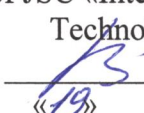





AGREED

Chairman of the educational and methodological council of JSC «International Information Technology University»

 Mustafina A.K.  
«19» 03 2024

APPROVED

Chairman of the Board – Rector of JSC «International Information Technology University»

 Khikmetov A.K.  
«24» 03 2024



## EDUCATIONAL PROGRAM

### 6B06107 «Cyberphysical Systems»

Code and classification of the field of education: 6B06 – Information and Communication Technology

Code and classification of training area: 6B061 – Information and Communication Technology

Group of educational programs: B057 – Information Technology

ISCED level: 6

NQR level: 6

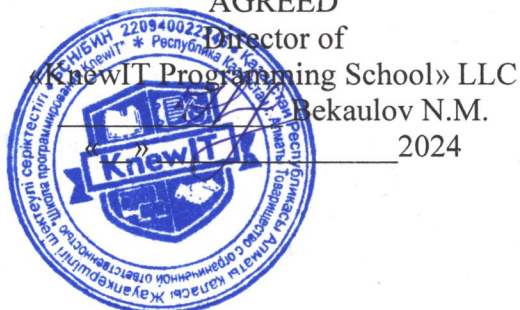
ORC level: 6

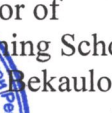
Duration: 3 years

Number of credits: 240

AGREED

Director of «KnewIT Programming School» LLC



 Bekaulov N.M.  
2024

AGREED

Technical director of «Scientific and production association of innovative technologies» LLP



 Tuenbayev M.K.  
2024

## Content

List of abbreviations and notation .....	3
1 Description of the educational program .....	4
2 The goal and objectives of the educational program.....	4
3 Requirements for the results of the mastering of the educational program.....	5
4 Passport of the educational program .....	5
4.1 General information .....	5
4.2 Matrix of correlation of learning outcomes of the educational program with competencies.....	8
4.3 Information about courses .....	8
4.4 List of modules and learning outcomes.....	15
5 Curriculum of the educational program .....	17
6 Developer approval sheet .....	24

## List of abbreviations and notation

BC	Basic competence
BM	Base module
HE	Higher education
SCES	State compulsory education standard
EQF	European qualification framework
EEF	European Education Foundation
KSC	Knowledge, skills, cum-savvy
NCO	National Classification of Occupations
NQF	National Qualifications Framework
NQS	National qualifications system
HM	Humanitarian module
CM	Common module
EP	Educational program
GPM	General Professional Module
IQF	Industry Qualifications Framework
PS	Professional standard
PE	Postgraduate education
PC	Professional competence
PM	Professional module
SW	Software
WG	Working group
RK	The Republic of Kazakhstan
LO	Learning outcome
SM	Special module
QMS	Quality Management System
SEM	Socio-economic module
TVE	Technical and vocational education
TaVPE	Technical and vocational education and post-secondary education
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO	Specialized agency of the United Nations Educational, Scientific and Cultural Organization
Cedefop	European Center for Development of Vocational Training
DACUM	from Eng. Developing curriculum
ECVET	European Credit System for vocational education and training
EQAVET	European Quality Assurance in Vocational Education and Training
ENQA	European Association for Quality Assurance in Higher Education / Europe-Skye association by to ensure qualities at higher education
ESG	Standards and Guidelines for Quality Assurance in the European Higher Education Area
FIBAA	International Agency (non-profit foundation) for accreditation and examination of the quality of higher education (Bonn, Germany)
IQM-HE	Internal Quality Management in Higher Education
TACIS	Technical Assistance for the Commonwealth of Independent States
WSI	WorldSkills International



## 1 Description of the educational program

The basis for the development of educational program 6B06107 «Cyberphysical systems» is the need to train qualified specialists in the field of robotics and information and communication systems who have the necessary knowledge to develop and maintain software products that have the necessary practical skills in the field of hardware construction of information and communication systems with engineering thinking.

At present, new types of robotic systems are developing rapidly and are in demand. There is wide experience in the use of robots and flexible manufacturing systems in industry and manufacturing. Their application requires a new organization of the technological process and, as a result, special training of specialists in this field. Only under such a condition industrial robots and production robotics can give the greatest effect during application.

Robotic systems with adaptive and intelligent robots need microprocessor-based distributed control. Therefore, the training of specialists of this level requires systematic training and affects the development of this subject area. This profession requires artificial intelligence knowledge from a specialist and includes: the creation and operation of devices and systems based on the use of information processing, the ability to solve software development and maintenance tasks, the research and development of robotic technologies, the creation of robotic systems models, the ability to create smart technical systems obtaining information about technical objects, modeling robots, prototyping robots.

