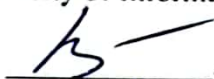AGREED
Chairman of the Educational and
Methodological Council JSC «International
University of Information Technologies»

_____ A.K.Mustafina
" 14 " 03 2023

APPROVE
Chairman of the Board – Rector
JSC International University of
Information Technologies

_____ A.K.Khikmetov
" __ " __ 2023

EDUCATIONAL PROGRAM

8D06103 "Information Systems"

(based on the professional standard "Creation and management of IT")

Code and classification of the field of education: 8D06 - Information and communication technologies

Code and classification of areas of study: 8D061 - Information and communication technologies

Group of educational programs: 057 - Information technology

ISCED level: 8

NQF level: 8

ORC level: 8

Duration of study: 3 years

Credits: 180

AGREED
Almaty Technological Institute
Department "Information Technology"
_____ Malikova F. U.
" __ " 02 2023

AGREED
Director LLP "Zerone Technology"
_____ Rashidinov D.R.
" __ " __ 2023

Almaty, 2023

The educational program "8D06101 "Clever Systems" is the main academic document of the university for training personnel in the direction of 8D06 - Information and communication technologies for the 8th level of qualification (PhD degree).

This educational program was discussed and approved at the meeting of the department "_3_" dated " 7 " _02_ 2023 Protocol № 3

Head of the Department   _____signature_____ Kozhamzharova D.Kh.

This educational program was reviewed and approved at a meeting of the University CC dated March 30, 2023 Protocol No. 8

Manager of the Department   _____signature_____ Ajibaeva A. Sh.

for Educational and Methodological Affairs

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List of abbreviations and symbols

BC	Basic competence
BM	Basic module
HE	Higher education
GOSO	State obligatory standard of education
ECR	European Qualifications Framework
ETF	European Training Foundation
ZUN	Knowledge, skills, skills
NKZ	National Classifier of Occupations
NQF	National Qualifications Framework
NQS	National Qualifications System
OGM	General humanitarian module
OM	General module
OP	Educational program
OPM	General professional module
OQF	Sectoral Qualifications Framework
OK	General educational competence
PS	Professional Standard
Air Defense	Postgraduate Education
PC	Professional competence
PM	Professional module
WG	Working Group
RK	Republic of Kazakhstan
RO	Learning Outcome
CM	Special module
QMS	Quality management system
SEM	Socio-economic module
TVE	Technical and Vocational Education
TVET	Technical and Vocational Education and Post-Secondary education
UNESCO	United Nations Educational, Scientific and Cultural Organization/
UNESCO	is a specialized agency of the United Nations Educational, Scientific and Cultural Affairs.
Cedefop	European Center for the Development of Vocational Training
DACUM	from English Developing Curriculum
ECVET	European Credit System for vocational education and training
EQAVET	European Quality Assurance in Vocational Education and Training
ENQA	EuropeanAssociationforQualityAssuranceinHigherEducation / European - Russian Association for Quality Assurance in 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

This educational program (EP) was developed on the basis of professional standards (PS) of the National Chamber of Entrepreneurs "Atameken", the National Qualifications Framework (NQF), the Sectoral Qualifications Framework (SQF) in the field of information technology and regional standards (RS) of education, based on research and trends indicated in the Atlas of new professions and competencies (ANPiK) of Kazakhstan in the field of information technology.

In the modern world of information technology, there is a fundamentally new qualitative shift that is radically changing the markets and the environment in which we live and work every day. This is primarily due to the penetration of digital technologies both into the daily lives of people and companies that have become "digital". Indeed, with every bit of data digitized and paperless, the global business landscape has become a highly interconnected network.

According to a study by the international research and consulting company International Data Corporation (IDC), almost half of the companies declared their "aspiration to digital technologies". This means that a workforce is needed that is ready to develop digital strategies and architectures that mimic the work of companies that initially built businesses around digital technologies. Cloud, Agile and DevOps workforce, digital innovation platforms and communities, and integrated data management and monetization.

The digital system is a metaphor that suggests considering modern organizations as mixed communities and systems in which people and digital agents interact. At the same time, openness in combining the efforts of developers, developing public-private partnerships and building a competitive environment in order to ensure the rapid growth in the number of available digital services, as well as improve their quality.

The PhD- level educational program is a co-educational program for all IT programs and provides professional qualifications
- in the field of representation and processing of knowledge in information systems,
- in the field of studying methods for constructing logical, production, network models and their use in information systems for various purposes: expert systems, fuzzy systems, decision support systems, neural network and genetic algorithms.
- development of methods for solving problems for which there are no formal algorithms: natural language understanding, learning, theorem proving, complex pattern recognition, etc.

Theoretical research is aimed at studying information processes and creating appropriate mathematical models. Experimental work is carried out by compiling computer programs and creating machines that solve particular information problems or behave reasonably in a given situation.

The educational program will contribute to the formation of the doctoral candidate's skills and abilities in the areas of solving design and management problems based on artificial intelligence methods, software development for modern information systems.

2. Purpose and objectives of the educational program

The purpose of the EP: training of competent research professionals is necessary to meet the demands of science. These professionals should be familiar with patterns of knowledge of information processes, methods of searching for, processing, and presenting professionally significant information in computer science, education and production in the area of contemporary information systems.

Tasks:
− study of the principles of organization of modern information systems;
− mastering the methods of knowledge representation and inference methods in modern information systems;

- study of methods and software tools for the development of information systems for various purposes;
- analysis of real problems, application of information systems for solving problems by means of expert systems, decision support systems.
- familiarization with the concepts and methods that form the basis of modern achievements of information systems;
- determining the value of a software product through integration with other products
- familiarization with the features of the practical use of information systems and decision-making systems.
- consideration of a set of services, devices, and other products of one company that are inextricably linked into a single network;
- development, maintenance of applied information in various fields.

