able to work with architectures that include open deep learning libraries, compare the results of theory and experiment, and isolate their formulation for machine learning from practical problems. Be able to train personnel to work with an artificial intelligence system.
LO 2 - Apply deep knowledge in the field of numerical methods and solving applied problems. Develop various types of mathematical models and simulations, including dynamical systems, statistical models, differential equations, game theoretic models (mathematical calculus, ordinary differential equations, numerical methods, statistics, etc.) and a practical modeling course.
LO 3 - Be able to apply theoretical knowledge in solving mathematical and other applied problems; analyze problems and build a mathematical model. Demonstrate skills in solving typical problems of the calculus of variations.
LO 4 - Apply methods of mathematical and computer modeling to solve scientific, applied, industrial and technological problems using professional software, computer graphics, visualization and development of own software packages.
LO 5 - Be able to use basic knowledge in the field of financial mathematics, number theory applications, data management and analysis. Evaluate the possibilities (limitations) of mathematical modeling for problems in the financial and/or insurance industry, develop powerful mathematical models and implement them in practice.
LO 6 - Search and study scientific and technical information on mathematical and computer modeling and be able to express written and oral opinions on the topic in Kazakh (Russian) and English.
LO 7 - Know the basics of management psychology and the basics of pedagogy of higher education, have teaching skills, know and critically analyze sources on the history and philosophy of science.
LO 8 - Know the fundamental concepts of information theory and their relationship with the fundamental concepts of cybernetics; methods used for mathematical modeling of information sources and communication channels; areas of application of the studied methods. Be able to determine the parameters of information sources and communication channels; find the most efficient coding methods under specific conditions; use computer technology to solve the above problems.
LO 9 - Know how to analyze fuzzy production systems and neural networks; know the basics of fuzzy logic, neural and hybrid networks; be able to develop and apply

mathematical methods to solve problems of scientific and design and technological activities.
LO 10 - To be able to design software to solve the problems of the oil and gas processing industry in general. Be able to use specialized software to manage project development, assign tasks to system analysts, programmers and other specialists.
LO 11 - Know the architecture features, principles of organizing hybrid computing systems based on graphics processors, multi-core systems, classes of tasks suitable for efficient execution on graphics processors.
LO 12 - Be able to implement parallel data processing algorithms in high-level programming languages using libraries; solve problems on parallel computing systems.
LO 13 - To be able to put into practice modern solutions in the field of computer modeling; evaluate the prospects and possibilities of applying modern developments to solve modeling problems in porous media of oil fields.
LO 14 - Know the laws of fluid movement in porous media. Be able to create hydrodynamic models of hydrocarbon fields, run them for calculations and analyze the results.
LO 15 - To have in-depth knowledge and competencies in the development and implementation of sustainable development strategies at various levels, ranging from global environmental challenges such as climate change, biodiversity loss and natural resource depletion, to socio-economic aspects including inequality, health and education.
LO 16 - Be able to develop educational and methodological materials in the disciplines taught, taking into account the integration of education, science and innovation; be able to organize and conduct training sessions taking into account the principles of student-centered learning and assessment.

Learning strategy

The strategy of the educational program "Digital modeling" is focused on training highly qualified specialists with fundamental knowledge in the fields of natural science, engineering mechanics and computer modeling to work in the field of high technology, taking into account current trends in the development of science in general and mathematical modeling in particular.

In the process of training special attention is paid to learning mathematical, numerical and computer modeling methods, proven software for solving and researching a wide range of engineering problems by masters. To implement this goal, the structure of classes of almost all specialized disciplines includes both laboratory and practical classes, i.e. theoretical knowledge of students is firmly consolidated by the skills of their practical application.

In the course of graduates' dissertations in the educational program, the main attention is paid to imparting to graduates the skills to develop independently or in teams physical or virtual models of complex mechanical, physical and biochemical processes and phenomena, to create computer codes or apply modern software for their research.

Mastery of fundamental knowledge in a variety of fields and computer modeling skills will allow graduates to integrate relatively easily into the workflow of almost any area of industry and learn a wide range of new technologies fairly quickly.

