ALIKHAN BOKEIKHAN UNIVERSITY

Faculty of Information Technology and Economics

Department of "Information and technical Sciences»

CATALOGUE OF ELECTIVE COURSES

6B06103- ARTIFICIAL INTELLIGENCE ENGINEERING AND BLOCKCHAIN

Year of admission – 2024

Semey, 2024

Awarded degree: bachelor in the field of information and communication technologies in the educational program «6B06103-Artificial intelligence engineering and blockchain»

Elective course №	The name of subject	Number of credits	Prerequisites	Postrequisites	Short description of the content, the aims of education, expected results
				BASIC DISCIPLINES	
				Components of choice (KV)	
1	Computer architecture	3	Information and communication technologies	Information theory, operating systems, network architectures and security	**Purpose:** the study of computer architecture includes several aspects aimed at providing students with the knowledge and skills necessary to work with the hardware of computer systems. **Content:** The main components of the computer. The principles of operation of processors, including the execution of commands, memory management and peripherals. Different levels of computer architecture. Processor instructions, cache memory, vector computing and parallel processing. Memory organization and data management, including memory hierarchy, virtual memory, and caching. The principles of interaction with peripheral devices and data input and output. **Expected result:** **To know:** the principles of building computer systems, hardware components (processors, memory, I/O), architectural approaches (CISC, RISC) and basic concepts (cache memory, data bus, etc.). **Be able to:** application of knowledge in practical scenarios, such as designing or optimizing hardware components, choosing architectural approaches according to specific requirements. **Own:** the ability to apply knowledge and skills in specific projects, optimize architecture to achieve high performance, energy efficiency and security.
1	Technology of computer and communication systems	3	Information and communication technologies	Information Technology, operating systems, architectures and high-security network communication protocols	**Purpose:** it consists of providing students with the knowledge and skills they need to understand, design, develop, and maintain computer and communication systems. **Content:** Computer architecture: processors, memory, AI and tires for solving blockchain problems. Peripherals: graphics cards for neural networks, big data storage devices. Computer networks: topology, protocols, communication stacks for building blockchain systems. Local and global networks for organizing distributed computing in AI. Wireless networks for building blockchain-based IoT. Data transfer methods in highly loaded blockchain systems. IP address in large-scale blockchain applications. Diagnosis and elimination of problems in AI and blockchain systems. Ensuring the cybersecurity of blockchain platforms and AI. **Expected result:** **To know:** fundamentals of computer architectures, including processors, memory, I / O devices; principles of building and operating computer networks;

№	Subject name		Prerequisites	Postrequisites	Description
					fundamentals of programming and software development; **Be able to:** design of computer systems taking into account the requirements of performance, reliability and security; analysis and solution of problems in Computer and communication systems; design and configuration of computer networks; **Own:** develop software based on modern development methods; design and optimize the architecture of computer systems to increase productivity; apply methods to ensure the security of information in computer systems; work in a team, communicate and cooperate effectively in the process of solving problems.
2	Information theory	4	Information and communication technologies, computer architecture	Cloud technologies, Information Protection and information security	**Purpose:** teach students the basic concepts and principles of transmitting and processing information. **Content:** Basic concepts of information theory. Methods of encoding and compressing information. Work with information entropy. Optimality of codes and Shannon's theorem. Cryptography and Information Protection. Application of information theory in it. Work with communication channels. Algorithms and **Expected result:** **To know:** basic concepts of information theory, such as bits, bytes, information entropy, etc.; mathematical foundations of information theory, including the concepts of probability and statistics; basic theorems of information theory, such as Shannon's theorem on the bandwidth of a communication channel; various methods of encoding information, including Huffman codes, hamming codes and others. **Be able to:** assess 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 data transmission errors; understand the basic concepts of probability theory and their application in information theory; **Own:** work with various methods of data compression for effective storage and transmission of information; design and analysis of codes to correct errors in data transmission; apply theoretical knowledge to optimize the operation of Information Systems; apply methods of information theory in the field of signal processing and data transmission.
2	Information technology	4	Information and communication technologies, computer and Communication Systems Technology	Fundamentals of Data Science, Information Protection and information security	**Purpose:** providing students with comprehensive knowledge and skills in the field of information technology that can be successfully applied in the fields of business, science, education, etc. **Content:** Definition of the concepts of information and Information Technology. Definition of the concepts of information and Information Technology. Programming and software engineering. Basics of programming in the selected language (for example, Python, Java). Principles of software development. Computer networks. Database management systems (DBMS). Problems of ethics in Information Technology. The impact of it on society and social

					problems. **Expected result:** **To know:** fundamentals of computer systems and hardware; principles of operation of operating systems; principles of construction and operation of computer networks; principles of construction and operation of computer networks; **Be able to:** writing programs in one or more programming languages; designing and configuring computer networks; managing and maintaining information systems; **Own:** use algorithms and data structures to solve practical problems; work with modern tools for software development and repair; effective project management in the field of Information Technology.
3	Network architectures and security	5	Computer architecture	Cloud technologies, manufacturing experience	**Purpose:** understanding the principles of design, configuration and security of computer networks, which allows them to work effectively in the field of network technologies and information security. **Content:** Basic principles of network technology. Data protocols, network architecture, routing and packet switching. TCP / IP protocol, network models and standards. Security of networks and Information Systems. Attack protection methods, encryption and authentication principles. Methods for identifying and responding to security incidents. The principles and technologies of virtualization and cloud computing. Modern trends in network technologies such as Software-Defined Networking (SDN) and Network Function Virtualization (NFV). **Expected result:** **To know:** fundamentals of network technologies, including data protocols (e.g. TCP/IP), architectural principles, and network topologies; principles for building computer networks, including routing, switching, and quality of service assurance mechanisms (QoS); hardware used in networks such as routers, switches, firewalls (Firewalls), and points of Wi-Fi access; **Be able to:** design and configure computer networks taking into account performance, scaling and security requirements; configure network routing and switching for optimal data transmission; manage and maintain network devices and security systems; work with intrusion detection (IDS) and intrusion prevention (IPS)systems; **Own:** use tools for monitoring and analyzing network traffic; skills in conducting network security audits and detecting vulnerabilities; design and implement virtual private networks (VPNs) to ensure secure data transmission over open networks; work with wireless networks and take security measures in wireless scenarios.
3	Higher network communication architectures and protocols	5	Technology of computer and communication systems	Fundamentals of Data Science, production practice	**Purpose:** provide students with the in-depth knowledge and skills in network architectures and protocols necessary to work with modern and sophisticated network technologies and ensure their security and efficiency.