## 2 The goal and objectives of the educational program

**The goal of the EP** – to provide practice-oriented training of highly qualified specialists in the field of robotics and production and management activities related to the process of creating and using fundamentally new technical means of complex automation of production processes - robotic systems for the manufacturing industry of the Republic of Kazakhstan.

### **The objectives of the EP:**

1. The formation of knowledge, skills: on the design and operation of specialized software and hardware for industrial use; on the organization of database systems, information processing and storage systems; on the design and administration of local and corporate computing systems and networks; business process automation.

2. Obtaining knowledge and skills in the field of network and telecommunication technologies, system, application, software and hardware.

3. Providing training for bachelors in robotics researching the theory, development and application of robotic technologies. Development of skills in applying information technologies for robotics, machine learning, artificial intelligence and design of robotics systems, as well as creating new generation technical systems designed for industrial robotics.

4. Developing respect for the university. Ensuring the demand, mobility of the specialty, obtaining high-quality knowledge and the ability to work in a team.

5. Formation of competitive graduates in the labor market, which would provide the opportunity for the fastest possible employment in the specialty.

6. Training of specialists in the field of robotics and production and management activities related to the process of creating and using a fundamentally new technical tool for the comprehensive automation of production processes - robotic systems.

7. Creation of conditions for professional growth and self-improvement, development of social and personal competencies of graduates and the formation of a steady interest in robotics (active citizenship, determination, organization, industriousness, sociability, the ability to make organizational and managerial decisions and stimulate creative activity, knowledge of modern information technologies, fluency in several languages, the desire for self-education and self-development, the



ability to work in a team, responsibility for the end result of one's professional activity, involvement in universal values), social mobility and demand in the labor market.

### 3 Requirements for the results of the mastering of the educational program

The following examination forms are used as an assessment of learning outcomes: computer testing, a written exam (answers on the sheets), an oral exam, a project (passing a course project), practical (open questions on a computer, solving problems on a computer, including in ACM format) comprehensive (test / written / oral + others). In accordance with table 1, the following exams are recommended:

Table 1

№	Exams form	Recommended share, %
1	Test	10%
2	Written	10%
3	Oral	5%
4	Project	30%
5	Practical	30%
6	Complex	15%

Final attestation is help on the form of defending a diploma project.

### 4 Passport of the educational program

#### 4.1 General information

№	Field name	Note
1	Code and classification of the field of education	6B06 – Information and Communication Technology
2	Code and classification of training areas	6B061 – Information and Communication Technology
3	Group of educational programs	B057 – Information Technology
4	Name of the educational program	6B06107 «Cyberphysical Systems»
5	Short description of the program	The educational program «Cyberphysical Systems» is aimed at training specialists in the development and operation of robotic systems using various technologies.
6	Purpose of EP	To provide practice-oriented training of highly qualified specialists in the field of robotics and production and management activities related to the process of creating and using fundamentally new technical means of complex automation of production processes - robotic systems for the manufacturing industry of the Republic of Kazakhstan.
7	ISCED level	6
8	NQF level	6
9	IQF level	6
10	Qualification characteristics of an OP graduate:	<b>The field of professional activity of a graduate of the EP:</b> The field of professional activity of the graduate of the OP "6B06107 - Cyberphysical systems" covers the field of science and technology based on the synthesis of cybernetic systems and physical processes aimed at

		<p>creating, managing and ensuring the functioning of devices and systems combining software and hardware components.</p> <p><b>Objects of professional activity of a graduate of the EP:</b> The graduate of the OP "6B06107 - Cyberphysical Systems" works with cyberphysical systems, including software components, sensors, actuators, microcontrollers, microprocessors, mechanical devices, as well as systems and methods of their design, modeling, development, implementation and maintenance.</p> <p><b>The subject of professional activity:</b> The subject of professional activity of the graduate of the OP "6B06107 - Cyberphysical systems" are organizations engaged in the development and implementation of cyberphysical systems in various fields, such as automation of industrial processes, smart cities, medical equipment, autonomous vehicles and others.</p> <p><b>Types of professional activity of a graduate of the EP:</b> - design and development of cyberphysical systems; - programming of embedded systems and microcontrollers; - development of control algorithms and optimization of cyberphysical systems; - integration of sensors and actuators into cyber-physical systems; - testing, debugging and verification of cyber-physical systems; - maintenance and support in the operation of cyber-physical systems.</p> <p><b>The functions of the professional activity of a graduate of the EP:</b> - design and analysis of cyberphysical systems; - development and implementation of software for cyber-physical systems; - integration and configuration of the hardware component of cyberphysical systems; - testing and debugging of cyber-physical systems; - technical support and maintenance of cyber-physical systems.</p>
11	<p>List of competencies :</p> <p>KC1: The ability to use modern information and communication technologies in substantive activities.</p> <p>KC2: The ability to formalize the subject area of the project and draw up the terms of reference for the development of robotic systems.</p> <p>KC3: The ability to develop and integrate software modules and software components. Maintain robotic system management software.</p> <p>KC4: The ability to develop and implement intelligent algorithms for robotic systems.</p> <p>KC5: The ability to develop and model robots according to the terms of reference. Prototype</p>	



