ALIKHAN BOKEIKHAN UNIVERSITY

MODULE EDUCATIONAL PROGRAM
6B06103-ARTIFICIAL INTELLIGENCE ENGINEERING AND BLOCKCHAIN

Семей, 2024

Developed by the Department of "Information and Technical Sciences"

Discussed and approved at the meeting of the Department of Information and Technical Sciences
Protocol №6 of February 08, 2024

Reviewed and recommended for re-approval at a meeting of the Academic Quality Council of the Faculty
Protocol №1 of February 21, 2024

Reviewed and recommended for re-approval at a meeting of the educational and Methodological Council of the University
Protocol №5 of May 28, 2024

TABLE OF CONTENTS

1. Explanatory note

The modular educational program (MEP) is compiled on the basis of regulatory documents of the Ministry of Education and Science of the Republic of Kazakhstan and internal regulatory documents of Alikhan Bokeikhan University:

- The State mandatory standard of Higher Education, approved by Order No. 2 of the Minister of Science and Higher Education of the Republic of Kazakhstan dated 20.07.2022.
- Rules for the organization of the educational process on credit technology of education, approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated 20.04.2011 No.152;
- Standard rules of activity of organizations of higher and (or) postgraduate education, approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No.595;
- Structure of the modular educational program.

Professional standard:

- «Development of artificial intelligence applications», approved by the Deputy Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" dated 05.12.2022 No.222.
- Atlas of new professions - Engineer-developer of artificial neural networks.

The MOS is designed as a set of sequential training modules for the entire period of study and is aimed at mastering the competencies necessary for awarding a bachelor's degree in information and communication technologies under the educational program «6B06103-Artificial Intelligence Engineering and Blockchain».

The modules of the OOD block (56 academic credits in total) include disciplines common to all educational programs, during the study of which the graduate must master the following competencies:general education.

The DB block includes disciplines of the university component (VC) – 40 academic credits and elective components (CV) - 72 academic credits. Modules of these disciplines form a set of competencies: basic and professional

The PD block includes disciplines of the university component (VC) -22 academic credits and elective components (CV) - 42 academic credits. Modules of these disciplines allow you to form a complex of special and professional competencies acquired by a graduate.

The criterion for the completion of the educational process is the student's mastering of at least 240 credits, including at least 232 academic credits of theoretical training and 8 credits of final certification. The MOS consists of 19 modules that ensure the achievement of the set goals.

The modular educational program «6B06103-Artificial Intelligence Engineering and Blockchain» was developed jointly with the partner university "Technical University-Sofia".

The partner of the educational program is LLP «Abai IT-Valley».

During the development of the modular educational program, the wishes and recommendations of potential employers were taken into account, aimed at the formation of professional competencies that meet the requirements of the labor market (round table with employers «Employer – Higher education institution – Future specialist» dated 06.02.2024 года)

Social partners who took part in the discussion of the MOS: Aidana Kaskyrbek – Director and founder of the «Blockchain Center»; Duisenbayeva A.K. - Head and instructor of «Cisco Networking Academy»; Turlybaev R.K. - regional representative of JSC «National Information Technologies» of the Abai region, Kamelkhanov D.B. – Regional representative of Semey city, LLP «DAMU Information Technology Development Center».

The purpose of the modular educational program «6B06103-Artificial Intelligence Engineering and Blockchain» - training of qualified specialists with deep knowledge and skills in the field of artificial intelligence and blockchain, who are able to apply these technologies for innovation, development and solving complex problems in various fields of activity.

Expected results of the educational program «6B06103-6B06103-Artificial Intelligence Engineering and Blockchain»:

ON1 - Demonstrate knowledge about the idea of a modern rule of law to instill entrepreneurial skills, leadership, and receptivity to innovation based on scientific research in compliance with the principles of academic integrity, as well as ensuring safety standards.

ON2 - Demonstrate oral and written professional communication skills in Kazakh, Russian and English. Demonstrate the skills of reading and translating professional texts from Kazakh, Russian and English. To study the preparation of business documentation, reports, reviews in the state and foreign languages. Apply language skills to solve professional problems in a multicultural environment.

ON3 - To master the basic understanding of programming concepts, to develop the ability to develop programs in Python and GO languages, to perform system programming. Demonstrate skills in analyzing and solving problems related to both programming and system programming. To train efficiency in working in a team of software developers and system programmers.

ON4 - To study the basics of physics, apply its principles in the development of microcontroller and microprocessor systems. Demonstrate skills in working with "IoT" and creating distributed control systems. Apply knowledge and skills to solve specific technical problems.

ON5 - To apply mathematical methods to solve problems of artificial intelligence and blockchain, to develop logical and abstract thinking, to form skills of practical application of mathematical knowledge, to apply knowledge in the field of artificial intelligence, data analysis and blockchain in practice.

ON6 - Demonstrate skills in developing user interfaces (Frontend) using modern web technologies, be able to create a backend with basic principles and tools, analyze the principles of Web3 and decentralized applications, be able to program in PHP, develop the principles of dynamic web applications and interaction with databases. Analyze frequent changes to the requirements of web development technology, apply the knowledge gained in creating modern and innovative web applications.

ON7 - Describe the basic principles of computer architecture structures, be able to design and create efficient and reliable computer and communication systems using modern technologies and tools; gain software development skills using modern tools and learn the principles of UI/UX design to create user-friendly and attractive user interfaces.

ON8 - To analyze the theory of information and the basic principles of information processing and transmission in information systems. Master the skills of designing, developing and managing information technologies, create and be able to support network architectures taking into account security and data protection. To study protocols and architectures of network communications with enhanced security, encryption, authentication and intrusion protection mechanisms. Demonstrate the ability to apply their knowledge and skills in practical situations and make information technology decisions, taking into account aspects of security and data protection.

ON9 - Integrate the basic principles and methods of information protection and information security, study modern threats and methods of their prevention and detection; be able to use artificial intelligence to analyze and detect threats in information systems, as well as to develop and apply innovative protection methods; understand the basics of cryptography and apply cryptographic methods to ensure confidentiality and data integrity; demonstrate skills in working with cloud technologies and understanding their role in ensuring the security of information systems; apply Data Science skills, the ability to work with data, analyze and extract information to support decision-making in the field of information security.

ON10 - Analyze the principles of the blockchain technology concept, principles of decentralization, reliability and security; study the basics of databases and methods of their application in the context of blockchain systems; develop decentralized applications using the Ethereum, Web3 and Truffle development environments, and demonstrate skills in developing smart contracts and interacting with the blockchain network.

ON11 - To apply the basic principles of the algorithm of neural networks and their applications in various fields such as computer vision, natural language processing and automatic decision making; to develop artificial neural networks using various architectures and learning algorithms; to study the basics of artificial intelligence and its applications, the principles of machine learning, deep learning and solving problems of classification, regression and clusterization.

ON12 - Evaluate modern Java programming methods and tools and .NET, allowing you to develop high-quality software for various platforms and tasks; be able to design and develop 3D games, describe the principles of game system architecture, create graphic effects and implement game logic; demonstrate multimedia design skills, create and edit graphics, audio and video visualization, to develop interfaces, advertising materials and media projects.