					Content: Different network architectures. Data protocols, network models and standards. Mechanisms and protocols that ensure the security of network communications and protection of data from unauthorized access. Principles and methods of data encryption, authentication, digital signature and Information Integrity Control. Network connection protection protocols, including Virtual Private Networks (VPN) and Secure Socket Layer (SSL). Analysis of network protocol vulnerabilities and development of security measures to prevent them. Methods for detecting and responding to security events, principles for building protected network architectures. **Expected result:** **To know:** the basic principles of modern network architecture, including scalability, performance and flexibility; different network topologies and their application in different scenarios; principles of operation of high-level network communication protocols such as HTTP/HTTPS, DNS, FTP, etc.; Software-Defined Network (SDN) and Network Function Virtualization (NFV)technologies; **Be able to:** design modern network architectures taking into account performance, scaling and security requirements; develop and optimize network communication protocols taking into account specific tasks and operating conditions; work with Software-Defined Networking (SDN) and Network Function Virtualization (NFV) technologies to build flexible and managed networks; **Own:** programming and developing applications that interact with network protocols; working with network architecture modeling and analysis tools; configuring and managing network equipment, including routers, switches, firewalls, etc.
4	Introduction to blockchain	6	Information and communication technologies	Decentralized applications, introduction to artificial intelligence	**Purpose:** gain theoretical knowledge of blockchain technologies, as well as explore the related topics of cryptography, wallets, nodes, smart contracts and tokens. **Content:** Introduction to blockchain. Blockchain basics. Cryptocurrency and smart contracts. Decentralized applications. Examples of using the blockchain. Development of smart contracts. Development tools. Web3 defi development tools. Web3 development tools. Alternative Web3 development tools. Architectural design of blockchain. Advanced blockchain concepts. Solidity-writing smart contracts on the Ethereum platform. **Expected result:** **To know:** basic concepts, advantages and limitations of blockchain technology; the main differences between blockchain and other technological systems;. Cryptographic fundamentals of blockchain technology on the Net platform;. Technologies for creating blockchain applications on the Net platform; possible consequences of blockchain technology for society; ethical considerations to consider when developing

					decentralized applications; **Be able to:** use of blockchain technologies;. application of the cryptographic foundations of blockchain technology on the net platform;. Creation of blockchain applications on the Net platform; formation of skills in working with existing and promising blockchain technologies; mastering the mathematical foundations of technology (cryptography, consensus) and familiarization with environments and structures for the development of blockchains; secure smart contracts, fully functional decentralized applications, independent financial services, NFT and gamefi projects; **Own:** Create 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.
4	Fundamentals of blockchain technology	6	Information and communication technologies	Database Basics, introduction to artificial intelligence	**Purpose:** the study of blockchain (distributed registry) technology with an emphasis on its mathematical and technical foundations, as well as applied aspects **Content:** Definition of blockchain technology. Blockchain architecture. Cryptographic foundations. The order of operation of the blockchain transaction. The purpose of the blockchain. Limitations of blockchain technology. Types of blockchain networks. The use of blockchain technology to organize distributed databases. Smart contracts. Decentralization. Transactions on the blockchain. Mining and consensus mechanisms. Problems and solutions on the blockchain. Interoperability and standards. Business and blockchain. Trends and prospects of the blockchain. **Expected result:** **To know:** understand basic concepts such as decentralization, distributed registry, blocks and block chain; know the differences between public and private blockchains; understand the principles of cryptography used in the blockchain to ensure data security and integrity; fundamentals of the operation of smart contracts, their purpose and principles of writing on Ethereum-type platforms; **Be able to:** sending and receiving cryptocurrencies, signing transactions and checking balances; creating program codes to execute on the blockchain to automate and manage agreements; research and analysis of transactions to determine information on the transfer of assets on the blockchain; **Own:** Skills in using specific blockchain platforms such as Ethereum, Hyperledger or others; creating applications that use blockchain as the main component; using security methods to protect blockchain networks and transactions; the ability to integrate blockchain into various business processes and Information Systems.
5	Decentralized	5	Introduction to blockchain	Blockchain	**Purpose:** focused on learning the technical skills needed to create decentralized applications on public

6	applications			system architecture	blockchains. As well as mastering applications, that perform business transactions without the participation of a trusted third party. **Content:** The main components of a Decentralized Application (DApp). DApp, social and project issues that hinder the implementation of smart contracts. Written in the solid programming language, Ethereum is a development environment required for writing, testing, and deploying DApp. **Expected result:** **To know:** planning, design, implementation and testing through dApps with the appropriate blockchain network configuration on an enterprise scale; **Be able to:** Understanding the architecture and components of Dapp, including front-end and internal processing supported by Blockchain and Smart contracts; **Own:** critical assessment of new standards and blockchain architecture and their application in various situations.
5	Database Basics	5	Fundamentals of blockchain technology	Ethereum, Web3 and Truffle development environments	**Purpose:** is the preparation of students for the effective design, use and management of databases, which is a fundamental skill in Information Technology and other fields. **Content:** Different types of databases, including relational, hierarchical, network, and NoSQL databases. The structure and organization of databases, including tables, diagrams, indexes, and queries. SQL (Structured Query Language) and its use to manipulate data in databases. Basic SQL Operations. Methods of data normalization and database design. **Expected result:** **To know:** understand the principles of organizing data in the form of tables, relationships, and keys; know the basics of SQL for creating, querying, and modifying data in a database; understand the basic concepts of transactions and methods for ensuring data integrity in a database; **Be able to:** creating a database schema, defining objects, attributes, connections, and keys; writing queries to select, enter, update, and delete data in the database; applying Normalization Principles to improve the database structure and ensure its efficiency; creating indexes to improve query performance; **Own:** creating databases for specific applications and projects; skills in analyzing the structure of databases, identifying problems and providing solutions; ability to work with the command line of various database management systems; integration of databases with various applications and Web Services
6	Blockchain system architecture	5	Cloud technologies, decentralized applications	Data mining on the blockchain	**Purpose:** this course aims to understand and develop the architecture of blockchain systems. **Content:** Blockchain architecture. Database and blockchain architecture. Algorithmic management through smart contracts, hierarchical and alternative blockchain structures to distributed registry technologies (DLT). There are no permissive and

					permissive architectures, programmable circuits versus corporate architectures. Enterprise Development and security architecture and DLT connectivity. Development and implementation of DLT in the future: scenarios of Use, expansion, possible risks and problems. **Expected result:** **To know:** internal operation of smart contracts as a tool for developing decentralized applications; interaction between a closed network of smart contracts and the outside world, about the further consequences of these interactions-understanding the set of technologies that support the network's reference decentralized storage network (e.g. IPFS, Swarm, Filecoin; **Be able to:** define the main characteristics of the blockchain (i.e. decentralization, stability, anonymity, verifiability, etc.); explain the different 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 operation, storage options, and the main existing **Own:** predict the development and implementation of DLT in the future based on various usage examples; understand how other emerging technologies (such as IoT and AI) can be used in blockchain.
6	Ethereum, Web3 and Truffle development environments	5	Fundamentals of data science, fundamentals of databases	Data analysis	**Purpose:** As part of this course on Ubuntu and Debian servers, create your own Ethereum blockchain node for further work. **Content:** Introduction to Ethereum. Fundamentals of the work of the Ethereum blockchain fundamentals of the Web3 library.js. Truffle Framework. Introduction and installation instructions for working with Truffle. Develop, test, and deploy smart contracts using Truffle. Project in the Truffle environment. Contracts in the Ethereum network. Work with contracts in Web3j.Use of Web3.js for creating decentralized applications (DApps). **Expected result:** **To know:** Understand the main components and tools in the development environment for Ethereum, including Ethereum Virtual Machine (EVM), smart contracts, Ethereum blockchain, etc.; know the Web3 library. JS, which provides a JavaScript API to interact with the Ethereum blockchain from web applications; understand the Truffle tool, which provides a set of tools for developing, testing, and deploying smart contracts on the Ethereum blockchain; **Be able to:** Use of Web3.using JS; Web3 to send transactions, Invoke smart contract methods, and retrieve data from the blockchain.js to send transactions, Invoke smart contract methods, and retrieve data from the blockchain; use debugging tools provided by Truffle to detect and eliminate errors in smart contracts; **Own:** interact with the Ethereum blockchain from web