	<p>robots.</p> <p>KC6: The ability to program and reprogram robots. Upgrade and upgrade robotic systems.</p> <p>KC7: To carry out commissioning work on the launch of the robotic system (load calculation, construction of optimal motion paths, troubleshooting). Perform maintenance of robotic systems.</p> <p>KC8: Explain the principles and laws of the historical development of society, know your role in the development of information technology, strive for self-improvement.</p>	
12	<p>Learning outcomes. Students will be able to:</p> <p>LO1: Demonstrate the ability to use basic mathematical tools to solve the problems of analysis and calculation of the characteristics of robotic systems.</p> <p>LO2: To conduct a feasibility study of projects of robotic systems, to collect, process, analyze and systematize scientific and technical information on the research topic.</p> <p>LO3: To develop design and technical documentation, to draw up design work.</p> <p>LO4: Operate and maintain robotic systems.</p> <p>LO5: Carry out the calculation and design of robotic equipment.</p> <p>LO6: Own the methods of installation, configuration and adjustment of robotic systems, perform maintenance and installation work on robotic equipment.</p> <p>LO7: To carry out verification, adjustment and adjustment of equipment, tuning of software tools used for the development, production and tuning of robotic systems and devices.</p> <p>LO8: Conduct software testing for robotic systems, technical support and maintenance of software for robotic systems.</p> <p>LO9: Develop operating instructions for technical equipment and software for robotic systems.</p> <p>LO10: Perform mathematical modeling of objects of robotic systems, design and development of software for robotic systems.</p> <p>LO11: Independently critically analyze modern sources, draw conclusions, argue them and make decisions based on information.</p>	
13	Form of study	Full-time
14	Language of instruction	English
15	Number of credits	240 ECTS credits
16	Awarded academic degree	Bachelor in Information and Communication Technology in educational program 6B06107 «Cyberphysical Systems»
17	Professional standards	1. Development of It systems; 2. Technical support of electronics.
18	Developers and authors:	«International Information Technology University» JSC, Computer Engineering Department: - T.T. Chinibayeva, PhD, head of the «CE» department, associate professor - O.K. Tuenbayev, senior-lector of the «CE» department - K. Sarsenbk, tutor of the «CE» department

#### 4.2 Matrix of correlation of learning outcomes of the educational program with competencies

	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11
KC1	V									V	
KC2		V	V						V		V
KC3			V	V		V	V	V	V	V	
KC4	V				V					V	
KC5	V				V					V	
KC6	V					V				V	
KC7				V		V	V				
KC8		V		V			V	V	V		V

#### 4.3 Information about courses

Code and Name of the course	Short description of the course	Number of credits	Formed competencies (codes)	Prerequisites	Post-requirements
<b>General disciplines (GD)</b>					
<b>Mandatory component (MC)</b>					
ICT6001 Information and Communication Technologies	The skills of applying information and communication technologies in substantive activities are taught.	5	LO4	-	
LAN6001A Foreign language	Written and oral communication skills in English are taught.	5	LO2, LO3	-	LAN6001A
LAN6002A Foreign language	Written and oral communication skills in English are taught.	5	LO2, LO3	LAN6001A	LAN5003PA
PhC6005 Physical Culture	The ability to understand the practical use of healthy living standards, including prevention issues, is being instilled.	4		-	PhC6005
PhC6006 Physical Culture	The ability to understand the practical use of healthy living standards, including prevention issues, is being instilled.	4		PhC6005	-
LAN6001KR Kazakh (Russian) language	The skills of written and oral communication in the state language (the language of interethnic communication) are inculcated.	5	LO2, LO3	-	LAN6001KR
LAN6002KR Kazakh (Russian) language	The skills of written and oral communication in the state language (the language of interethnic communication) are inculcated.	5	LO2, LO3	LAN6001KR	LAN6007K
HK6002 History of Kazakhstan	The laws of the historical process, the place of man in the historical process are studied. Historical knowledge is given about the main stages of development of modern Kazakhstan; focuses on the	5	LO11	-	