ON13 - To study the basic concepts and methods of using data in machine learning, data collection, preprocessing, visualization and analysis; demonstrate skills in applying various machine learning algorithms to solve classification, regression and clustering problems; be able to use the Azure machinelearning platform and the Azure cognitive service to develop and deploy machine learning models, pattern recognition, natural language processing and text analysis.

ON14 - Evaluate data mining methods and tools in the context of blockchain, allowing you to extract valuable information from blockchain data and make informed decisions; analyze data using various statistical and machine learning methods for knowledge extraction and forecasting; demonstrate skills in developing and deploying smart contracts on the Ethereum platform, describe blockchain architectures and blockchain applicationstechnologies for creating innovative business models.

In order to create special conditions for people with special educational needs to receive education, the graduate's competence model is complemented by professional competencies that ensure the adaptive nature of the main educational program. To this end, courses for the formation of the ability of people with special educational needs to successfully socialize in society and actively adapt to the labor market, taking into account the characteristics of the disease, are introduced into the catalog of courses of the additional educational program "Minor".

2. Graduate competence model

As a result of mastering the modular educational program 6B06103-Artificial Intelligence Engineering and blockchain, the graduate must have the following competencies:

Competencies of general education

- to use solid knowledge about blockchain technologies, including the principles of distributed registries, consensus algorithms, cryptography, smart contracts and decentralized applications (DApps). The ability to analyze and evaluate various blockchain platforms, their capabilities and limitations;
- apply the programming skills necessary to create smart contracts and develop dApps. It includes knowledge of programming languages used in popular blockchain platforms such as Solidity for Ethereum, as well as an understanding of security standards and best practices in development;
- to design an understanding of how blockchain can add value in different industries such as finance, logistics, healthcare, and law, as well as knowledge about current trends and innovations in the field of blockchain;

- aimed at forming the ideological, civic and moral positions of the future specialist, competitive on the basis of knowledge of information and communication technologies, building communication programs in Kazakh, Russian and foreign languages, focusing on a healthy lifestyle, self-improvement and professional success;

- form a system of general competencies that ensure the socio-cultural development of the personality of a future specialist based on the formation of his ideological, civic and moral positions;

- develop the ability to interpersonal social and professional communication in Kazakh, Russian and foreign languages;

- contribute to the development of information literacy through the mastery and use of modern information and communication technologies in all areas of their lives and activities;

- form lifelong self-development and education skills;

- they form a personality capable of mobility in the modern world, critical thinking and physical self-improvement;

- to assess the surrounding reality on the basis of worldview positions formed by knowledge of the fundamentals of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical cognition, to reveal the meaning of the content and specific features of the mythological, religious and scientific worldview;

- to show a civic position based on a deep understanding and scientific analysis of the main stages, patterns, and peculiarities of the historical development of Kazakhstan, to use methods and techniques of historical description to analyze the causes and consequences of events in the history of Kazakhstan;

- to assess situations in various spheres of interpersonal, social and professional communication, taking into account basic knowledge of sociology, political science, cultural studies, psychology, arguing for their own assessment of everything happening in the social and industrial spheres, as well as synthesize knowledge of these sciences as a modern product of integrative processes;

- to use scientific methods, research techniques of a specific science, as well as the entire socio-political cluster, to select a methodology, analyze and summarize the results of the study;

- to develop their own moral and civic position on the basis of social, business, cultural, legal and ethical norms of the Kazakh society;

- to put into practice knowledge in the field of social sciences and humanities, which is internationally recognized, synthesize new knowledge and present it in the form of humanitarian socially significant products;

- to engage in communication in oral and written forms in Kazakh, Russian and foreign languages, using linguistic and speech means based on grammatical knowledge to solve problems of interpersonal, intercultural and industrial (professional) communication, as well as to analyze information, actions and deeds of communication participants in accordance with the communication situation;

- to use various types of information and communication technologies in personal activities: Internet resources, cloud and mobile services for the search, storage, processing, protection and dissemination of information;

- to build a personal educational trajectory throughout life for self-development and career growth, to focus on a healthy lifestyle to ensure full-fledged social and professional activities through methods and means of physical culture;

- to know and understand the basic patterns of the history of Kazakhstan, the basics of philosophical, socio-political, economic and legal knowledge, communication in oral and written forms in Kazakh, Russian and foreign languages;

- apply the acquired knowledge for effective socialization and adaptation in changing socio-cultural conditions, possess the skills of quantitative and qualitative analysis of social phenomena, processes and problems.

Basic competencies:

- to use knowledge about the basic principles of the theory of differential and integral calculus of functions of several variables, the theory of differential equations, the theory of series;
- create algorithms for solving problems;
- to use knowledge in the field of differential and integral calculus, the theory of differential equations and the theory of series to solve problems related to blockchain algorithms and cryptography, the use of various data type models, information processing algorithms; rationally - to use the opportunities provided by technology;
- create algorithms for efficient execution and validation of transactions in blockchain networks;
- structure and manage data in the context of blockchain technologies, ensuring efficiency and security;
- calculate, analyze and process the results of a physical experiment;
- use methods for building various data models, information processing algorithms;
- rationally use the possibilities provided by the algorithmization technique to solve practical problems;
- formalize, factorize, normalize, decompose and structure input, intermediate, and output data;
- build mathematical models of artificial intelligence and blockchain algorithms. solve engineering problems using mathematical methods;
- the use of modern information technologies and software tools, including domestic production, in solving problems of professional activity; development, debugging and testing of prototypes of software and hardware complexes of tasks.

Professional competencies:

- application of data analysis methods to extract valuable information from the blockchain,
- develop and analyze business models based on the use of blockchain and artificial intelligence, design, development and implementation of decentralized applications using the principles of blockchain;
- programming skills in languages used to create smart contracts and applications on the blockchain.
- use information computer systems in blockchain applications, theoretical foundations of computer science, collection, storage, search, processing, transformation, dissemination of information in artificial intelligence and blockchain, state standards.
- have an idea about the features of artificial intelligence tasks and the role of logical programming as a methodology for solving these problems, knowledge representation models, methods for developing and creating expert systems and expert shells;
- use programming languages and systems to automate information processes for collecting information necessary for processing and making management decisions, work with general-purpose software tools, search for information using search rules in databases;
- use a unified modeling language, establish architectures and key points of a distributed client-server application;
- to apply instrumental software tools and mathematical models in the decision-making process of artificial intelligence and blockchain, formulation and formalization of tasks of expert decision support, analysis and interpretation of the results obtained;
- creation and management of local blockchain networks for testing smart contracts without the need to use the main Ethereum network.

Special competencies:

- use multitasking and multithreading in system software, modeling software development processes using CASE tools, the basics of working with a selected framework for creating and training neural networks;

- understand the basic concepts, types of tasks and metrics for evaluating the quality of models; knowledge of the main components of the platform and their roles in the process of developing and deploying models, the main stages of a machine learning project, as well as understand the methods of integration and interaction between blockchain protocols and artificial intelligence technologies

- be able to choose the architecture and configuration of neural networks depending on a specific task; choose the architecture and configuration of neural networks depending on a specific task; apply knowledge about neural networks to solve specific tasks within real projects in the blockchain;

- integrate and interact with artificial neural networks in the blockchain environment, methods of analysis and audit of smart contracts, especially those that manage artificial neural networks in the blockchain, development and work with blockchain platforms on which artificial neural networks are implemented;

- develop and analyze applications based on blockchain technologies and using artificial intelligence, applications based on blockchain technologies and using artificial intelligence, as well as the ability to apply new innovations in practical tasks;

- create and use probabilistic models to analyze random events in the blockchain; solve problems for calculating various events, including conditional probabilities; identify and use various distributions, effectively use multitasking and multithreading in system software.