					applications, including data transfer, transaction execution, and performance display; create and manage local blockchain networks to test smart contracts without using the underlying Ethereum network
7	Probability theory	5	Mathematics	Mathematical foundations of artificial intelligence	**Purpose:** to analyze and model random phenomena, as well as apply probabilistic methods in various fields of knowledge, is to provide students with the necessary theoretical knowledge and practical skills. **Content:** Application of knowledge of probability theory to the analysis of real data and adoption of justified statistical conclusions. Rules for adding and multiplying probabilities. Algebra and sigma-event algebra. Discrete and continuous random variables. Mathematical expectation and variance. Multidimensional distributions. The laws of large numbers and the Central Limit Theorem. Statistical conclusions. Statistical conclusions. **Expected result:** **To know:** understand basic terms such as probability space, random event, probability, conditional probability, etc.; know the basic operations of events as well as the properties of Sigma algebra; be aware of the different distributions (discrete and continuous) and their properties; **Be able to:** creation and use of probability models for the analysis of random events; solving problems of calculating the probability of various events, including conditional probabilities; identifying and using various distributions, including normal distributions, Poisson distributions, etc.; calculating mathematical expectations, variance and other characteristics of random variables **Own:** calculate mathematical expectation, variance and other characteristics of random variables; build models of random processes and use them to predict; use software tools such as Python with NumPy, SciPy and others to calculate and analyze data related to probability theory; apply knowledge of probability theory to the analysis of real data and take statistical data based on inferences.
7	Probability theory and Mathematical Statistics	5	Mathematics	Graph theory	**Purpose:** To obtain generalized knowledge about any probabilistic and statistical systems, to identify the General Laws of their construction and functioning. Identification of objects of application of the acquired knowledge using modern information technologies **Content:** Basic concepts of probability theory. Tests and events. Actions on events. Random events. Types of random events. Basic formulas of combinatorics. Classical definition of probabilities. Theorem on adding the probability of inconsistent events. Full group of events. Opposite events. Independent and dependent events. Multiplication theorem for independent events. Conditional probability. Solving problems with conditional probability. **Expected result:** **To know:** patterns in random and Information Processes (type of distribution, quantitative

						characteristics, accumulation, recycling, distribution, etc.); **Be able to:** creation of mathematical and computer models of random phenomena in various spheres of human activity; **Own:** Information on the main scientific achievements in probability theory and Mathematical Statistics.
8	Mathematical foundations of artificial intelligence	5	Probability theory		Mathematical logic and algorithm theory	**Purpose:** training students with the mathematical basis necessary for successful work in the field of artificial intelligence and machine learning. **Content:** history and relevance of the creation of artificial intelligence systems. The main methods and models of knowledge presentation (logical model, product rules, network models, frameworks, scenarios, object-oriented model). Mathematical description of the latest Automata and Turing machines. Problems of solving tasks on the example of a Turing machine. Mathematical foundations of neural networks. Pattern recognition. The study of mathematical concepts and methods used in artificial intelligence. **Expected result:** **To know:** understand vectors, matrices, operations on them, eigenvalues and vectors; fundamentals of probability theory, Probability Distribution, statistical methods, including parameter estimation and hypothesis testing; knowledge of the principles of building and analyzing mathematical models, especially in the context of artificial intelligence; **Be able to:** Working with vectors and matrices, applying linear algebra to training and forecasting problems; developing mathematical models for artificial intelligence and machine learning problems; **Own:** application of mathematical methods in solving real problems of artificial intelligence; work with libraries such as NumPy, SciPy to effectively implement mathematical operations in program code.
8	Graph theory	5	Probability theory and Mathematical Statistics		Logical mathematics	**Purpose:** to provide students with theoretical knowledge and practical skills for the successful application of graph theory in solving problems of various fields. **Content:** The study of graphs as abstract mathematical objects and their application in various fields, including artificial intelligence, blockchain and other information systems. Basic concepts of graphs such as vertices, edges, oriented and non-oriented graphs, weights and symbols on edges, as well as various types of graphic structures such as trees, cycles, and networks. **Expected result:** **To know:** knowledge of the basic concepts of graph theory, such as Vertex, edge, graph, directed graph, Subgraph, etc.; distinguish between oriented and non-oriented graphs, connected graphs, trees and other types of graphs; **Be able to:** ability to mathematically represent graphs using matrices and other data structures; apply theoretical knowledge to solving specific problems such as network planning, routing, and social media

					analysis; **Own:** writing graphic programs, including the implementation of algorithms and visualization; the effective use of graphic theory to solve various problems on the blockchain.
9	Python programming	5	Introduction to programming	Modern methods and tools for Programming Java	**Purpose:** familiarization with the object-oriented Python programming language, language syntax, technology and methods of programming in the Python environment, training practical programming skills in Python for solving typical problems. **Content:** Python programming. Basic principles and concepts of programming, such as variables, conditional operators, loops, functions, and data structures. Features of the Python language, its syntax and capabilities, as well as the main libraries and tools for developing programs. Processing errors and exceptions. Work with libraries. Interact with databases using libraries such as SQLite or sqlalchemy. Execution of SQL queries from Python. Fundamentals of testing: unit testing, Functional Testing. **Expected result:** **To know:** understand syntax, data types, operators, conditional operators, and loops; understand the principles of Object-Oriented programming, including the creation of classes and objects, inheritance, and encapsulation; understand the basics of working with databases, such as executing SQL queries from Sqlite and Python; fundamentals of testing, including unit testing and functional testing; **Be able to:** Writing programs for solving various problems and creating applications in Python; writing programs for solving various problems and creating applications in Python; working with databases, executing queries and processing results; reading, writing and processing data from files of various formats; **Own:** the ability to put into practice the knowledge and skills acquired during the development of software solutions; the ability to independently learn new libraries, frameworks and programming methods; the ability to work effectively in the development team, use version control systems (for example, Git)
9	Programming in GO	5	Introduction to programming	Modern methods and tools for programming the NET	**Purpose:** provide students with the skills necessary to work effectively with this programming language and develop reliable and productive applications. **Content:** Basics of programming using the Go language. Study the basic concepts and syntax of GO. Learn basic data types in GO and use them. Features and capabilities of the language, BASIC programming concepts and development of program code using go to create applications and solve problems in artificial intelligence and blockchain. Learning methods to optimize code performance in Go. **Expected result:** **To know:** Syntax, basic structures and data structures of the GO language; fundamentals of web development using the GO language; development of microservices and APIs in the go language;

					Be able to: create applications in the Go language, including console and web applications; use structures such as Gin or Echo to develop web applications; write test cases and check the correctness of the code; **Own:** Effectively apply knowledge and skills in practice when developing software solutions; the ability to independently learn new libraries, structures and programming methods in the Go language; apply knowledge to solve complex problems in various fields, such as development, web development, microservice architecture and blockchain.
10	Instrumentation of program development	5	Operating systems	Modern methods and tools of Java programming, architecture and development of 3D games	**Purpose:** prepare students for the effective use of CASE technologies in the software development process, improve the quality and performance of development, and provide an understanding of modern tools and methodologies widely used in the software development industry. **Content:** Case-acquaintance with technologies. Classification of instrumentation. Methods and tools. Modern CASE (Computer-Aided Software Engineering) - Technologies. Technology of development and implementation of CASE tools. Evaluation of Case tools. Description of modern case Tools. Testing and repair. Design methods and the life cycle of programs. Use of code analysis tools. Integration with cloud services. **Expected result:** **To know:** Basic principles and concepts of Case technologies; modeling software development processes using CASE-tools; principles of code generation using CASE-Tools; **Be able to:** development of project models using case-Tools; analysis of test results and program debugging; work with version control systems in the context of case; **Own:** application of CASE-technologies in the process of software development; optimization of software development processes using CASE-technologies; analysis and implementation of best practices in the field of case.
10	UI/UX designs	5	Operating systems	Modern methods and tools for programming NET, Multimedia Design	**Purpose:** prepare students to create satisfying, effective, and visually appealing user interfaces, as well as provide an understanding of the principles underlying a successful user experience. **Content:** Stages of development and support of internet resources. The purpose of UX and UI design. Analysis of user needs and usability testing. Principles of UX. Designing the user experience and building an information architecture. Fundamentals of web page design and prototyping. Development of a prototype and interface for a web page in Figma and Adobe Photoshop. **Expected result:** **To know:** the difference between the user interface (UI) and the user experience (UX); popular tools for creating layouts and prototypes(for example, Sketch, Adobe XD, Figma); knowledge of color combinations, palette selection, and creating contrast elements;