	problems of historical and cultural processes and the development of Kazakhstan.				
SPS6001 Philosophy	Studying the principles of understanding philosophy as a methodology of human activity, the main directions and problems of the world. The formation of a holistic vision of philosophy as a special form of knowledge of the world, its main problems and methods of studying them in the context of future professional activity.	5	LO11	-	
SPS6006 Cultural studies- Psychology	As a result of studying a course in the field of cultural studies, students will acquire the fundamentals for studying the entire complex of social sciences and humanities, and master intercultural communication. At the same time, the discipline of cultural studies can serve as an addition to general courses in history and philosophy. The course material can serve as a methodological guide for a number of special disciplines: for example, ethics, history of culture, styles of art, national schools of management, strategy and negotiation tactics, management of culture. Methods and technologies of training used in the implementation of the program: role-playing games and educational discussions in various formats; case study, project method. The psychology course studies main issues of psychology in a wide educational and social context. Knowledge and skills gained in the course give students the opportunity to practically apply them in different life spheres such as personal, family, professional, business, social (working with people of different age and social categories).	4	LO11	-	
SPS 6007 Sociology- Political science	During the course "Sociology" various phenomena of social life are studied. At the same time the study is carried out from various paradigms of social knowledge, using theories and scientific methods. Students successfully completing the course will be able to: 1. Use qualitative and quantitative research methods, which will be useful in scientific and professional field. 2. Distinguish between scientific and non-scientific knowledge. 3. Understand and analyze social phenomena and issues from different perspectives. 4. Manage to work in a team. The course Political science provides comprehensive coverage of all key elements, the study of sources and political relations, types of political systems, democratic and authoritarian systems, political mechanisms, political competition and power, political capital and values, survival of political ideas, nationalism, analysis of domestic and foreign policy, political growth, state policy in the world political system.	4	LO11	-	
<b>Basic disciplines (BD)</b>					
<b>University component (UC)</b>					
MAT6001** Algebra and geometry	Studying the elements of linear algebra and analytic geometry using real life and various science examples.	4	LO1	-	MAT600 2
NET6301 Introduction to computer networks	Acquaintance with the basic network concepts and technologies, as well as developing the skills of planning and implementing small networks. The architecture, structure, functions, components and models of the Internet and other computer networks	5	LO6	-	NET6303



	are considered. The principles and structure of IP addressing, as well as the basics of Ethernet concepts, media and operations, are presented as the basis for the curriculum.				
SFT6301 Algorithmization and programming	More complex, advanced algorithms and data structures using the C ++ programming language are considered.	6	LO6, LO10	-	SFT6302 SFT6304
HRD6301 Introduction to robotics	Comprehensive and comprehensive coverage of robotics as a science and technology. It covers topics from basics to advanced applications and services, providing students with practical experience with Arduino and desktop robots.	6	LO4, LO5	-	HRD6304
MAT6002 Mathematical analysis	We consider such concepts as limits and differentiation of functions of one variable, indefinite and definite (Riemannian) integrals of functions with applications, as well as an introduction to topics related to ordinary differential equations.	6	LO1	MAT600 1**	MAT600 5
PHY6001 Physics	Studying the basic laws of classical mechanics, electricity, magnetism, thermodynamics, quantum mechanics, special relativity in search of ways to solve physical problems.	6	LO5	-	EECG001
PP6301 Educational practice	The acquisition of primary professional skills and the consolidation of skills by independently solving the problems of algorithmization, design and practical implementation of programs using modern programming technologies.	4	LO2, LO3	-	
SFT6305 Database design. Introduction to SQL	During the course, students will learn how to create relational databases, going through all the stages of the database design process (conceptual, logical and physical). In the second part of the course, students will learn the basics of Structured Query Language (SQL).	5	LO7	-	EECG004
EECG001 Basic circuit theory	Familiarity with the fundamental principles of the theory of electrical circuits. The basic concepts are considered, such as voltage, current, resistance, Ohm and Kirchhoff law; main methods for analyzing electrical circuits, resistive circuits, circuits with a constant and sinusoidal voltage source, stationary power.	4	LO5	PHY3001	HRD6310
MAT6005 Discrete mathematics	The study of discrete objects, the solution of combinatorial problems, the study of types of mappings and binary relations, the reduction of propositional algebra formulas to normal forms, the application of logic algebra to the theory of switching circuits. The capabilities for analysis and synthesis, and mathematical maturity are developing.	4	LO1	MAT600 2	MAT600 6
SFT6302 Algorithms and data structures	The principles of algorithm development, analysis of algorithms and fundamental data structures are considered. The emphasis is on choosing appropriate data structures and developing effective and correct algorithms for their implementation. Important elements of the course are measuring the performance and effectiveness of programs when comparing and comparing the results of small programs written in different languages.	5	LO7	SFT6301	
SFT6304 Programming in Python language	Familiarity with the Python programming language and its libraries. The emphasis is on procedural programming, non-strict types of variables, designing algorithms, working forms of applications (libraries), object-oriented programming, creating web and database applications, as well as data preprocessing.	5	LO8, LO10	SFT6301	SFT6322