Table 1. The sequence of mastering disciplines in the process of forming special competencies

№	Competencies	The list of compulsory, elective disciplines and the sequence of their study		Expected results
		List of disciplines	The sequence of their study (sem.)	
1	Special competencies	Information theory	2	**To know:** the basic concepts of information theory, such as bits, bytes, information entropy, etc.; the mathematical foundations of information theory, including the concepts of probability and statistics; the basic theorems of information theory, such as the Shannon theorem on the bandwidth of the communication channel; various methods of encoding information, including Huffman codes, Hamming codes and others. **Be able to**: evaluate the amount of information in a system or message; apply mathematical methods to analyze and optimize information transmission; design and use effective codes to compress and correct errors in data transmission; understand the basic concepts of probability theory and their application in information theory; **Own:** to work with various data compression methods for efficient storage and transmission of information; design and analyze codes to correct errors in data transmission; apply theoretical knowledge to optimize the operation of information systems; use information theory methods in the field of signal processing and data transmission
		Information technology		**To know:** fundamentals of computer systems and hardware; principles of operation of operating systems; principles of construction and functioning of computer networks; principles of functioning of computer networks; **Be able to**: write programs in one or more programming languages; design and configure computer networks; manage and maintain information systems; **Own:** applying algorithms and data structures to solve practical problems; working with modern software development and debugging tools; effective project management in the field of information technology.
2	Special competencies	Probability theory	4	**To know:** understanding of basic terms such as probability space, random event, probability, conditional probability, etc.; knowledge of basic operations on events, as well as properties of sigma algebra; awareness of various distributions (discrete and continuous) and their properties; **Be able to**: create and use probabilistic models for the analysis of random events; solve problems for calculating the probabilities of various events,

				including conditional probabilities; determine and use various distributions, including the normal distribution, Poisson distribution, etc.; calculate mathematical expectation, variance and other characteristics of random variables; **Own:** calculation of mathematical expectation, variance and other characteristics of random variables; creation of models of random processes and their use for forecasting; use of software tools such as Python with libraries NumPy, SciPy and others to perform calculations and data analysis related to probability theory; application of knowledge of probability theory to the analysis of real data and making informed statistical conclusions.
		Probability theory and mathematical statistics		**To know:** patterns in random and information processes (type of distribution, numerical characteristics, accumulation, processing, distribution, etc.); **Be able to**: create mathematical and computer models of random phenomena in various fields of human activity; **Own:** information about the main scientific achievements in probability theory and mathematical statistics.
3	Special competencies	System programming	5	**To know:** the basic principles of the architecture of computer systems and the interaction of software and hardware; low-level programming languages and their features (assembler, C, C++); principles of the organization of operating systems and the structure of device drivers; fundamentals of security and reliability of system software; **Be able to**: design and implement algorithms at a low level, taking into account the features of hardware; effectively use multitasking and multithreading in system software; design and develop system software such as operating systems or compilers; test and debug system software; **Own:** work with low-level programming languages to create effective and optimized solutions; apply the principles of security and reliability in the development of system software; work with version control systems and other development tools.
		System programming and computer technology		**To know:** understanding the principles of interaction between software and hardware; understanding the principles of interaction between software and hardware; understanding and ability to develop programs using effective multitasking and multithreading mechanisms; **Be able to:** develop programs that interact with hardware in low-level languages; design and develop system software such as operating systems or device drivers; optimize program code and algorithms to improve system

				performance; **Own:** development for embedded systems, the Internet of Things (IoT) and other relevant technologies; methods for ensuring the security and reliability of system software;
4	Special competencies	Microcontrollers and microprocessor systems	5	**To know:** the software and logic model of the microprocessor 1810VM86; operating modes of the microprocessor 1810 VM86; principles of construction of microprocessor systems; software and logic model of microcontrollers of the 1816 series; operating modes of the microcomputer 1816 VE48; **Be able to:** build microprocessor systems based on kits 1816 and 1810; test microprocessors as part of computers; **Own:** drawing up electronic circuits for the operation of microprocessors and switching methods.
		Fundamentals of microprocessor technology		**To know:** principles of building electronic devices based on modern element base and MPS; principles of functioning of electronic devices based on modern element base and MPS; basic technical parameters, operational characteristics and applications of the main devices and functional components of electronics and MPS; basic principles of designing circuits based on MPS. **Be able to:** design and calculate typical MPS nodes; select MPS for the required task. **Own:** performing analysis and synthesis of electronic circuits with MPS; designing and calculating electronic devices using a computer
5	Special competencies	Software development tools	6	**To know:** The basic principles and concepts of CASE technologies; modeling of software development processes using CASE tools; principles of code generation using CASE tools; **Be able to:** create project models using CASE tools; analyze test results and debug the program; work with version control systems in the context of the CASE; **Own:** application of CASE technologies in the software development process; optimization of software development processes using CASE technologies; analysis and implementation of best practices in the field of CASE.
		UI/UX design		**To know:** the difference between the user interface (UI) and user experience (UX); popular tools for creating layouts and prototypes (for example, Sketch, Adobe XD, Figma); knowledge about color combinations, palette selection and creating contrasting elements; **Be able to:** develop user interface layouts, taking into account design

				principles and user needs; create designs that easily adapt to different devices and screen resolutions; **Own:** the ability to be creative in creating unique and innovative design solutions; the ability to clearly and effectively explain and argue their design decisions; understanding the ethical aspects of design, including accessibility and respect for user privacy
6	Special competencies	Azure machine learning	6	**To know:** understanding the basic concepts, types of tasks and metrics for evaluating the quality of models; knowledge of the main components of the platform and their roles in the process of developing and deploying models; knowledge of various machine learning algorithms and methods of their training on the Azure platform; **Be able to:** select suitable models for specific tasks and develop them; use the main features and tools of the Azure Machine Learning platform to solve practical problems; organize experiments, track model versions and conduct comparative analysis; **Own:** work with real data and solve specific tasks using Azure Machine Learning; work effectively in a team, communicate results and discuss strategies for solving problems; quickly master new technologies and methods in the field of machine learning.
		Azure Cognitive Service		**To know:** understanding what cognitive services are and how they are used in cloud computing; knowledge of the basics of the architecture of cognitive services in Azure; knowledge of the basics of natural language processing and image recognition; **Be able to:** use Azure cognitive services to solve specific tasks; skills in working with APIs and tools for interacting with services; integrate cognitive services with other Azure services; work with cloud services to create comprehensive solutions; **Own:** processing and analyzing textual and visual information using cognitive services; working with real data and participating in projects using cognitive services; effective communication of the results of work with cognitive services and documenting processes.
7	Special competencies	Neural networks and their applications	7	**To know:** the basic principles of operation and activation of artificial neurons; various methods of training neural networks, including error propagation and optimization methods; the basics of working with the selected framework for creating and training neural networks; **Be able to:** choose the architecture and configuration of neural networks