					Be able to: develop UI layouts taking into account design principles and user needs; create designs that can be easily adapted to different devices and screen resolutions; **Own:** the ability to be creative when creating unique and innovative design solutions; the ability to explain and justify design solutions clearly and effectively; understanding the ethical aspects of design, including respect for accessibility and user privacy.
11	Mathematical logic and algorithm theory	5	Mathematical foundations of artificial intelligence	Blockchain business models	**Purpose:** to provide students with the theoretical foundations necessary to understand fundamental concepts in mathematical logic and algorithm theory and to give them the tools for formal analysis and solution of computational problems. **Content:** The basic concepts and principles of mathematical logic, including formal systems, logical operations, reasoning and reasoning. Basic concepts of algorithm theory, such as algorithmic complexity, formal languages, and Automata. The use of Turing machines to formalize algorithms. Development and analysis of effective algorithms, the use of logical methods and formal models in the field of artificial intelligence and blockchain. **Expected result:** **To know:** basic concepts: statements, quantifiers, logical connections; Set Theory and its application in mathematical logic; the concept of calculus and formal languages; types of algorithms: recursive, iterative, divide and conquer, greedy algorithms, etc. ; **Be able to:** ability to create mathematical arguments; the ability to abstract from specific problems and work with General models; **Own:** Application of the theory of algorithms in practice through programming; application of mathematical logic in the formalization and analysis of computational processes. ability to create and analyze formal mathematical arguments.
11	Logical mathematics	5	Graph theory	Blockchain and the basics of cryptocurrency	**Purpose:** the formation of basic knowledge and skills in students in the field of mathematical logic, teaching the basic principles and methods of logical inference, the development of critical thinking and the ability to think logically. **Content:** The theme and meaning of logic. The origin of logic. The meaning of logic. Concept as a form of thinking. Basics of describing correct thinking. Laws of correct thinking. General concept of the conclusion and its types. Simple categorical syllogism. Conclusions of statement logic. Mathematical symbolic logic. The structure and types of proof. Rules of reasoned reasoning. Logical errors in proof. The concept of logical paradoxes, paralogisms and sophisms. Types of hypotheses. Hypothesis construction and stages of its development. **Expected result:** **To know:** basic concepts of statements, predicates, quantifiers and logical operations; basic definitions and concepts in algorithm theory, including the concept of algorithm, Turing machine and computation;

					understanding the basic concepts of algorithmic complexity, including the use of running time and resources; **Be able to:** use mathematical logic to formalize and solve various problems; master the work with formal systems, apply the rules of conclusion and proof; use the concepts of the theory of algorithms in the design and analysis of programs; **Own:** the ability to apply the theory of mathematical logic and algorithms on the blockchain; apply knowledge and skills in real professional problems, including in the field of programming and data analysis.
12	Neural networks and their applications	5	Introduction to artificial intelligence, the Internet of things	Artificial intelligence for information security	**Purpose:** to understand the principles of operation and application of neural networks, as well as to develop skills in working with modern technologies in the field of blockchain. **Content:** The basic principles and methods of neural networks and their practical application. The structure and function of artificial neural networks, including various architectures and types of neural networks, training and optimization algorithms. Various areas of application of neural networks, including computer vision, natural language processing, suggestion systems, speech recognition, etc. Development of the use of neural networks, which is a key aspect of work in the field of artificial intelligence and blockchain. **Expected result:** **To know:** basic principles of operation and activation of artificial neurons; various methods of training neural networks, including methods of reverse error propagation and optimization; basics of working with the selected framework for building and training neural networks; **Be able to:** selection of the architecture and configuration of neural networks depending on a specific task; selection of the architecture and configuration of neural networks based on a specific task; application of knowledge about neural networks to solve specific problems within the framework of specific projects on the blockchain **Own:** mastering the framework chosen for the construction and training of neural networks; programming skills in languages used to implement neural networks, such as Python; data skills for use in neural networks, their analysis and preprocessing.
12	Artificial neural networks	5	Introduction to artificial intelligence, design of distributed control systems	Cryptography	**Purpose:** preparing students for the use and design of artificial neural networks in various contexts and in the blockchain area. **Content:** Basic principles and methods of artificial neural networks. Creation, training and application of neural networks. Different types and architectures of neural networks, including perceptrons, repetitive neural networks, convolutional neural networks, and deep neural networks. Error reverse propagation algorithms, optimization of neural network parameters and solving problems of data classification, regression and generation using neural networks. Development

№					
					and application of artificial neural networks in the field of artificial intelligence and blockchain. **Expected result:** **To know:** different neural network architectures and structures, including perceptrons, convolutional networks, and iterative networks; understand how smart contracts can be used to manage and interact with artificial neural networks on the blockchain; **Be able to:** the ability to integrate and interact artificial neural networks in a blockchain environment; the ability to ensure the security and integrity of artificial neural networks used in the blockchain; **Own:** master the skills of developing and working with blockchain platforms that implement artificial neural networks; master the methods of analysis and audit that manage smart contracts, especially artificial neural networks in the blockchain.
13	Modern methods and tools for Programming Java	3	Python programming, software development	Blockchain business models	**Purpose:** Mastering the methods and tools, as well as the basics of programming in Windows OS in Java and preparing them for active use in solving the problems of the chosen specialty. **Content:** Overview of Java technology and platform. Java data types. Reference data types. Expressions and operators. Types of transformations. Main () method. Variables and constants, fields of objects and classes. Field of view. Complex data types. Arrays are one-dimensional, multidimensional. Roads. Methods of working with strings. Shell classes. The Math class, its methods and constants. Java Object Model. Class and object. **Expected result:** **To know:** data types, characteristics, operations, language operators; principles of Object-Oriented programming; fundamentals of computer networks and network integration, Internet services, concepts, Java programming environment. **Be able to:** use classes for processing applications; working with files; using the principles of building a graphical interface, graphical primitives; converting applets. **Own:** working with operators, application processing arrays; creating classes, class methods, object publishing; creating client components and applications; working with Java network technologies
13	Modern methods and tools for programming the NET	3	Programming in Go, UI / UX design	Blockchain and cryptocurrency basics	**Purpose:** Mastering methods and tools, as well as the basics of programming in NET on Windows OS and preparing them for active use in solving the problems of the chosen specialty. **Content:** Platform concept. . Components of the .NET Framework. Application, project, solution, development environment, concept of compiling and executing programs in the CLR environment. Features of traditional data structures. Communication with object standard libraries. Net. the paradigm of Object-Oriented Programming. The most important concepts of encapsulation, inheritance, polymorphism. Features of the object model for the .NET platform. **Expected result:**