EGR6303 Fundamentals of computer graphics	"Fundamentals of Computer Graphics" presents the basic principles of creating and processing graphic images using a computer. The discipline covers the basic concepts of raster and vector graphics, image editing techniques, as well as the basics of three-dimensional modeling and animation.	5	LO3	-	EGR6305
EEC6004 Fundamentals of logic design	Acquaintance, development and application of digital logic circuits, including combinational and sequential logic circuits.	5	LO5	SFT6305	EEC6006
MAT6006 Probability theory and mathematical statistics	The course focuses on the probability and statistics of any events, as well as on the relationship between mathematics and programming through an interdisciplinary training program that deepens the mathematical understanding of probability and develops the skills of logical and algorithmic thinking.	4	LO1	MAT6005	ECO6002
HRD6310 Embedded Systems 1. Architecture of microcontrollers and microprocessors	The objectives of the course "Embedded Systems 1. Architecture of Microcontrollers and Microprocessors" is to provide basic theoretical knowledge and practical skills of Embedded Systems. This discipline is the initial stage in a series of courses studying Embedded Systems and how to develop them.	6	LO4, LO9	EEC6001	HRD6311
HRD6304 Sensor technologies	Familiarity with the various types of sensors that are used for industrial automation, environmental assessment, as well as for human-computer interaction.	6	LO4	HRD6301	HRD6305 HRD6306
LAN6007K Business correspondence in the state language	Business language skills are taught. The formation and development of listening, speaking, reading and writing skills on topics related to professional activities, as well as the development of social skills such as presentations.	3	LO2, LO3	LAN6002 KR	EGR6303
HRD6311 Embedded systems 2. Digital systems design	The purpose of mastering the discipline "Embedded Systems 2. Design of Digital Systems" is to consolidate the past material and continue to study Embedded Systems in depth. The students' tasks are to study the process and independently design digital systems.	6	LO3	HRD6310	HRD6312 HRD6313
EEC6006 Digital signal processing	The discipline studies basic methods and algorithms for digital signal processing and their computer modeling using the software package (MATLAB). The specifics of the representation of signals and digital signal processing systems in MATLAB are considered in detail. Linear discrete systems, the synthesis of digital filters and the modeling of these objects and processes using the MATLAB software are described.	6	LO10	EEC6004	
HRD6305 Applied robotics (IoT)	Modeling, creating and demonstrating complex multi-robotic systems, including sensing, computation and actuation. The industrial problems of the real world are considered. The student will design and build a mechanical subsystem with appropriate drives and sensors for computer control.	6	LO6	HRD6304	
HRD6306 Robotics with artificial intelligence	The study of the basic methods in the field of artificial intelligence, including probabilistic inference, planning and search, localization, tracking and control, all with an emphasis on robotics.	6	LO6	HRD6304	
RM6301 Research fundamentals	Studying the issues of practical organization of scientific research, analysis and generalization of research results, mastery of the theory of engineering decision making, the basics of project management,	5	LO2, LO11	LAN6003 PA	



	requirements analysis, architecture development, detailed design, development of user interfaces and testing methods.				
HRD6312 Embedded systems 3. Development of cyber-physical systems	The goals of studying the discipline “Embedded Systems 3. Development of Cyber-Physical Systems” are to teach independent practical development of cyber-physical systems, and to consolidate the knowledge acquired in previous courses.	5	LO3	HRD6311	
LAN6003PA Professionally oriented foreign language	Business English skills are taught. The formation and development of listening, speaking, reading and writing skills in English on topics related to professional activities, as well as the development of social skills such as presentations.	3	LO2, LO3	LAN6002 A	RM6301
PP6305 Industrial practice	Systematization, consolidation and expansion of theoretical knowledge, development of practical skills, mastery of the elements of independent practical and research work in enterprises.	7	LO3, LO4, LO6, LO7	-	
EGR6303 Project management	Learning the basics of project management and the necessary steps to ensure successful project management. Studying the main characteristics of project management and various roles in the project to ensure success. Application of key skills to the project to evaluate, plan and develop control mechanisms.	4	LO3, LO11	LAN5007 K	
PP6304 Pre-diploma practice	Search for information for writing the diploma project	5	LO2, LO3	-	
<b>Elective courses (EC)</b>					
FIN6720 Basics of Financial Literacy	The course «Basics of Financial Literacy» is aimed at gaining knowledge and skills in the field of personal finance management. As part of the course, students will learn how to use all kinds of financial tools in practice, protect and increase savings, plan a budget competently, gain practical skills in calculating and paying taxes, and correctly filling out tax reports, learn how to analyze financial information and navigate financial products to choose an adequate investment strategy.		PO1		
MGT6706 Startups and entrepreneurship	This course provides an introduction to what a business is, how it works and how to run it. Students will define ownership and processes used in manufacturing and marketing, finance, personnel, and management in business operations.	5	PO11		
JUR 6470 Fundamentals of law and anti-corruption culture	The course outlines the legal, economic, and social foundations of fighting corruption. Throughout the course, students will gain practical knowledge in identifying the peculiarities of state policies, applying international experiences in combating corruption, mastering skills in conflict resolution, and detecting corruption activities using professional ethics and methods. After successful completion of the course, students will gain the following competencies: 1. Understand the measures of legal responsibility for participation in corruption violations. 2. Determine the conflict of interests in the activities of organizations leading to corruption. 3. Analyze the work of organizations using various research methods.		PO11		