				depending on a specific task; choose the architecture and configuration of neural networks depending on a specific task; apply knowledge about neural networks to solve specific tasks within real projects in the blockchain **Own:** knowledge of the selected framework for creating and training neural networks; programming skills in languages used to implement neural networks, such as Python; skills in working with data, their analysis and preprocessing for use in neural networks.
		Artificial neural networks		**To know:** architectures and structures of various types of neural networks, including perceptrons, convolutional networks, and recurrent networks; understanding how smart contracts can be used to manage and interact with artificial neural networks in the blockchain; **Be able to:** the ability to integrate and interact with artificial neural networks in the blockchain environment; the ability to ensure the security and integrity of artificial neural networks used in the blockchain; **Own:** possess skills in developing and working with blockchain platforms on which artificial neural networks are implemented; possess methods of analyzing and auditing smart contracts, especially those that manage artificial neural networks in the blockchain
8	Special competencies	Using data in machine learning	7	**To know:** principles of constructing feature vectors, decisive rules and classifications; main types of classifiers; principles of constructing linear classifiers; principles of constructing nonlinear classifiers; selection of classification features and features of data preprocessing. **Be able to:** choose the appropriate type of classifier depending on the task being solved; select sets of features for classification and preprocessing data; use algorithms for training and compiling a classifier by selection; perform calculations related to the study and operation of the classifier. **Own:** select, create, train and use basic classifiers to solve problems.
		Introduction to Machine Learning and Data Analysis		**To know:** the main ways of data transformation; the main stages of a machine learning project; **Be able to:** work with arrays - formulate business tasks as machine learning tasks - find solutions to machine learning tasks in specific business tasks; **Own:** loading, converting, cleaning and visualizing data in Python using machine learning models in Python - quality assessment and interpretation of the results obtained.

Table 2. Mastering the disciplines of socio-professional interactionsequence

Курс	Disciplines that ensure	Competencies	Expected result
General education subjects			
Required component			
1	History of Kazakhstan	Competencies of general education	**To know:** to demonstrate knowledge and understanding of the main stages of the development of the history of Kazakhstan; Be able to: correlate phenomena and events of the historical past with the general paradigm of the world-historical development of human society through critical analysis; be able to objectively and comprehensively comprehend the inherent features of the modern Kazakh model of development; **Own:** to possess the skills of analytical and axiological analysis in the study of historical processes and phenomena of modern Kazakhstan; to systematize and give a critical assessment of historical phenomena and processes of the history of Kazakhstan
1	Foreign language	Competencies of general education	**To know:** the lexical minimum and the linguistic material of topics and subtopics in this discipline (socio-household and socio-cultural spheres of communication). **Be able to:** understand by ear not only individual phrases and frequently used words, but also more voluminous statements on topics directly related to it, understand the main content of short simple communications on the radio, at the airport, at the train station; understand when reading the content of short, simple texts, advertisements, brochures, menus, bus and train schedules, a short simple personal letter, e-mail; communicate in simple typical situations that require the exchange of information within familiar topics and activities, be able to talk about family, living conditions, educational activities; write a simple personal letter, a note, an autobiography. **Own:** an understanding of foreign-language dialogical and monological speech within the framework of general cultural and professional topics; a foreign language at a level that allows for the main types of speech activity; various methods of oral and written communication; skills of adequate response in situations of everyday, academic and professional communication; listening, reading, writing skills.
1	Kazakh (Russian) language	Competencies of general education	**To know:**: the theoretical foundations of the course (language, its functions, forms of speech, text, its signs, speech styles, functional and semantic types of speech); features of dialogic and monological speech; types of scientific information and the specifics of its implementation in a scientific text; elements of structural and semantic analysis and semantic analysis of a scientific text, components of a speech situation, the speaker's intentions. **Be able to:** make the right choice and use of language and speech tools to solve certain

			communication and cognition tasks based on knowledge of a sufficient amount of vocabulary, a system of grammatical knowledge, pragmatic means of expressing intentions; compose everyday, socio-cultural, official business texts in accordance with generally accepted norms, functional orientation, using an adequate set goal lexical, grammatical and pragmatic material of a certain certification level; to convey the factual content of texts, formulate their conceptual information, describe the deductive knowledge (pragmatic focus) of both the entire text and its individual structural elements; interpret the information of the text, explain in the scope of certification requirements the stylistic and genre specifics of texts of socio-cultural, socio-political, official business and professional spheres of communication; to participate in communication in various situations of different spheres of communication in order to realize one's own intentions and needs (domestic, educational, social, cultural), stating them ethically correctly, meaningfully fully, lexically-grammatically and pragmatically adequate to the situation; to discuss ethical, cultural, socially significant problems in discussions, express one's point of view, to defend it in a reasoned manner, to critically evaluate the opinion of the interlocutors; to build programs of speech behavior in situations of personal, social and professional communication in accordance with the norms of language, culture, specifics of the sphere of communication, certification requirements; to request and report information in accordance with the communication situation, evaluate the actions and deeds of participants, use information as a tool to influence the interlocutor in situations of cognition and communication in accordance with certification requirements. **Own:** skills of producing oral and written speech in accordance with the communicative purpose and professional sphere of communication; language skills in various situations of everyday, socio-cultural, professional communication; skills of searching, processing information in Russian; types of speech activity
1	Information and communication technologies	Competencies of general education	**To know:** what economic and political factors contributed to the development of information and communication technologies; features of various operating systems, architecture. **Be able to:** identify the main trends in the field of information and communication technologies; use information resources to search and store information; work with spreadsheets, consolidate data, build graphs; apply information security methods and tools; design and create simple websites; process vector and raster images; create multimedia presentations; use various platforms for communication; calculate and evaluate performance indicators of supercomputers; use various forms of e-learning to expand professional knowledge; use various cloud services.

			Own: database structure development; designing and creating presentations; receiving data from the server; creating video files; work with Smart applications; work with services on the website of the electronic
2	Philosophy	Competencies of general education	**To know:** basic philosophical concepts and categories, patterns of development of nature, society and thinking; the essence of philosophical categories, terminology of philosophy and structure of philosophical knowledge, functions of philosophy, methods of philosophical research; the place and role of philosophy in public life; **Be able to:** use the basics of philosophical knowledge to form a worldview position; analyze worldview, socially and personally significant philosophical problems; navigate the system of philosophical knowledge as a holistic view of the foundations of the universe and the prospects for the development of planetary society; understand the characteristic features of the modern stage of philosophy development **Own:** the skills of philosophical analysis of various types of worldview; the skills of philosophical thinking to develop a systematic, holistic view of the problems of society; the skills of analyzing texts with philosophical content
1	Political Science	Competencies of general education	**To know:** the main stages of the development of political knowledge in the history of civilization; schools and directions of modern political science; the political life of society; the political system and its institutions; the essence of political processes in the country and the world. **Be able to:** analyze the features of political systems and the functioning of political institutions; critically evaluate the theoretical approaches of political science; identify the interrelationships and patterns of the political process; compare political systems, institutions and actors in an inter-national and subnational context, based on the knowledge gained and mastered methods. **Own:** have the skills (gain experience) of working with primary sources on course topics; analyzing normative legal acts and other documents; searching, processing and analyzing information; solving problems related to evaluating a political course; working in groups, project activities, business games; public speaking; academic writing; expressing one's thoughts and opinions in interpersonal and business communication in a foreign language; the skills to extract the necessary information from the original text in a foreign language.
1	Sociology	Competencies of general education	**To know:** the patterns and stages of the historical process, the main historical facts, dates, events and names of world and domestic historical figures; the main events and processes of national history in the context of world history **Be able to:** critically perceive, analyze and evaluate historical information, factors and mechanisms of historical changes; analyze civil and ideological positions in society,