4. Passport of the educational program

4.1 General information

№	Field name	Note
1	Code and classification of the field of education	7M06 Information and Communication Technology
2	Code and classification of training areas	7M061 Information and Communication Technology
3	Group of educational programs	M094 Information Technology
4	Name of educational program	7M06110 - Digital modeling
5	Brief description of the educational program	The educational program 7M06110 - "Digital modeling" is aimed at training masters who can independently solve a wide range of engineering problems using modern analytical, numerical and experimental methods and methods of mathematical and computer modeling. The educational program is designed to train specialists in mathematical and computer modeling of various processes and complex systems, to master competitive knowledge and the ability to apply them to create new methods and knowledge in mathematical and computer modeling of three-dimensional objects, and to solve applied problems arising in physics, chemistry, biology, economics, etc. The specialists will also be able to model various problems arising in theoretical computer science. The program aims to train highly qualified specialists in mathematical computer modeling with innovative problem-solving skills in their area of expertise. Graduate students will also apply their knowledge to the analysis of various problems arising in physics, economics, finance, biology, computer science, and engineering. The curriculum of the educational program "7M06110 - Digital modeling" was developed taking into account the curricula of the educational program "Computational and mathematical engineering" of the master's degree program of famous research and engineering universities of the world, such as Stanford University, Universitat Obertade Catalunya and the educational program "Mathematical Modeling, Programming and Artificial Intelligence" of the master's degree program at St Petersburg State University. The curriculum is fully consistent with modern trends in the development of mathematical and computer modeling,

		information technology and the needs of the economy and science of Kazakhstan. The educational program consists of core courses in mathematical modeling and coursework in programming algorithm design and construction, extensive and in-depth electives, and seminars. The core courses provide instruction in mathematical and computational tools applicable to a wide range of scientific, industrial, and engineering disciplines, and expand and deepen elective courses. The computer modeling requirement ensures mastery of scientific methods and professional skills. Seminars highlight new research in engineering and science. All levels of training are taught by highly qualified faculty, including graduates of universities in Europe, Russia, and other countries. Graduates may choose a variety of career paths. Some may go directly into industry as practicing engineers, while others may pursue doctoral studies in mathematical and computer modeling. The educational program of the master's degree "Digital modeling" is the second level of qualification of the three-tier system of higher education; it lays the foundation for doctoral programs.
6	Purpose of the EP	The purpose of the educational program "Digital modeling" is to train highly qualified personnel with relevant competencies of masters in the field of mathematical and computer modeling, creation and use of new effective methods of information processing, mathematical models of complex processes and objects, development and application of modern mathematical methods and software. As a result of graduation, graduates will be able to work as specialists in the field of technology construction and research of mathematical models of a wide variety of systems and processes, allowing to predict the evolution of the studied systems, and thereby verify the correctness of the decisions taken.
7	Type of EP	Master's Degree
8	NRC level	7M
9	Level on OCR	7
10	Distinctive features of the EP	The program is notable for the fact that it combines information-technology fundamentals with practical modeling capabilities. In the process of training, special attention is paid to the acquisition by graduates of profound knowledge in relevant areas, the ability to develop mathematical, physical and computer models of engineering problems and mastering the skills of independent research. The acquired knowledge and experience in computer modeling and research using modern computational and information technologies will allow graduates to quickly integrate into the work process, quite easily master a wide range of new technologies.

11	List of competencies of the educational program:	General competencies • English language skills for: search for scientific and technical information; work with scientific and technical literature; oral and written communication with a native speaker on a professional topic and in real-life situations. • Mastery of critical systems thinking, transdisciplinarity, and cross-functionality. • ICT competencies, the ability to develop software using algorithmic languages. • Possess the skills of independent learning; deepening your knowledge; being open to new information; thinking systematically and exercising your own judgment. • The ability to be tolerant of another nationality, race, religion, culture; the ability to engage in intercultural dialogue. • Mastery of communication skills, ability to cooperate and work in a team. • Ability to work in a mode of high uncertainty and rapidly changing task conditions; work with customer requests. • The possession of a broad social, political and professional outlook; ability to use data from various sources and special literature, analyze and critically evaluate historical facts and events. • Mastery of the basics of entrepreneurship and business economics, readiness for social mobility. Professional competencies • Mastery of fundamental knowledge of mathematics, physics, and scientific principles and the ability to use them in solving engineering problems. • Ability to independently develop adequate physical and mathematical models, computer modeling algorithms. • Ability to use mathematical and computer models of technological processes for independent research. • Ability to develop new mathematical models of information technology. • Ability to work with high-tech laboratory and research equipment. • Mastery of algorithmic languages and programming technology using object-oriented programming of mathematical and numerical models of physical processes and engineering problems. • Mastery of mathematical modeling and machine learning methods and computer modeling skills to work as a designer in mechanical engineering, energy, transportation, chemical production. Possession of methodology: system analysis; design and decision making in complex and professional situations; ways of communication and reconciliation of points of view; execution and presentation of analytical and project documentation.
12	Learning outcomes of the	LO 1 - Know the formulation of classification, clustering,