JUR 6507 Fundamentals safety of life activity and ecology	Studying ways of safe human interaction with the environment (industrial, domestic, urban, natural), sustainable operation of business facilities (organizations) in emergency situations, issues of protection from negative factors, prevention and elimination of the consequences of natural and man-made emergencies and the use of modern means defeat. Also the course reveals the role of ecology in solving modern economic, social and political problems, as well as the emergence of global environmental problems as a result of human production activities and the responsibility of the world community for them. A very important aspect is also international cooperation to ensure sustainable development. Various areas of practical application of ecology are also considered - natural resources and environmental pollution.		PO9		
RM6502 Research metodology	The course is devoted to the study of activities aimed at developing students " ability to independent theoretical and practical judgments and conclusions, skills of objective evaluation of scientific information, freedom of scientific research and the desire to apply scientific knowledge in educational activities, including for the diploma project (work).		PO2, PO3		
ECO6006 Economic theory	The purpose of the course is to study and explain the processes and phenomena of economic life, explain patterns and predict ways to use them.		PO1		
SFT6322 Introduction of artificial intelligence	The course will cover basic machine learning algorithms such as regression, classification, clustering, and neural networks, as well as deep learning and natural language processing technologies.			SFT6304	SFT6317
EGR6305 3D modeling Altium Designer	Altium Designer 3D Modeling teaches you how to create three-dimensional models of electronic components and printed circuit boards in Altium Designer. Students learn how to create and edit 3D models, which helps in the visualization and design of electronic devices and their components.	5		EGR6300	EGR6304
SFT6317 Machine Learning - 1	Machine Learning - 1 introduces students to the basic concepts and methods of machine learning. Teacher-led, unsupervised and partial learning, as well as classification and regression algorithms; including linear regression and the support vector machine, are the key topics of this discipline.			SFT6322	SFT6331
EGR6304 3D printing Solidworks	3D Printing Solidworks teaches students how to use the Solidworks software to create models and prepare them for 3D printing. The course covers the basic principles of modeling, the choice of materials and printing processes, as well as methods of quality management and economical use of resources.	5		EGR6305	SEC6301
MIN601 Minor 1	Additional educational program (minor) - a set of disciplines and (or) modules and other types of educational work, determined by students for study in order to form additional competencies	5		-	
MIN602 Minor 2	Additional educational program (minor) - a set of disciplines and (or) modules and other types of educational work, determined by students for study in order to form additional competencies	5		-	
SFT6331 Smart technologies	The subject of the discipline is information technology infrastructure, the use of software, communication systems, networks and databases. The purpose of this course is to study rapidly	4		SFT6317	

	developing and changing technologies in the field of embedded systems, sensors, and wireless networks.			
SEC6301 Fundamentals of information security	It covers basic security concepts, principles, and technologies, cryptography, attack methods and security monitoring. Studying basic security methods for searching for threats on the network using various popular security tools in a real network infrastructure.		KC3 KC4 KC6	EGR6304
NET6303 Network programming	The study of network connectivity from local networks to the global Internet. We study standard problems and a number of solutions for each of them with special emphasis on the set of TCP / IP protocols. This course provides students with a working vocabulary, as well as the knowledge and skills necessary to implement, debug, and improve basic network applications.	5		NET6301
HRD6313 Electronic systems	The objectives of the course are to introduce students to the basic principles and technologies of design, analysis and development of electronic systems; consideration of various types of sensors and actuators, their operating principles, connection and control.			HRD631
MIN603 Minor 3	Additional educational program (minor) - a set of disciplines and (or) modules and other types of educational work, determined by students for study in order to form additional competencies	5		-