			form and improve their views and beliefs, transfer philosophical worldview to the field of material and practical activities; use various philosophical methods to analyze trends in the development of modern society, philosophical and legal analysis **Own:** skills of a holistic approach to the analysis of society's problems; methods of philosophical, historical and cultural studies, techniques and methods of analyzing society's problems; cause-and-effect relationships in the development of Kazakh society; human place in the historical process and political organization of society; skills of respectful and careful attitude to historical heritage
1	Cultural studies	Competencies of general education	**To know:** the basic theories of culture, the basic concepts of cultural studies; the main directions of the methodology of modern cultural analysis; the history of the formation of world culture and civilization, theoretical features of basic cultural concepts, various interpretations of culture and civilization in world and domestic literature; current problems of the development of modern culture; the idea of culture as a socio-historical phenomenon; patterns of development of world cultures, as well as the typology of the classification of cultures; basic knowledge about the history of the most important cultures of mankind; about the ways of acquiring, storing and transmitting basic cultural values - about the diversity and self-worth of various cultures, forms and types of culture, patterns of their functioning and development, the main cultural and historical regions - the history of Kazakh culture, its place in the system of world culture and civilization **Be able to:** be able to identify the features of this culture, the dominant values in it; explain the specifics of intercultural communication; be able to conduct independent professional activities in a dynamically changing multicultural society; be able to navigate the cultural environment of modern society; be able to explain the phenomenon of culture, its role in human life; be able to navigate cultural issues, independently understand the influence of cultural factors on the behavior of individuals; **Own:** practical skills for the preservation and enhancement of national and world cultural heritage; practical skills for the practical use of knowledge and skills in taking into account the specifics of cultural behavior of various individuals and collectives in the modern conditions of the formation of civil society in the Republic of Kazakhstan.
1	Psychology	Competencies of general education	**To know:** the meaning and place of psychology in the system of sciences; the main directions of personality development in modern psychology; personal values and meanings in professional self-determination; the relationship and mutual influence of the psyche and body; techniques and techniques of effective communication. **Be able to**: interpret basic psychological theories, concepts; use methods and mechanisms for regulating emotions in everyday life; - identify patterns of behavior in a

			conflict situation and conduct self-diagnosis. **Own:** definitions of individual psychological characteristics of personality, value-semantic concepts in professional self-determination of personality; recognition of psychological impact and effective communication
General education subjects			
The university component			
1	Fundamentals of economic and legal knowledge	Competencies of general education	**To know:** methods of scientific research in economics, various theories about entrepreneurship, financial literacy and market economy, types of entrepreneurial activity, the field of entrepreneurship, to master various quantitative and qualitative methods for creating a future business, entrepreneurial calculations, analytical calculations and forecasts, the main provisions of the Constitution and current legislation of the Republic of Kazakhstan, the system of public administration and the scope of their powers, the mechanism of interaction of substantive and procedural law, the essence of corruption and the causes of its origin, the current legislation in the field of anti-corruption. **Be able to**: analyze and substantiate the reality of business plans, market segmentation, competently and professionally assess the market situation for the organization of their business, creatively approach various business tasks, possess practical skills of independent economic work in the field of entrepreneurship, calculate a personal budget, have clear background information and a quick and correct orientation to economic indicators, analyze events and actions from the point of view of the field of legal regulation and be able to refer to the necessary regulations, to navigate the current legislation, using the law to protect their rights and interests, to use spiritual and moral mechanisms to prevent corruption. **Own:** acquire practical skills in constructing graphs and diagrams illustrating various economic models, independently conducting economic work in the field of entrepreneurship, quickly and correctly navigate the actual source information and calculated economic indicators, determine levels of financial security, have the skills to identify economic problems when analyzing specific situations and solving them, taking into account the actions of economic patterns in the market micro and macro levels, conducting discussions on legal issues, on the application of norms in the modern period, analysis of the situation of conflict of interests and moral choice.
1	Fundamentals of scientific and environmental knowledge	Competencies of general education	**To know:** forms and methods of pre-scientific, scientific and extra-scientific cognition, modern approaches to socio-humanitarian knowledge and their commensurability; basic epistemological models, the nature of transformations of the concept of rationality; fundamentals of ecology and safe human life in the environment, environmental factors

			and their impact on living organisms, methods for identifying, eliminating the influence of harmful factors on humans and the environment, and providing comfortable conditions for human life and activity. **Be able to:** formulate and solve problems that arise in the course of scientific research and require in-depth professional knowledge; modify existing and develop new methods based on the tasks of a specific study; choose methods of protection from hazards in relation to the field of their professional activities and choose ways to ensure comfortable living conditions. **Own:** the skills of conducting independent research and scientific and pedagogical activities that require extensive education in the appropriate direction; the ability to apply methodological and methodological knowledge in conducting scientific research; skills to ensure the safety of life in professional activities, living conditions and in emergency situations.
Basic disciplines			
Required component			
2	Physics	Basic competencies	**To know:** basic physical theories, laws and principles and their mathematical expression; the possibility of applying theoretical knowledge to solve specific physical problems and situations; basic laws and principles of physics; **Be able to:** mathematically represent physical laws; apply theoretical knowledge to solve specific physical problems of the situation; determine the physical essence of phenomena and processes in various devices of physical nature and perform simple technical tasks relative to them; work with measuring instruments, instruments and instruments; **Own:** graphically perform information obtained during observations and carry out statistical processing;
1	Mathematics	Basic competencies	**To know:** properties of functions of several variables: (limitation, presence of the largest and smallest values, complex functions, partial multiplications and derivatives, complete multiplications and differentials; basic methods of integration of double and triple integrals (substitution of variables, calculation in polar coordinates); types of differential equations and methods of their solution; methods for determining power series of functions. and Fourier series decomposition; apply basic formulas to calculate the probability of random variables; **Be able to:** apply methods for solving differential and integral calculus of functions of several variables in applied problems; apply methods for solving differential equations in solving applied problems; obtain approximate values of solutions by decomposing into a power series and a Fourier series with a given accuracy; determine optimal methods for