	educational program:	forecasting problems; know algorithms and methods of deep learning. Be able to work with architectures that include open deep learning libraries, compare the results of theory and experiment, and isolate their formulation for machine learning from practical problems. Be able to train personnel to work with an artificial intelligence system. LO 2 - Apply deep knowledge in the field of numerical methods and solving applied problems. Develop various types of mathematical models and simulations, including dynamical systems, statistical models, differential equations, game theoretic models (mathematical calculus, ordinary differential equations, numerical methods, statistics, etc.) and a practical modeling course. LO 3 - Be able to apply theoretical knowledge in solving mathematical and other applied problems; analyze problems and build a mathematical model. Demonstrate skills in solving typical problems of the calculus of variations. LO 4 - Apply methods of mathematical and computer modeling to solve scientific, applied, industrial and technological problems using professional software, computer graphics, visualization and development of own software packages. LO 5 - Be able to use basic knowledge in the field of financial mathematics, number theory applications, data management and analysis. Evaluate the possibilities (limitations) of mathematical modeling for problems in the financial and/or insurance industry, develop powerful mathematical models and implement them in practice. LO 6 - Search and study scientific and technical information on mathematical and computer modeling and be able to express written and oral opinions on the topic in Kazakh (Russian) and English. LO 7 - Know the basics of management psychology and the basics of pedagogy of higher education, have teaching skills, know and critically analyze sources on the history and philosophy of science. LO 8 - Know the fundamental concepts of information theory and their relationship with the fundamental concepts of cybernetics; methods used for mathematical modeling of information sources and communication channels; areas of application of the studied methods. Be able to determine the parameters of information sources and communication channels; find the most efficient coding methods under specific conditions; use computer technology to solve the above problems. LO 9 - Know how to analyze fuzzy production systems and neural networks; know the basics of fuzzy logic, neural and hybrid networks; be able to develop and apply mathematical methods to solve problems of scientific and design and technological activities. LO 10 - To be able to design software to solve the problems

		of the oil and gas processing industry in general. Be able to use specialized software to manage project development, assign tasks to system analysts, programmers and other specialists. LO 11 - Know the architecture features, principles of organizing hybrid computing systems based on graphics processors, multi-core systems, classes of tasks suitable for efficient execution on graphics processors. LO 12 - Be able to implement parallel data processing algorithms in high-level programming languages using libraries; solve problems on parallel computing systems. LO 13 - To be able to put into practice modern solutions in the field of computer modeling; evaluate the prospects and possibilities of applying modern developments to solve modeling problems in porous media of oil fields. LO 14 - Know the laws of fluid movement in porous media. Be able to create hydrodynamic models of hydrocarbon fields, run them for calculations and analyze the results. LO 15 - To have in-depth knowledge and competencies in the development and implementation of sustainable development strategies at various levels, ranging from global environmental challenges such as climate change, biodiversity loss and natural resource depletion, to socio-economic aspects including inequality, health and education. LO 16 - Be able to develop educational and methodological materials in the disciplines taught, taking into account the integration of education, science and innovation; be able to organize and conduct training sessions taking into account the principles of student-centered learning and assessment.
13	Form of training	Full-time
14	Duration of training	2 years
15	Volume of credits	120
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree	Master
18	Developer(s) and authors:	Azhibekova A.S., Lukpanova L.Kh.

4.2 Interrelation of achievability of the learning outcomes of the educational program and academic disciplines

№	Name of discipline	Brief description of the discipline	Number of credits	Formable learning outcomes (codes)															
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11	LO12	LO13	LO14	LO15	LO16
Module of basic training University component																			
1	Foreign language (professional)	The course is aimed at studying the main problems of scientific knowledge in the context of its historical development and philosophical understanding, the evolution of scientific theories, principles and methods of scientific research in the historical construction of scientific paintings of the world. The discipline will help to master the skills of developing critical and constructive scientific thinking based on research on the history and philosophy of science. At the end of the course, undergraduates will learn to analyze the ideological and methodological problems of science and engineering and technical activities in building Kazakhstan's science and the prospects for its development.	3						V										

2	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.	3							v								
3	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3							v							v	v

4	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.	3							v									
Module of basic training Component of choice																			
5	Calculus of variations	Purpose: Increasing the level of professional competence in solving optimization problems. Content: studying the basic methods for solving classical variational problems, developing skills in abstract mathematical thinking and the ability to apply it in specific problems, improving mathematical culture.	5			v													

6	Geometric and computer modeling.	Purpose: Formation of basic theoretical concepts underlying computer graphics, study and mastery of methods and algorithms used in the development of computer graphics. Content: peculiarities of perception of raster images; methods of quantization and sampling of images; knowledge of software structure and implementation of computer graphics algorithms; geometric modeling methods; graphical data models; geometric modeling and its tasks; the use of interactive graphic systems for creating and editing images and drawings.	5				v									v			
7	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5						v									v	v