4.4 List of modules and learning outcomes

Module name	Total number of credits	Learning outcomes	Criteria for assessing learning outcomes	Module-forming disciplines
<b>GENERAL EDUCATION MODULES</b>				
<b>General education module</b>	10	The student has an idea of the principles and laws of the historical development of society, the historical periodization of the history of Kazakhstan, the place of the history of Kazakhstan in world history and the history of Eurasia, the place and role of philosophy in the life of society and man; the main stages of development of world and Kazakh philosophical thought.	Testing, interview, term presentation, midterm. oral report, paper,	History of Kazakhstan Philosophy
<b>Social and political knowledge module</b>	26	The student has an idea of socio-ethical values based on public opinion, traditions, customs, social norms and focuses on them in their professional activities; traditions and culture of the peoples of Kazakhstan; the rights and freedoms of man and citizen; the foundations of the legal system and legislation of Kazakhstan; social development trends in society; the basics of physical culture and the principles of a healthy lifestyle.	Testing, interview, term presentation, midterm. oral report, paper,	Sociology-Political science Cultural studies-Psychology Physical Culture Fundamentals of law and anti-corruption culture Fundamentals safety of life activity and ecology
<b>Language module</b>	26	The student can freely express himself in writing and verbally, including professionally in the state language, the language of interethnic communication and English; knows how to logically correctly, reasonably and clearly build oral and written speech.	Testing, interview, paper, presentation, midterm. oral term	Foreign language Kazakh (Russian) language Business correspondence in the state language Professionally oriented foreign language
<b>BASIC MODULES</b>				
<b>Basic module</b>	25	The student is able to use modern ICT in professional activities, independently versatile and critically analyze modern sources, draw conclusions, argue them and make decisions based on information.	Testing, oral interview, report, term presentation, laboratory work, midterm control.	Information and Communication Technologies Research fundamentals Research methodology Basics of Financial Literacy Startups and entrepreneurship
<b>Math module</b>	28	The student is able to use basic mathematical tools to solve professional problems.	Testing, oral interview, course, laboratory, control work, midterm.	Algebra and geometry Mathematical analysis Discrete mathematics Probability theory and mathematical statistics Fundamentals of computer graphics Economic theory
<b>Hardware</b>	25	The student is able to analyze the structure of the main	Testing, oral interview,	Physics



module	components of the computer, use a wide range of technologies of internal and external memory; write program code for manipulating bits in the processor.	course, laboratory, control work, midterm.	Basic Circuit Theory Fundamentals of Logic Design 3D modeling Altium Designer 3D printing Solidworks
<b>PROFESSIONAL MODULES</b>			
<b>Programming module</b>	The student is able to apply suitable data structures and develop appropriate algorithms to solve various computational problems. The student is able to use various tools for software development, user interface, storage and data processing systems.	Testing, oral interview, course, laboratory, control work, midterm.	Algorithmization and Programming Algorithms and Data Structures Database Design. Introduction to SQL Programming in Python language Digital signal processing Introduction of artificial intelligence Machine Learning - 1
<b>Network and system administration module</b>	The student is able to administer systems and networks of any configuration, troubleshoot and prevent threats.	Testing, oral interview, course, laboratory, control work, midterm.	Introduction to computer networks Network programming Fundamentals of information security
<b>Robotics module</b>	The student is able to develop, operate and maintain robotic systems.	Testing, oral interview, course, laboratory, control work, midterm.	Introduction to Robotics Sensor Technologies Applied Robotics (IoT) Robotics with Artificial Intelligence Embedded Systems 1. Architecture of microcontrollers and microprocessors Embedded systems 2. Digital systems design Electronic systems Smart technologies
<b>Project module</b>	The student is able to use various software development methodologies, draw up program documentation using the required diagrams, develop models of the logical and physical architecture of the software system, database, and manage the development process.	Testing, oral interview, course, laboratory, control work, midterm.	Economics and organization of production Project management Embedded systems 3. Development of cyber-physical systems