					To know: dlanguage operators; principles of Object-Oriented programming; fundamentals of computer networks and network integration, Internet services, concepts, net programming environment. **Be able to:** use classes for processing applications; working with files; using the principles of building a graphical interface, graphical primitives; converting applets. **Own:** working with operators, application processing arrays; creating classes, class methods, object publishing; creating client components and applications; working with NET network technologies.
14	Using data in machine learning	3	Azure machine learning	Writing a thesis	**Purpose:** this discipline introduces students to the theoretical foundations and algorithms of machine learning, their practical implementation and application in solving specific problems. **Content:** Classification of machine learning algorithms stages of machine learning. Setting the tasks of classification, regression, forecasting and differentiation. Setting the tasks of clustering, searching for associative rules, filtering emissions, creating a confidence zone, reducing dimensionality, and filling in missing values. Algorithms for creating associative rules. Filtering data. Classification of neural network architectures deep learning neural networks. Convolutional neural networks. Basic concepts and stages of genetic algorithms. **Expected result:** **To know:** principles of constructing sign vectors, decisive rules and classifications; main types of classifiers; principles of constructing linear classifiers; principles of constructing nonlinear classifiers; features of selection of classification signs and preliminary data processing. **Be able to:** selection of the appropriate type of classifier depending on the problem being solved; selection of a set of signs for classification and preliminary processing of data; training of the classifier by choice and the use of compilation algorithms; carrying out calculations related to the study and operation of the classifier. **Own:** selection, creation, training and use of the main classifiers problem solving.
14	Introduction to machine learning and data analysis	3	Azure Cognitive activity	Writing a thesis	**Purpose:** Possess Python skills, know and understand data management tasks, including data loading, data conversion and preliminary data analysis and visualization, get acquainted with the main tasks and models of machine learning, know methods for assessing the quality of work of various machine learning models, understand the process of integrating machine learning models within the framework of the tasks facing potential consumers. **Content:** Discrete analysis and probability theory. Introduction to machine learning. Neural networks. Criteria for selecting models and methods for selecting signs. Stages and methods of conducting cluster analysis. Methods of logical classification. Clustering methods.

					Expected result: **To know:** basic approaches to data transformation; the main stages of conducting a machine learning project; **Be able to:** working with arrays-formulate business tasks as machine learning tasks-find solutions to machine learning problems in specific business tasks; **Own:** Loading, converting, cleaning, and visualizing data in Python using machine learning models in Python is a quality assessment and interpretation of results.
15	Architecture and development of 3D games	4	Instrumentation of program development	Production practice, writing a thesis	**Purpose:** prepare students to work in the game development industry by providing practical skills and knowledge in 3D graphics, programming, and game scenario design. **Content:** Architecture and development of three-dimensional games. Software of computer games. Various aspects of creating 3D games, including game scene design, object modeling, texturing, lighting, and animation. Principles of operation of game engines and software tools for developing 3D games, such as Unity or Unreal Engine. Design and develop high quality 3D games. Artificial intelligence and blockchain industries. **Expected result:** **To know:** understand the basic principles of three-dimensional graphics, including working with three-dimensional models, lighting, shadows, and textures; know the operating principles of game engines, including scene, resource management, and interaction with a physical engine; know how to test and debug 3D gaming applications; **Be able to:** development of 3D games, including the creation of graphic effects and interaction with the user; import, animate and integrate 3D models into the game environment; use the functionality of game engines to control the development process; **Own:** master professional tools for developing 3D games, including editors, compilers, and development environments; be able to work in a team of developers, artists, and sound designers to develop a unified game concept; be able to solve technical and creative problems that arise in the process of developing 3D games
15	Multimedia Design	4	UI/UX designs	Production practice, writing a thesis	**Purpose:** The development of visual and Information Culture for the purpose of personal and professional self-determination, the formation of skills in using multimedia design forms for professional tasks of interface design. **Content:** Visual design, color theory, composition, typography and other aspects. Various tools and software tools used in multimedia design, such as Adobe Photoshop, Adobe Illustrator, Adobe After Effects, and others. Graphic elements, animations, video effects and sound accompaniment for various purposes. Multimedia and blockchain to interact with artificial intelligence and create innovative multimedia solutions. **Expected result:**

№	Name		Prerequisites	Postrequisites	Content
					To know: the essence of the concept of multimedia, types of multimedia, stages of development and the main trends in the development of multimedia in visual culture, the role and tasks of multimedia in modern visual culture, the place of Multimedia Design in the design of information resources, the principles of Multimedia Design **Be able to:** determining the tasks and means of developing multimedia projects, using design tools for designing multimedia, choosing the type of media in accordance with the tasks set; **Own:** Multimedia Design through design tools and special applications.
16	Artificial intelligence for information security	4	Information protection and information security, neural networks and their applications	Prediploma practice, writing a thesis	**Purpose:** Students study possible ways to use artificial intelligence to ensure information security and prevent unauthorized access to information, as well as minimize the consequences of information security violations. **Content:** Artificial intelligence methods and technologies used in the field of Information Security. Different algorithms and models of machine learning. Ways to use artificial intelligence to detect and prevent cyber-attacks, analyze threats, automate security processes, and develop protected systems. The basic principles of machine learning algorithms and their application in information security issues, including detecting anomalies, classifying malware, analyzing data streams, and predicting vulnerabilities. Artificial intelligence technologies in the tasks of ensuring information security and increasing the efficiency of Information Systems and data protection. **Expected result:** **To know:** modern information and communication and intellectual technologies for solving professional tasks, instrumental environment, software and technical platforms; new scientific principles and methods of developing software and hardware support for artificial intelligence technologies and systems for solving professional tasks in various subject areas; features of modernization of software and hardware support for artificial intelligence technologies and systems for solving professional tasks. in different subject areas; **Be able to:** justification of the choice of modern information and communication and intellectual technologies, development of unique software tools for solving professional tasks; development of software and hardware support of artificial intelligence technologies and systems, taking into account information security requirements for solving professional tasks in various subject areas; modernization of software and hardware support of artificial intelligence technologies and systems, taking into account information security requirements for solving professional tasks in various subject area **Own:** it is carried out by methods of developing unique software tools using modern information and communication and intellectual technologies to solve professional tasks.

| 16 | Cryptography | 4 | Information protection and information security, artificial neural networks | Prediploma practice, writing a thesis | **Purpose:** development of the ability to develop algorithmic and software solutions in the field of mathematical, information models.
Content: The basic principles and methods of cryptography. Various encryption algorithms and protocols, authentication methods and digital signature. Principles of steganography and strength analysis of cryptographic algorithms. Classical methods of cryptography, such as the Caesar cipher and the Wijener cipher. Modern symmetric and asymmetric encryption algorithms, including RSA, AES, DES, and others. Principles of cryptographic hash functions, digital certificates and key exchange protocols.
Expected result:
To know: Basic concepts in the field of algorithmization, properties of algorithms, methods for analyzing the complexity of algorithms, effective algorithms for data encryption and decryption; about the consequences of their professional activities;
Be able to: development of algorithms for solving typical problems in the field of cryptography; application of typical algorithms in solving problems; formation of judgments about the essence of their professional activity;
Own: methods of reading, creating and writing algorithms; skills in encrypting and decrypting data; skills in forming judgments about their professional activities. |