			solving practical problems.; **Own:** solve engineering problems using mathematical methods;
1	Introduction to Programming	Basic competencies	**To know:** the basics of information technology and programming and the main components of software tools, as well as their purpose and composition; algorithmization methods, programming languages and technologies suitable for practical use in the field of information systems and technologies; **Be able to:** choose modern information technologies and software tools, including domestic production, when solving professional tasks, as well as justify their choice; apply algorithmization methods, programming languages and technologies when solving professional problems in the field of information systems and technologies; **Own:** using modern information technologies and software tools, including domestic production, in solving professional tasks; developing, debugging and testing prototypes of software and hardware complexes of tasks;
2	Professional Kazakh (Russian) language	Professional competencies	**To know:** scientific vocabulary of a technical profile and scientific structures; rules for the representation of texts of various genres; linguistic norms in the field of technical activity; fundamentals of business communication; **Be able to:** choose language tools, build statements taking into account literary norms and the communicative situation; distinguish the logical and compositional structure of a scientific test, possess oral public comments (message, report), analyze publicly listened statements; communicate professionally; use dictionaries and talk about the linguistic units obtained from them correctly interpret information; extract the read or listened text from the educational, professional, socio-cultural spheres, indicating the necessary information and presenting it in a certain sequence; **Own:** working with scientific and technical literature; independent search for scientific and technical information as the basis of professional activity; listening to and fully understanding the claimed information at a normal pace with subsequent transmission of its content; conducting dialogues, interview requests and conversations;
2	Professionally oriented foreign language	Professional competencies	**To know:** functional features of oral and written texts of a scientific and technical nature in the specialty; requirements for the preparation of documents accepted in professional communication; strategy of communicative behavior in professional communication; **Be able to**: understand oral speech within the framework of a professional topic; participate in the discussion of topics related to the profession; independently prepare and create oral messages on professional topics using multimedia technologies; receive the necessary information from foreign language sources created in various sign systems (text, table, table, diagram, audiovisual series, etc.); annotation, abstracting and presentation in the native language of the main content of literature in the specialty using

			a dictionary, if necessary; writing messages, articles, abstracts, and abstracts on professional topics. **Own:** basic grammatical structures characteristic of oral and written professionally oriented communication;
Component of choice			
2	Network architectures and security/ Architectures and protocols of network communications with enhanced	Professional competencies	**To know**: the basics of network technologies, including data transfer protocols (for example, TCP/IP), architectural principles and network topologies; principles of building computer networks, including routing, switching and quality of service (QoS) mechanisms; hardware used in networks, such as routers, switches, firewalls and Wi-Fi access points; **Be able to**: design and configure computer networks, taking into account performance, scalability and security requirements; configure routing and switching in the network for optimal data transfer; administer and maintain network devices and security systems; work with intrusion detection (IDS) and intrusion prevention (IPS) systems; **Own:** the use of tools for monitoring and analyzing network traffic; skills in conducting network security audits and identifying vulnerabilities; designing and implementing virtual private networks (VPNs) to ensure secure data transmission over open networks; working with wireless networks and applying security measures in wireless scenarios.
			To know: the basic principles of modern network architectures, including scalability, performance and flexibility; various network topologies and their application in various scenarios; principles of operation of high-level network communication protocols such as HTTP/HTTPS, DNS, FTP and others; Software-Defined Networking (SDN) and Network Function Virtualization (NFV) technologies; **Be able to**: design modern network architectures, taking into account performance, scalability and security requirements; develop and optimize network communication protocols tailored to specific tasks and use cases; work with Software-Defined Networking (SDN) and Network Function Virtualization (NFV) technologies to create more flexible and manageable networks; **Own:** program and develop applications that interact with network protocols; work with tools for modeling and analyzing network architectures; configure and administer network equipment, including routers, switches, firewalls, etc.
2	Introduction to Blockchain/ Fundamentals of Blockchain Technology	Professional competencies	**To know**: the basic concepts of blockchain, the advantages and limitations of blockchain technologies; the key differences between blockchain and other technological systems; the cryptographic foundations of blockchain technology on the platform.Net; technologies for creating blockchain applications on the platform .Net; potential implications of blockchain technology for society; ethical considerations to be

			considered when developing decentralized applications; **Be able to:** use blockchain technologies; apply the cryptographic foundations of blockchain technology on the platform.Net; create blockchain applications on the platform.To develop skills in working with existing and promising blockchain technologies; mastering the mathematical foundations of technology (cryptography, consensus) and familiarity with environments and frameworks for the development of blockchains; create secure smart contracts, full-featured decentralized applications, independent financial services, NFT and GameFi projects; **Own:** design smart contracts using the Solidity programming language; develop decentralized applications, programs, games and platforms based on blockchain technology; create and deploy decentralized applications through a series of practical exercises and projects.
			To know: understanding basic concepts such as decentralization, distributed ledger, blocks and block chain; knowing the differences between public and private blockchains; understanding the principles of cryptography used in blockchain to ensure data security and integrity; the basics of smart contracts, their purpose and principles of writing on platforms like Ethereum; **Be able to**: including sending and receiving cryptocurrency funds, signing transactions and checking balances; creating software codes running on the blockchain to automate and manage agreements; researching and analyzing transactions to identify information about the transfer of assets in the blockchain; **Own:** skills in using specific blockchain platforms such as Ethereum, Hyperledger, or others; creating applications using blockchain as a core component; applying security techniques to protect blockchain networks and transactions; the ability to integrate blockchain into various business processes and information systems.
2	Decentralized applications/ Database Basics	Professional competencies	**To know:**: planning, designing, implementing and testing end-to-end dApps with proper configuration of the blockchain network on an enterprise scale; **Be able to**: understand the architecture and components of DApp, including the external interface and internal processing supported by blockchain and smart contracts; **Own:** to critically evaluate new blockchain standards and architecture and apply them in various use cases.
			To know: understanding the principles of organizing data in the form of tables, relationships and keys; knowledge of the basics of SQL for creating, querying and modifying data in databases; understanding the basic concepts of transactions and methods for ensuring data integrity in a database; **Be able to:** create a database schema, define entities, attributes, relationships and keys;

			write queries to select, insert, update and delete data in the database; apply normalization principles to improve the database structure and ensure its efficiency; create indexes to improve query performance; **Own:** creating databases for specific applications and projects; skills in analyzing database structures, identifying problems and proposing solutions; ability to work with the command line of various database management systems; database integration with various applications and web services
3	Architecture of the blockchain system/ Development environment of Ethereum, Web3 and Truffle	Professional competencies	**To know:** the inner workings of smart contracts as a means to develop decentralized applications; the interaction between a closed network of smart contracts and the outside world, about the further consequences of these interactions - to understand the set of technologies that support the network's core decentralized storage network (for example, IPFS, Swarm, Filecoin); **Be able to:** identify the key characteristics of the blockchain (i.e. decentralization, permanence, anonymity, verifiability, etc.); explain the various levels of components that make up the architecture of a blockchain-based system; understand the problems of consensus algorithms at a high level; understand algorithmic execution in DLT, their consensus model, code execution, its network, storage options, etc. key actors who participate in each protocol; understand the underlying incentive and management models; **Own:** predict the development and implementation of DLT in the future based on various use cases; understand how other emerging technologies (for example, IoT and AI) can be used in combination with blockchain.
			To know: understanding the main components and tools in the development environment for Ethereum, including Ethereum Virtual Machine (EVM), smart contracts, Ethereum blockchain, etc.; knowledge of the Web3 library.js, which provides a JavaScript API for interacting with the Ethereum blockchain from web applications; understanding the Truffle tool, which provides a set of tools for developing, testing and deploying smart contracts on the Ethereum blockchain; **Be able to**: use Web3.js for sending transactions, invoking smart contract methods, and retrieving data from the blockchain; using Web3.js for sending transactions, invoking smart contract methods and retrieving data from the blockchain; using debugging tools provided by Truffle to identify and fix errors in smart contracts; **Own:** interact with the Ethereum blockchain from web applications, including data transfer, transaction execution and display of results; create and manage local blockchain networks for testing smart contracts without the need to use the main Ethereum network.