5	GE R	CS	LAN6001K R	Culture	5	3	3	0	45	15	90	0	5.0			
6	GE R	CS	PhC6006	Physical Culture	4	3	3	4/120	45	15	60		4.0			
7	GE R	CS	SPS6001	Philosophy	5	4	4	5/150	30	15	90			5.0		
8	GE R	CS	LAN6002K R	Kazakh (Russian) language	5	4	4	5/150	45	15	90			5.0		
9	GE R	CS	HK6002	History of Kazakhstan	5	4	4	5/150	30	15	90			5.0		
10	GE R	CS	SPS6006	Cultural studies- Psychology	4	5	5	4/120	30.0	15	60				4.0	
11	GE R	CS	SPS6007	Sociology- Political science	4	6	6	4/120	30.0	15	60				4.0	
12	GE R	ES	FIN6720	Basics of Financial Literacy				5/150	30	15	90					
13	GE R	ES	MGT6706	Startups and entrepreneurship				5/150	30	15	90					
14	GE R	ES	JUR 6470	Fundamentals of law and anti-corruption culture	5	6	6	5/150	30	15	90					5.0
15	GE R	ES	JUR 6507	Fundamentals safety of life activity and ecology				5/150	30	15	90					









41	BS	U C	HRD6306	Robotics with Artificial Intelligence	6	6	5	6/18 0	30 0	30 0	15	105	6. 0
42	BS	U C	HRD6312	Embedded systems 3. Development of cyber- physical systems	5	5	5	5/15 0	30. 0	15 0	15	90	5. 0
43	AS	U C	LAN6003P A	Professionally oriented foreign language	3	3	3	3/90	30		15	45	3. 0
44	AS	U C	EGR6303	Project management	4	6	6	4/12 0	30. 0	15 0	15	60	4. 0
45	AS	U C	PP6304	Pre-diploma practice	5	6		5/15 0		15 0	0	0	5. 0
46	AS	ES	MIN601	Minor 1	5	3	3	5/15 0	30. 0	15 0	15	90	5. 0
47	AS	ES	SFT6322	Introduction of artificial intelligence	5	3	3	5/15 0	30. 0	15 0	15	90	5. 0
48	AS	ES	EGR6305	3D modeling Altium Designer	5	3	3	5/15 0	30. 0	15 0	15	90	5. 0
49	AS	ES	MIN602	Minor 2	5	4	4	5/15 0	30. 0	15 0	15	90	5. 0
50	AS	ES	MIN603	Minor 3	5	6	5	5/15 0	30. 0	15 0	15	90	5. 0
51	AS	ES	EGR6304	3D printing Solidworks	5	5	5	5/15 0	30. 0	15 0	15	90	5. 0
52	AS	ES	SFT6317	Machine Learning - 1	5	5		5/15 0	30. 0	15 0	15	90	5. 0


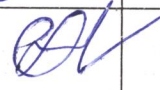
53	AS	ES	HRD6313	Electronic systems		5	5	5	5/15	15	30.	15	90	15	90	5.	
				Network programming	Fundamentals of information security												
54	AS	E3	NET6303	Network programming				5/15	15	30.	15	90				5.	
55	AS	ES	SEC6301	Fundamentals of information security		4	6	4/12	15	30	15	60				4.	
56	AS	ES	SFT6331	Smart technologies				4/12	15	30	15	60				0	
<b>Weekly average workload at hours</b>																	
1	General education subjects(GER)					56	12	0	1680	90	36	0	180	9	9	15	4
	Core subjects(GER/CS)					51	11	0	1530	75	33	0	165	9	9	15	4
	University component(GER/UC)					0	0	0	0	0	0	0	0	0	0	0	0
	Electives(GER/ES)					5	1	0	150	15	30	0	15	9	9	0	5
2	Base requirements(BS)					13	24	0	3570	42	18	0	345	30	15	23	31
	Core subjects(BS/CS)					0	0	0	0	0	0	0	0	0	0	0	0
	University component(BS/UC)					13	24	0	3570	42	18	0	345	30	15	23	31
	Electives(BS/ES)					0	0	0	0	0	0	0	0	0	0	0	0
3	Profession requirements(VRS)					46	9	0	1230	12	60	0	135	0	13	5	15
	Core subjects(VRS/CS)					0	0	0	0	0	0	0	0	0	0	0	0
	University component(VRS/UC)					12	2	0	210	15	30	0	30	0	3	0	9
	Electives(VRS/ES)					34	7	0	1020	10	180	0	105	0	10	5	15
4	Disciplines for the formation of professional competencies(BDFPC)					0	0	0	0	0	0	0	0	0	0	0	0
	Core subjects(BDFPC/CS)					0	0	0	0	0	0	0	0	0	0	0	0





**6 Developer approval sheet**

The title of the educational program: 6B06107 «Cyberphysical Systems»

№ п/п	Position, degree, last name and initials of a developer of the educational program	Date	Signature	Note
1	PhD, head of the «CE» department, associate professor T.T. Chinibayeva	15.03.2024		
2	Senior-lector of the «CE» department O.K. Tuenbayev	15.03.2024		
3	Tutor of the «CE» department K. Sarsenbek	15.03.2024	