| **Professional disciplines** |||||||
| **Selection components (KV)** |||||||

| 1 | Cloud technologies | 3 | Network architectures and security | Blockchain system architecture | **Purpose:** preparing students for successful work in the field of Information Technology, where cloud technologies are becoming more widespread and important.
Content: Introduction to cloud technology. Modern technologies associated with cloud computing (IaaS, PaaS, SaaS) and distributed systems. The main concepts, principles and methods of working with cloud resources. Amazon Web Services (AWS), Microsoft Azure cloud platforms. Concepts of security and data protection in a cloud environment. Authentication, authorization and encryption methods, as well as the use of security policies and monitoring mechanisms in the context of cloud computing. Cost management in the cloud.
Expected result:
To know: fundamentals of cloud computing, including maintenance and deployment models; basic services and capabilities of popular cloud platforms such as AWS, Azure, and GCP; security principles and threat protection methods in cloud computing; infrastructure concepts as code (IaC) and its role in process automation;
Be able to: development and deployment of applications in a cloud environment using the platform's core services; design and implementation of secure cloud architectures; cost optimization and Resource Management in the cloud; application of |

					infrastructure principles as code to automate infrastructure management; **Own:** programming and application development compatible with cloud platforms; configuring and managing cloud services; analyzing and solving security problems in cloud computing; optimizing resource usage and managing costs.
1	Data Science basics	3	Architectures and protocols of high-security network communications	Ethereum, Web3 and Truffle development environments	**Purpose:** preparation for the effective application of Data Science methods in various areas where data analysis is of strategic importance. **Content:** Definition and basic concepts of Data Science. Data Science programming tools and languages. Linear algebra for Data Science. Data collection and storage. Data processing and cleaning. Fundamentals of machine learning. Linear regression. The use of Data Science in real projects. Building and evaluating models. Data Science Trends and innovations. Methods for evaluating and selecting models, as well as the basics of validation and cross-checking. Development and implementation of the Data Science project. **Expected result:** **To know:** basic concepts and terms in data science; basic tools and programming languages used in data science(e.g. Python, Pandas libraries, NumPy); principles of working with databases and obtaining data for analysis; basic machine learning techniques such as linear regression, classification and clustering; **Be able to:** use data analysis tools for efficient data processing, analysis and visualization; work with databases to obtain and process data; use statistical analysis methods to interpret results; **Own:** development and implementation of projects in the field of Data Science, from task setting to results visualization; development and implementation of projects in the field of data Science, from task setting to results visualization; adaptation to new technologies and trends in the field of Data Science, continuing training and professional development.
2	System programming	5	Introduction to programming	Python programming	**Purpose:** skills in developing complex software systems and system applications that interact with the hardware of computers. **Content:** Basic definitions and concepts. Purpose, functions of system software. Operating system interfaces. Fundamentals of programming system elements in modern operating systems. Multi-flow concept. Compiler components. Compilation Phases. Features of the syntactic constructions of the assembly language. Features of the use of blocking variables in application development. **Expected result:** **To know:** 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 Organization of operating systems and structures of device drivers; fundamentals of security and reliability of system software;

					Be able to: designing and implementing algorithms at a low level, taking into account hardware specifications; efficient use of multitasking and multithreading in system software; designing and developing system software such as operating systems or compilers; testing and debugging system software; **Own:** work with low-level programming languages to create effective and optimized solutions; apply the principles of security and reliability when developing system software; work with version control systems and other development tools.
2	System programming and computer technology	5	Introduction to programming	Programming in GO	**Purpose:** to study in-depth aspects of software development that work at a close level with computer hardware **Content:** Network technologies and protocols. Methods of interaction and data exchange between computer systems. The principles of operation of networks, data transfer protocols and various communication methods, including client-server architecture and network programming. Principles of security and information protection in computer systems. Authentication methods, encryption and mechanisms for ensuring the confidentiality and integrity of data. **Expected result:** **To know:** understand the principles of software and hardware interaction; understand the principles of software and hardware interaction; be able to understand and develop programs that use efficient 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:** developments for embedded systems, the Internet of Things (IoT) and other relevant technologies; with methods to ensure the security and reliability of system software;
3	Microcontrollers and microprocessor systems	5	Physics	Internet of things	**Purpose:** To teach students the principles of creation, functionality and architectural solutions of modern microprocessor systems (MPs), microcontrollers (MK) and personal computers, as well as to master the methods of designing microprocessor systems (IV). **Content:** Fundamentals and tasks of organizing the design of microprocessor systems (MPs). Architecture of microprocessors, MPs and microcontrollers (MK). Management of peripheral equipment in the PPE. Data Processing, Management. Organization of MP and MK interfaces. Design of MPs. **Expected result:** **To know:** 1810vm86 software and logic model of the microprocessor; 1810vm86 operating modes of the microprocessor; principles of building microprocessor systems; software and logic model of microcontrollers of the 1816 series; 1816 VE48 operating modes of the micro-computer **Be able to:** Development of microprocessor systems

					based on sets 1816 and 1810; testing microprocessors in computers **Own:** Assembly of electronic circuits for the operation of microprocessors and connection methods.
3	Fundamentals of microprocessor technology	5	Physics	Design of distributed control systems	**Purpose:** Familiarization of students with the classification of microprocessor systems (MPs), basic architectures, functional nodes of the MPs and the principle of operation of the processor, study the architecture, command system, the procedure for working with the main peripherals and subsystems of a particular single-chip RISC microcontroller, approval of the main theoretical provisions. **Content:** Introduction to microprocessor technology. Creation of microprocessor control systems. Presentation of information in microprocessor systems. Operation of microprocessors. Data transfer commands. Arithmetic commands. Commands to control the order of execution of the program. Logical commands and bit control commands. Commands for working with arrays and strings. Modern tools for the development of microprocessor control systems. **Expected result:** **To know:** principles of creating electronic devices based on a modern element base and PPE; principles of operation of electronic devices based on a modern element base and PPE; basic technical parameters, operational characteristics and areas of application of the main devices and functional units of electronics and PPE; basic principles of designing circuits based on PPE. **Be able to:** Implementation of design and calculation of typical MPs nodes; implementation of the selection of MPs according to the required task. **Own:** Analysis and synthesis of electronic circuits with MPs; design and calculation of electronic devices using computers.
4	Azure machine learning	5	Operating systems	Using data in machine learning	**Purpose:** teaching students modern approaches to machine learning using Azure cloud resources, as well as providing practical experience in working with the tools and services of this platform. **Content:** Introduction to Azure machine learning. Various machine learning algorithms and their application using the Azure platform. Working with data in Azure. Classification, regression, clustering algorithms and other machine learning methods. The process of learning machine learning models using Azure Machine Learning. Optimization of hyperparameters, crossvalidation and evaluation of the quality of models through various metrics. Security and privacy in Azure machine learning. **Expected result:** **To know:** understand the basic concepts, types of tasks and indicators for assessing the quality of models; know the main components of the platform and their roles in the process of developing and deploying models; know the various algorithms of machine learning on the Azure platform and the methods of their training;