3	Mathematical foundations of Artificial Intelligence/ Graph Theory	Professional competencies	**To know:** understanding vectors, matrices, operations on them, eigenvalues and vectors; fundamentals of probability theory, probability distributions, statistical methods, including parameter estimation and hypothesis testing; knowledge of the principles of constructing and analyzing mathematical models, especially in the context of artificial intelligence; **Be able to**: Work with vectors and matrices, apply linear algebra to learning and prediction tasks; develop mathematical models for artificial intelligence and machine learning tasks; **Own:** application of mathematical methods to solving specific problems of artificial intelligence; work with libraries such as NumPy, SciPy, for the effective implementation of mathematical operations in software code.
			To know: knowledge of key concepts of graph theory, such as vertex, edge, graph, directed graph, subgraph, etc.; distinction between oriented and undirected graphs, connected graphs, trees and other types of graphs; **Be able to:** the ability to represent graphs mathematically using matrices and other data structures; applying theoretical knowledge to solving real-world problems such as network planning, routing, and social network analysis; **Own:** writing programs for working with graphs, including the implementation of algorithms and visualization; effective application of graph theory to solve various problems in the blockchain.
4	Artificial Intelligence for Information Security/ Cryptography	Professional competencies	**To know:** modern information and communication and intelligent technologies, tool environments, software and technical platforms for solving professional problems; new scientific principles and methods of software and hardware development of artificial intelligence technologies and systems for solving professional problems in various subject areas; features of software and hardware modernization of artificial intelligence technologies and systems for solving professional problems tasks in various subject areas; **Be able to**: justify the choice of modern information and communication and intelligent technologies, develop original software tools for solving professional problems; develop software and hardware for artificial intelligence technologies and systems, taking into account information security requirements, to solve professional problems in various subject areas; to modernize the software and hardware of artificial intelligence technologies and systems, taking into account the requirements of information security to solve professional tasks in various subject areas; Possess skills: methods of developing original software tools, including using modern information and communication and intelligent technologies to solve professional tasks

			To know: the mathematical foundations of cryptographic information protection; encryption algorithms and features of their implementation; **Be able to**: determine the possibilities of applying theoretical propositions and methods of higher mathematics to formulate and solve specific cryptographic problems; solve applied cryptographic protection problems; evaluate the effectiveness of various cryptographic methods; **Own:** standard mathematical methods and their application to solving data protection problems; skills in working with modern software packages in the field of cryptography and information security.
Core disciplines			
Required component			
2	Introduction to Artificial Intelligence	Professional competencies	**To know:** modern information technologies and software tools, including domestic production in solving professional tasks; classification of software tools and the possibility of their application to solve practical problems in the blockchain; **Be able to:** choose modern information technologies and software tools, including domestic production, when solving professional tasks; find and analyze technical documentation on the use of software, select and use the necessary functions of software tools to solve a specific task; **Own:** apply modern information technologies and software tools, including domestic production, in solving professional tasks;
2	Operating systems	Professional competencies	**To know:** the basic principles of operating system design; purpose, function, classification of operating systems; principles of management of computing resources of the operating system; the concept of multiprogramming, processes and flows; principles of virtualization and mobility of the operating system. **Be able to:** implement basic algorithms for scheduling and synchronizing processes and threads; manage memory; plan disk scheduling; edit multithreaded applications; take into account the specifics of working in specific operating systems; use operating system tools. **Own:** install operating systems; manage accounts; configure work environment settings; configure hardware; manage disks and file systems; configure network settings.
Component of choice			
2	Cloud technologies/ Fundamentals of Data Science	Professional competencies	**To know**: the basics of cloud computing, including service models and deployment models; basic services and capabilities of popular cloud platforms such as AWS, Azure, and GCP; principles of security in cloud computing and methods of protection against threats; concepts of infrastructure as code (IaC) and its role in process automation; **Be able to:** develop and deploy applications in cloud environments using key platform

			services; design and implement secure cloud architectures; optimize costs and manage resources in the cloud; apply the principles of infrastructure as code to automate infrastructure management; **Own:** programming and developing applications compatible with cloud platforms; configuring and managing cloud services; analyzing and solving security problems in cloud computing; optimizing resource use and cost management.
			To know: basic concepts and terms in the field of Data Science; basic programming tools and languages used in Data Science (for example, Python, Pandas libraries, NumPy); principles of working with databases and extracting data for analysis; basic machine learning methods such as linear regression, classification and clustering; **Be able to:** apply data analysis tools to efficiently process, analyze and visualize data; work with databases to extract and process data; use statistical analysis methods to interpret results; **Own:** develop and implement projects in the field of Data Science, from task formulation to visualization of results; develop and implement projects in the field of Data Science, from task formulation to visualization of results; adapt to new technologies and trends in the field of Data Science, continuing training and professional development
3	Data Mining in Blockchain/ Data Analysis	Professional competencies	**To know:** knowledge of basic terms and concepts related to blockchain technology; knowledge of basic data analysis methods such as machine learning, statistics, data research; knowledge of the basics of security in the context of blockchain technology; understanding of encryption, signature and authentication methods in the blockchain; **Be able to:** analyze transactions, blocks and smart contracts in the blockchain; identify patterns and anomalies in blockchain data; design and implement intelligent systems for data analysis in the blockchain; the ability to integrate blockchain data with mining tools such as Python, R and other programming languages; **Own:** work with real data from the blockchain; apply data analysis to specific blockchain projects; use data analysis to solve specific business problems in the context of the blockchain; effectively communicate the results of blockchain data analysis; ensure data security and confidentiality in the context of the blockchain.
			To know: understanding of key concepts and methods of data analysis; knowledge of basic terms and concepts related to data analysis; knowledge of data analysis methods using mathematical approaches; **Be able to:** apply various data analysis techniques in practical scenarios; use modern data analysis tools such as Python, R, SQL and data visualization tools; use modern data analysis tools such as Python, R, SQL and data visualization tools;

			Own: processing large amounts of data; Using Big Data technologies such as Apache Spark or Hadoop; applying data analysis in real projects; effective communication of data analysis results; data analysis in compliance with ethical standards.
4	Introduction to Web3/ PHP Programming	Professional competencies	**To know**: the deployment of smart contracts; understanding the concepts and principles of Web3; knowledge of the principles of decentralization in the context of blockchain technologies; knowledge of the role of cryptocurrencies in the Web3 ecosystem; **Be able to**: apply protocols in Web3 applications; create and manage cryptocurrency wallets; use decentralized applications (dApps); develop and deploy decentralized applications; **Own:** apply decentralization in applications; develop Web3 applications; integrate Web3 technologies with traditional web technologies; solve specific business problems using Web3 technologies.
			To know: the purpose, functions, classification of PHP programming, principles of operation of Internet services; principles of organization and operation of technologies for processing web information and the Internet; **Be able to**: create static and dynamic pages; create a conceptual proposal in WEB pages using technologies to create a website and publish it on the Internet; **Own:** the basics of programming in PHP (compilation, debugging and testing of programs; development and creation of a website); programming and client-server technologies.
4	Smart Contract Architecture/ Working with Ethereum	Professional competencies	**To know**: the inner workings of smart contracts as a means to develop decentralized applications; Ethereum models, consensus models, execution code, network operation, data storage options and the main actors who participate in its protocol; **Be able to:** develop smart contracts using the Solidity programming language (including a deep understanding of the libraries provided); interact between a closed network of smart contracts and the outside world, realize the further consequences of these interactions for the aspect of decentralization; **Own:** smart contract development (contract implementation, testing, deployment and migration of a contract); a set of technologies that support a backbone decentralized data storage network (for example, IPFS, Swarm).