8	Information technology in the oil and gas industry	Purpose: familiarization with existing achievements of information technologies in the context of their use in the oil and gas industry. Content: knowledge of the implementation, use and development prospects of IT at the stages of exploration, production, transportation and processing of oil and gas.	5										v			v			
9	Machine learning methods	Objectives of the discipline: to form theoretical knowledge on the basics of machine learning for the construction of formal mathematical models and interpretation of modeling results; to develop skills in the practical application of machine learning methods for the construction of formal mathematical models and interpretation of modeling results in solving applied problems in various applied fields.	5	v											v				
10	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international	5															v	

		standards and best practices. Cases and examples of successful sustainable development strategies are included.																	
11	Numerical methods for solving applied problems	Purpose: mastering practical skills in numerical solution of various applied problems using mathematical methods. Content: practical aspects of the mathematical formulation of applied problems, selection and numerical implementation of mathematical methods for solving them are considered. Particular attention is paid to the need to take into account the specifics of the problems under study, both when formulating applied problems and when developing methods for their numerical analysis.	5		v														
12	Python for deep machine learning	Objectives: familiarization with modern approaches to the construction, training and use of recognition and classification systems based on machine learning methods, the formation of professional competencies among undergraduates. The content is aimed at mastering algorithms and methods of deep learning – a special section in machine learning; the formation of skills and abilities in solving practical problems using deep learning	5	v															

		methods.																
Module of professional activity University component																		
13	Geostatistics	Purpose: mastering the theoretical foundations of geostatistics and applying them to analyze geological exploration data obtained during exploration of solid minerals. Content: application of mathematical methods in geology and geostatistical techniques for assessing resources and reserves of solid mineral deposits. Features of the current stage of development of computer technologies and modern possibilities of using mathematical methods. Features of the use of statistical techniques in solving geological problems.	5		v													
14	Interfaces for multi-core systems	Objectives: formation of theoretical knowledge and practical skills in the use of modern computing systems, software tools for solving a wide range of tasks in various fields. The course examines the features of the architecture of GPUs, the principles of the organization of hybrid computing systems based on GPUs, classes of tasks suitable for efficient execution on GPUs.	5				v							v				
15	Models of financial mathematics	Purpose: study of mathematical models and methods in various sections of financial economics.	5					v										v	

		Content: the main interrelated parameters of any credit or commercial operation, knowledge of the quantitative relationships between these parameters and obtaining certain financial results based on them.																	
16	Modeling in porous media	Purpose: acquiring knowledge in the field of modern computer modeling technologies in the oil and gas industry. Content: understanding and the possibility of applying theoretical knowledge in the professional activities of an engineer when constructing computer models of deposits that reflect the most realistic picture of the deposit.	5													v	v		
17	Fuzzy and neural network modeling	Purpose: acquiring knowledge in the theory of fuzzy sets, mastering fuzzy logic methods and the theory of neural networks, which form new approaches to the analysis and modeling of practical problems arising in the study of computer systems and networks. Content: basic concepts of the theory of fuzzy sets, fuzzy mathematics; basic classes and principles of training neural networks, both traditional and based on fuzzy logic; practical skills in using neural network modeling programs to solve practical problems.	4									v							
18	Concept of cloud technology	The purpose of the course is to acquire knowledge and skills on the basics of parallel programming	5												v				

		and parallel data processing. Objectives of the course: to teach methods of parallel information processing and representation of parallel algorithms; to form means of specification of parallel processes; to teach parallel programming languages; to master methods of automatic parallelization of sequential algorithms.																	
19	Applied information theory	The purpose of mastering: formation of ideas about information theory as a universal language of science, a means of modeling phenomena and processes; development of logical thinking, spatial imagination, algorithmic culture, critical thinking at the level necessary for future professional activity, continuing education, self-education; mastering theoretical knowledge and skills necessary in everyday life to study related disciplines professional cycle.	5								v								
20	Digital hydrodynamic modeling	Purpose: to become familiar with the theoretical foundations of digital hydrodynamic modeling of hydrocarbon fields and to develop basic practical skills in constructing hydrodynamic models. Content: physical principles, implementation technology and methods for interpreting the results of modern complex hydrodynamic testing of wells, justification of geological	5													v	v		

		and technical activities in the medium and long-term development prospects, as well as optimization of development systems for depleted fields using modern optimization technologies.																	
21	Numerical solution of the fluid motion equation by the finite difference method	Purpose: study and practical mastery of the main stages of mathematical modeling of hydrodynamic processes. Content: statement of the problem, selection of a mathematical model and formulation of an initial boundary value problem, construction of a grid model of a region, selection or development of grid approximations, finite difference method, finite volume and finite element method.	5		v														
22	Machine Learning & Deep Learning	The course focuses on deep learning models. As a field within machine learning, deep learning models exemplify the quantitative-qualitative transition. New models and their properties require a separate study and practice of setting the metaparameters of such models. This course covers deep learning fundamentals, neural networks, convolutional networks, RNN, LSTM, Adam, Dropout, BatchNorm, Xavier/He initializations.	5	v														v	