					Be able to: select suitable models for specific tasks and develop them; use the main capabilities and tools of the Azure Machine Learning platform to solve practical problems; organize experiments, track model options and conduct comparative analysis; **Own:** Work with real data and solving real problems with Azure Machine Learning; work effectively in a team, link results and discuss problem solving strategies; quickly master new technologies and methods in the field of machine learning.
4	Azure Cognitive activity	5	Operating systems	Introduction to machine learning and data analysis	**Purpose:** is preparing students to use Azure Cognitive Services effectively in specific projects, as well as to understand technology in different areas of business and industry. **Content:** Principles of application of blockchain technologies in the context of congnive services. Features of using blockchain to ensure security. Different scenarios for using Azure Cognitive Services. Development of intellectual assistants. Social media key analysis, automatic document classification, automatic translation, etc.work with the Azure Data Warehouse. Project development using Cognitive Services. **Expected result:** **To know:** understand what cognitive services are and how they are used in cloud computing; know the basics of Cognitive Services Architecture in Azure; know the basics of natural language processing and image recognition; **Be able to:** use Azure Cognitive Services to solve specific problems; skills in working with APIs and services interaction tools; integrate cognitive services with other Azure services; work with cloud services to create comprehensive solutions; **Own:** processing and analysis of text and visual information using cognitive services; working with real data and participating in projects using Cognitive Services; effectively correlating the results of working with cognitive services and documenting processes.
5	Data mining in the blockchain	5	Blockchain system architecture	Architecture of smart contracts	**Purpose:** is the use of data mining to extract valuable blockchain information. **Content:** The study of various scenarios for the use of data mining algorithms in blockchain technologies. Features of analysis and detection of anomalies, forecasting and classification of data. Data clustering and segmentation methods in the context of the blockchain environment. Ways to combine data mining with blockchain. Smart contracts and smart contracts that use data analysis results to automate business processes and make decisions in a blockchain environment. **Expected result:** **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 encryption, signing and authentication

					methods in blockchain; **Be able to:** analysis of transactions, blocks and smart contracts on the blockchain; identification of patterns and deviations in blockchain data; design and implementation of intelligent systems for analyzing data on the blockchain; ability to integrate blockchain data with intelligent tools such as Python, R and other programming languages; **Own:** work with specific blockchain data; apply data analysis to specific blockchain projects; use data analysis to solve specific business problems in the blockchain context; effectively link the results of blockchain data analysis; ensure data security and privacy in the blockchain context.
5	Data analysis	5	Ethereum, Web3 and Truffle development environments	Working with Ethereum	**Purpose:** acquire the theoretical knowledge and practical skills necessary for successful data analysis in various contexts and areas of application. **Content:** Data visualization methods. Complex data sets in a convenient and understandable way. Data visualization tools and technologies. Principles of designing information dashboards and graphical data representation. Methods for finding and extracting knowledge from data. Machine learning and statistical modeling algorithms for data analysis, pattern detection, trend prediction, and data-driven decision-making. Methods and techniques for working with large amounts of data, including cloud computing and distributed storage and processing systems. Principles of functioning and application of databases, tools for working with Big Data and technologies for Parallel Data Processing. **Expected result:** **To know:** Understand the basic concepts and methods of data analysis; know the basic terms and concepts related to data analysis; know the methods of data analysis using mathematical approaches; **Be able to:** use a variety of 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; using data analysis in specific projects; effectively linking data analysis results; analyzing data in accordance with ethical standards.
6	Internet of things	3	Microcontrollers and microprocessor systems	Neural networks and their applications	**Purpose:** To study the organization of automated systems based on the Arduino microcontroller, the use of these systems in the problems of automation of a scientific experiment, practical skills in working with modern controllers, solving automation problems. **Content:** Applied electronics. The case of" computer vision". Software development. Case" game console". Web technologies. Case" smart home". Basics of construction. Case "smart mirror". **Expected result:** **To know:** principles of organization and functioning of the" Internet of things"; history of emergence and

					development; main factors in the development of the" Internet of things"; existing technologies in the field of" Internet of things"; main trends and directions in the region; **Be able to:** work with microcontrollers and core debug boards (Arduino and Raspberry Pi); understand existing IoT technologies and their application to specific scenarios; design whole IoT systems (including end devices, network connections, data exchange, cloud platforms, data analysis) **Own:** terminological apparatus; basic skills in programming end devices; basic skills in connecting end devices to the network; basic cloud technologies for developing a software solution for processing and storing data.
6	Design of distributed control systems	3	Fundamentals of microprocessor technology	Artificial neural networks	**Purpose:** Mastering the concept and methodology of analysis and synthesis of complex systems, the principles of designing Information Systems. **Content:** Stages and stages of water design. Sketch design. Analysis and synthesis of data processing systems. Synthesis and analysis of the control system. Measures to assess the quality of the designed system. Synthesis of XOIU structure. **Expected result:** **To know:** properties, characteristics and architecture (structure and topology) of distributed control and automation systems (MSU), types of support (methodological, Technical, Software, Information, Metrological, ergonomic and organizational-legal); functional responsibilities and efficiency criteria of MSU; **Be able to:** Implementation of projects of automation tools, automation systems of technological processes: implementation of automation of scientific research and tests: design and implementation of information pretreatment algorithms (compression, filtering, increasing the accuracy of conversion, etc.), creation of modern control algorithms (modal, neural, network Center, etc.); determination of the network site with the maximum delay in transmitting IP packets; formation of http requests and analysis of HTTP; **Own:** Formal construction and transformation of analytical and simulation models of MSU; application of methods and techniques for analysis and synthesis of MSU architectures; development and use of analytical and simulation models of MSU to evaluate design decisions; implementation of the sequence of stages of design of control and automation systems

7	Introduction to Web3	5	Web Technology 2 (Backend)	Blockchain business model	**Purpose:** this course aims to understand the basic principles of decentralization and use Web3 to create different types of decentralized applications. **Content:** Fundamentals of Web3 and decentralization. The difference between Web2 and Web3, the basic principles of decentralization, distributed IPFS and Swarm systems, Ethereum protocols, the creation of smart contracts for voting tasks, Asset Management and identification. Security in Web3. Communication in decentralized networks. Using protocols and communication tools in Web3. Analysis of successful cases of using Web3 in various fields. **Expected result:** **To know:** deploying smart contracts; understand Web3 concepts and principles; know the principles of decentralization in the context of blockchain technologies; know the role of cryptocurrencies in the Web3 ecosystem; **Be able to:** Using protocols in Web3 applications; creating and managing cryptocurrency wallets; using decentralized applications (DApps); developing and deploying decentralized applications; **Own:** application of decentralization in applications; development of Web3 Applications; Integration of Web3 technologies with traditional web technologies; solving real business problems using Web3 technologies
7	Programming in PHP	5	Web Technology 2 (Backend)	blockchain and cryptocurrency basics	**Purpose:** Obtaining new knowledge in the field of creating Web documents in PHP, expanding the command set of the HTML language, acquiring practical skills in the field of designing and creating sites. **Content:** Introduction to server-side scripts for the web. Syntax and data in PHP. Control structures and functions of the PHP language. Preparation of the working environment with PHP. Working with files in PHP. Work with one-dimensional and multidimensional arrays. Databases and basic structures of the SQL language. PHP interaction with the MySQL database server. Processing exceptions and errors in PHP. Website services. Download files and dynamically generate images using PHP. Fundamentals of Object-Oriented Programming in PHP. The interaction of PHP and XML. **Expected result:** **To know:** Goals, functions, classification of PHP programming, principles of operation of internet services; principles of organization and operation of web information processing technologies and the Internet; **Be able to:** create static and dynamic pages; create a conceptual proposal on web pages using the technology of creating a website and publishing it on the internet; **Own:** Fundamentals of programming in PHP (Assembly, debugging and testing of Programs; website development and creation); programming and client-server technologies.
8		5		Blockchain	**Purpose:** Aims to understand the many possibilities of