			To know: the basics of blockchain and Ethereum; technologies for creating and managing tokens based on Ethereum; technologies for creating and managing tokens based on Ethereum; **Be able to**: create and manage Ethereum-based tokens; deploy smart contracts on Ethereum test and core networks; develop interfaces for decentralized applications (dApps); integrate Ethereum with external systems and use oracles to obtain external data; **Own:** working with Ethereum wallets and performing transactions; analyzing successful cases of using Ethereum and applying their experience.
4	Blockchain business Models/ The basics of blockchain and cryptocurrencies	Professional competencies	**To know**: business opportunities, to design and develop new blockchain-based services, as well as to create and develop a successful business; the relationship between blockchain and traditional business models; **Be able to**: develop ideas and innovative strategies; analyze business models and determine how blockchain can improve their effectiveness; analyze business models and determine how blockchain can improve their effectiveness; **Own:** develop a business model that conforms to the principles of digital currencies, decentralization and the growth of peer-to-peer transactional relationships between producers and consumers.
			To know: the features and principles of the functioning of cryptocurrencies, their types; the importance of blockchain technology in the functioning of cryptocurrency instruments; the main types of consensus in blockchain technology: PoW (Proof-of-work) and PoS (Proofof-stake); the main ways of investing in cryptocurrencies; features of existing cryptocurrency trading platforms; **Be able to**: develop the specifics of legal regulation of transactions in the cryptocurrency market in different countries of the world; solve problems of state regulation in the field of blockchain technology and the use of cryptocurrencies; **Own:** to raise funds through the mechanism of initial coin issuance (ICO).

Table 3. List of modules included in the educational program

№ of the module	Module name	List of disciplines included in the module	Block	Semester	Volume of loans	Form of control	Total credits by module
M.1	Historical and philosophical knowledge	History of Kazakhstan	GED/OC	2	5	SE	10
		Philosophy	GED/OC	4	5	Exam	
M.2	Instrumental and communication	Kazakh (Russian) language	GED/OC	1,2	10	Exam	25
		Foreign language	GED/OC	1,2	10	Exam	
		Information and communication technologies	BD/CU	1	5	Exam	
M.3	Socio-political knowledge	Sociology	GED/OC	2	8	Exam	8
		Political Science	GED/OC	2		Exam	
		Cultural studies	GED/OC	1		Exam	
		Psychology	GED/OC	1		Exam	
M.4	Fundamentals of Economics and Ecology	Fundamentals of economic and legal knowledge	ООД/CU	2	3	Exam	5
		Fundamentals of scientific and environmental knowledge	ООД/CU	2	2	Exam	
M.5	Professional communication and management	Professional Kazakh (Russian) language	BD/CU	3	3	Exam	6
		Professionally oriented foreign language	BD/CU	4	3	Exam	
M.6	Programming and system technologies	Introduction to Programming	BD/CU	1	5	Exam	16
		Educational practice	BD/CU	2	1	Dif.offset	
		Python programming/ Programming in the GO language	BD/CC	6	5	Exam	
		System programming/System programming and computer technology	CD/CC	5	5	Exam	
M.7	Computer physics and control systems	Physics	BD/CU	3	5	Exam	13
		Microcontrollers and microprocessor systems/ Fundamentals of microprocessor technology	CD/CC	5	5	Exam	
		Internet of Things/ Design of distributed control systems	CD/CC	6	3	Exam	
M.8	Mathematical foundations of intelligent technologies	Mathematics	BD/CU	1	4	Exam	19
		Probability Theory/ Probability Theory and Mathematical Statistics	BD/CC	5	5	Exam	
		Mathematical foundations of Artificial Intelligence/ Graph Theory	BD/CC	6	5	Exam	

		Mathematical logic and theory of algorithms/ Logical mathematics	BD/CC	7	5	Exam	
M.9	Web technology development and programming	Web technologies 1 (Front end)	BD/CU	4	5	Exam	15
		Web technologies 2 (Backend)	BD/CU	5	5	Exam	
		Introduction to Web3/ PHP Programming	CD/CC	7	5	Exam	
M.10	Information technology development systems	Computer architecture/ Technology of computer and communication systems	BD/CC	2	3	Exam	13
		Software Development Tools/ UI/UX design	BD/CC	6	5	Exam	
		Operating systems	CD/CU	4	5	Exam	
M.11	Information technology and network security	Information Theory/ Information Technology	BD/CC	3	4	Exam	15
		Network architectures and security/ Architectures and protocols of network communications with enhanced security	BD/CC	3	5	Exam	
		Cloud technologies/ Fundamentals of Data Science	BD/CC	3	4	Exam	
		Production practice	BD/CU	6	2	Dif.offset	
M.12	Cybersecurity and artificial intelligence	Information protection and information security	BD/CU	5	5	Exam	9
		Artificial Intelligence for Information Security/ Cryptography	BD/CC	8	4	Exam	
M.13	Blockchain and decentralized technologies	Introduction to Blockchain/ Fundamentals of Blockchain Technology	BD/CC	3	6	Exam	17
		Decentralized applications/ Database Basics	BD/CC	4	6	Exam	
		Architecture of the blockchain system/ Development environment of Ethereum, Web3 and Truffle	BD/CC	5	5	Exam	
M.14	Artificial neural network technologies	Neural networks and their applications/ Artificial Neural Networks	BD/CC	7	5	Exam	10
		Introduction to Artificial Intelligence	CD/CU	4	5	Exam	
M.15	Modern programming technologies	Modern Java Programming Methods and Tools/ Modern NET Programming Methods and Tools	BD/CC	7	3	Exam	7
		Architecture and development of 3D games/ Multimedia design	BD/CC	7	4	Exam	
M.16	Machine Learning with Azure	Using data in machine learning/ Introduction to Machine Learning and Data Analysis	BD/CC	7	3	Exam	8
		Azure machine learning/ Azure Cognitive Service	MS/CC	6	5	Exam	
M.17	Data Mining and blockchain	Data Mining in Blockchain/ Data Analysis	CD/CC	6	5	Exam	28
		Smart Contract Architecture/ Working with Ethereum	CD/CC	7	5	Exam	
		Blockchain business Models/ The basics of blockchain and cryptocurrencies	CD/CC	8	6	Exam	

		Production practice	CD/CU	8	10	Dif.offset	
		Pre-graduate practice	CD/CU	8	2	Dif.offset	
M.18	Health promotion	Physical Culture	GED/OC	1,2,3,4	8	Dif.offset	8
M.19	Final certification	Final certification	ATT	8	8	FC	8