	Architecture of smart contracts		Data mining in the blockchain	business models	creating decentralized applications using the Web3 stack and the Solidity language in the Ethereum Virtual Machine (EVM). **Content:** Introduction to blockchain and Ethereum, introduction to smart contracts, blockchain technology and support for full Turing languages, virtual machines. Introduction to the Dapp development pipeline, a deep dive into Solidity, global variables and functions, expressions, and control structures. Object-oriented structures, experiments with external libraries. Modular testing and contract repair. Deployment and other smart contract platforms. **Expected result:** **To know:** internal operation of smart contracts as a decentralized application development tool; Ethereum models, consensus models, execution code, network operation, data storage options and the main actors involved in its protocol; **Be able to:** Development of smart contracts using the Solidity programming language (including an in-depth understanding of proposed libraries); interaction between a closed network of smart contracts and the outside world, understanding the further consequences of these interactions for the decentralization aspect; **Own:** development of smart contracts (contract implementation, testing, deployment, and contract copying); a set of technologies that support a core decentralized data storage network (e.g. IPFS, Swarm).
8	Working with Ethereum	5	Data analysis	Blockchain and cryptocurrency basics	**Purpose:** is preparation for working with Ethereum technologies, from the basic principles to the implementation of specific projects using the blockchain. **Content:** Ethereum Basics. Ethereum Blockchain. Smart contracts and the solidity language. Creating and testing simple smart contracts. Security of smart contracts. Storage and processing of data in distributed registers. Implementation of gaming smart contracts. Decentralized applications (DApps). Integration with ERC tokens and standards. Ethereum Virtual Machine. Integration of Ethereum with external systems. Development and implementation of your own project based on Ethereum. **Expected result:** **To know:** fundamentals 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:** Technologies for creating and managing tokens based on Ethereum; deployment of smart contracts in benchmark and core Ethereum networks; development of interfaces for decentralized applications (DApps); integration of Ethereum with external systems and the use of oracles to obtain external data; **Own:** Working with Ethereum wallets and performing transactions; analyzing successful cases of using Ethereum and applying their experience.
9	Blockchain	6	Smart	Production	**Purpose:** this course focuses on the analysis of

	business models		Contract Architecture, mathematical logic and algorithm theory, introduction to Web3	practice, writing a thesis	entrepreneurship and Innovation Management based on blockchain technology. **Content:** The importance of innovation, the innovative nature of digital currencies (blockchain) DLT. Management and dissemination of Blockchain innovations. Turning the idea of blockchain into a business plan. The use of design thinking and strategy in blockchain projects. Analysis and management of risks associated with the blockchain, raising funds for the blockchain project. Smart contracts and algorithmic management explained. Study of Decentralized Autonomous Organizations. understand issues related to Human Resource Management in the blockchain. **Expected result:** **To know:** business opportunities, designing and developing new blockchain-based services, building and developing 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:** development of a business model that meets the principles of digital currency, decentralization and cultivation of peer-to-peer transaction relations between producers and consumers.
9	Blockchain and cryptocurrency basics	6	Working with Ethereum, programming in the PHP language	Production practice, writing a thesis	**Purpose:** the study of the features of blockchain technology and the use of cryptocurrencies, the formation of skills and abilities to invest in cryptocurrencies and the use of the ICO mechanism for financial support of an innovative project. **Content:** Cryptocurrency and blockchain technology. Fundamentals of blockchain technology and its place in the digital economy. Introduction to cryptocurrency economics. Legal basis of cryptocurrency. Intellectual property rights issues. Organization of crypto-currency systems. Risk management and security issues. Modern cryptographic technologies in the blockchain. Smart contracts and their fundamentals. **Expected result:** **To know:** 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 (proof-stake); the main approaches to investing in cryptocurrencies; features of existing trading cryptocurrency platforms; **Be able to:** development of the specifics of legal regulation of operations in the cryptocurrency market in different countries of the world; solving the problems of state regulation in the field of application of blockchain technology and the use of cryptocurrencies; **Own:** attracting financial funds through the mechanism of initial coin issuance (ICO).

LIST OF DISCIPLINES
components of choice for the educational program
6B06103- ARTIFICIAL INTELLIGENCE ENGINEERING AND BLOCKCHAIN

Duration of study**: 4 years**
Form of study**: full-time**   Year of admission: **2024**

№	Name of discipline	Code of discipline	Number of credits	Semester
	2.Basic disciplines			
1	**Component on a choice 1**		3	2
	Computer architecture	CA 1212		
	Technology of computer and communication systems	TCCS 1212		
2	**Component on a choice 2**		4	3
	Information theory	IT 2213		
	Information technology	IT 2213		
3	**Component on a choice 3**		5	3
	Network architectures and security	NAS 2214		
	Security-enhanced network communications architectures and protocols	SENCAP 2214		
4	**Component on a choice 4**		6	3
	Introduction to blockchain	IB 2215		
	Fundamentals of blockchain technology	FBT 2215		
5	**Component on a choice 5**		5	4
	Decentralized applications	DA 2216		
	Database basics	DB 2216		
6	**Component on a choice 6**		5	5
	Blockchain system architecture	BSA 3217		
	Ethereum, Web3 and Truffle development environments	EWTDE 3217		
7	**Component on a choice 7**		5	5
	Probability theory	PT 3218		
	Probability theory and mathematical statistics	PTMS 3218		
8	**Component on a choice 8**		5	6
	Mathematical foundations of artificial intelligence	MFAI 3219		
	Graph theory	GT 3219		
9	**Component on a choice 9**		5	6
	Python in programming	PP 3220		
	Programming in the GO	PIGL 3220		
10	**Component on a choice 10**		5	6
	Program development tools	PDT 3221		
	UI/UX design	UUD 3221		
11	**Component on a choice 11**		5	7
	Mathematical logic and theory of algorithm	MLTA 4222		
	Logical mathematics	LM 4222		
12	**Component on a choice 12**		5	7
	Neural networks and their applications	NNTA 4223		
	Artificial neural networks	ANN 4223		
13	**Component on a choice 13**		3	7
	Modern methods and tools Java programming	MJPMT 4224		
	Modern methods and means of NET programing	MNPMT 4224		

14	**Component on a choice 14**		3	7
	Using data in machine learning	UDML 4225		
	Introduction to machine learning and data analytics	IMLDA 4225		
15	**Component on a choice 15**		4	7
	3D game architecture and development	3DGAD 4226		
	Multimedia design	MD 4226		
16	**Component on a choice 16**		4	8
	Artificial intelligence for information security	AIIS 4227		
	Cryptography	C 4227		
	3.The main subjects			
1	**Component on a choice 1**		3	4
	Cloud technologies	CT 2305		
	Fundamentals of Data Science	FDS 2305		
2	**Component on a choice 2**		5	5
	System programming	SP 3306		
	System programming and computer technologies	SPCT 3306		
3	**Component on a choice 3**		5	5
	Microcontrollers and microprocessor systems	MMS 3307		
	Fundamentals of microprocessor technology	FMT 3307		
4	**Component on a choice 4**		5	6
	Azure machine learning	AML 3308		
	Azure cognitive service	ACS 3308		
5	**Component on a choice 5**		5	6
	Intelligent data analysis in blockchain	IDAB 3309		
	Data analysis	DA 3309		
6	**Component on a choice 6**		3	6
	Internet of Things	IT 3310		
	Design of distributed control systems	DDCS 3310		
7	**Component on a choice 7**		5	7
	Introduction to Web3	IW 4311		
	Programming in the PHP language	PPL 4311		
8	**Component on a choice 8**		5	7
	Smart-contract architecture	SCA 4312		
	Working with Ethereum	WWE 4312		
9	**Component on a choice 9**		6	8
	Blockchain business models	BBM 4313		
	Blockchain and cryptocurrency basics	BCB 4313		