The doctoral student must possess the skills of analytical generalization of the results of scientific research using modern achievements in science and technology, the skills of independent data collection, study, analysis and generalization of scientific and technical information on the subject of dissertation research, the ability to create theoretical models that allow predicting the properties of the objects under study, and develop proposals for the implementation of the results

3. Requirements for evaluating the learning outcomes of an educational program

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

Table 1

No.	Exam form	Recommended share, %
1	Computer testing	5%
2	Writing	25 %
3	Oral	60%
4	Project	5%
5	Practical	0%
6	Complex	5%

Disciplines submitted for the state exam: "Data Mining in IS", Theoretical Computer Engineering, "Analysis Methods and Big Data Processing".

4. Passport of the educational program

4.1 General information

No.	Field name	Note
1	Code and classification of the field of education	8D06 - Information and Communication Technology
2	Code and classification of areas of study	8D061 – Information and Communication Technology
3	Group of educational programs	057 - Information technology
4	Name of the educational program	8D06103 - Information systems
5	Brief description of the educational program	The PhD- level educational program is a co-educational program for all IT programs and

		provides professional qualifications • in the field of representation and processing of knowledge in information systems, • in the field of studying methods for constructing logical, production, network models and their use in information systems for various purposes: expert systems, fuzzy systems, decision support systems, neural network and genetic algorithms. • development of methods for solving problems for which there are no formal algorithms: natural language understanding, learning, theorem proving, complex pattern recognition, etc.
6	Purpose of the EP	Training of competent research professionals is necessary to meet the demands of science. These professionals should be familiar with patterns of knowledge of information processes, methods of searching for, processing, and presenting professionally significant information in computer science, education and production in the area of contemporary information systems.
7	ISCED level	8
8	NQF level	8
9	ORC level	8
10	List of competencies **Basic competencies (BC):** BC1: the ability to know the main types and classification of information systems, patterns of information processes, methods of searching, processing and presenting professionally significant information; BC2: the ability to effectively plan, implement, configure and maintain the organization's computer infrastructure; BC3: the ability to acquire new knowledge and skills with the help of information technology and put into practice, including in new areas of knowledge that are not directly related to the field of activity; BC4: possession of methods and means of obtaining, storing, processing and broadcasting information through modern computer technologies, including global computer networks; BC5: ability to create, configure and manage large ecosystems; BC6: culture of thinking, the ability to build the logic of reasoning and statements based on the interpretation of data, integrated from different areas of science and technology, to make judgments based on incomplete data; BC7: the ability to organize interaction between the development team and the customer; making managerial decisions in conditions of different opinions; BC8: the ability to analyze and evaluate the levels of their competencies, combined with the ability and readiness for self-regulation of further education and professional mobility. **Professional competencies (PC):** PC1: the ability to analyze professional information, highlight the main thing in it, structure, format and present in the form of analytical reviews with reasonable conclusions and recommendations; PC2: ability to develop terms of reference for specifications; formulate terms of reference and criteria for the effectiveness of information systems;

	PC3: ability to develop new methods for designing and developing information systems; PC4: the ability to build knowledge representation models, approaches and techniques for solving artificial intelligence problems, knowledge information models, knowledge representation methods (knowledge engineering methods); PC5: the ability to develop and program human-computer interaction, solve optimization problems using artificial intelligence algorithms; PC6: the ability to develop methods for solving non-standard problems and new ways of solving traditional problems; PC7: ability to develop design strategies, definition of design goals, performance criteria, applicability limitations; PC8: ability to predict the development of information systems and technologies; PC9: ability to develop competitive ideas in the theory and practice of information technologies and systems; PC10: ability to professionally operate modern equipment and instruments (in accordance with the goals of the doctoral program); PC11: organization of effective collaboration and synchronization stages of product development; PC12: ability to conduct staff training.	
11	**Learning Outcomes** LO1 Formulate research problems and find ways to solve them based on models and methods of data mining, machine learning, neural networks, theories of computational complexity and optimization; LO2 Demonstrate patterns of knowledge of information processes, methods of searching, processing and presenting professionally significant information; LO3 Apply big data processing and data mining methods to solve resource-intensive tasks; LO4 Develop computational algorithms for engineering problems and implement them in high-performance systems; LO5 Implement and scale DevOps methodologies by synchronizing all stages and elements process creating software products from the coding phase to the testing and release phase; LO6 Develop intelligent information systems and their components based on modern methods of data science; LO7 Design and develop a software architecture that includes many functions, maintaining their performance and consistent development; LO8 Generate own new scientific ideas in a specific subject area and communicate them to the scientific community; LO9 Propose substantiated proposals or explanatory notes for ICT research projects; LO10 Evaluate own and known scientific research and prepare analytical materials for the development of strategic decisions in the field of ICT; LO11 Apply control theory with the help of mathematical models, methods of intelligent system control.	
12	Form of study	full-time
13	Language of instruction	English
14	Volume of loans	180
15	Professional standards	Creation and management of information technologies, Development of systems for processing and storing big data, Management and design, Management of computer systems architecture, System analysis in information and communication technologies, Software development, Business analysis in information

16	Awarded Academic Degree	Doctor in the field of information and communication technologies in the educational program 8D06103 "Information Systems"
17	Developer(s) and authors:	JSC "International University of Information Technologies", Department of Information Systems: Head of the PhD Section of the Information Systems Department, Professor, Doctor of Technical Sciences Naizabayeva L.K. Professor of the Department of Information Systems, Doctor of Technical Sciences Sinchev B.K. Senior lecturer of the department "Information systems", Myrzakerimova A. Senior lecturer of the Department of Information Systems, Auezova A. Lecturer of the Department of Information Systems, Elle V.

4.2 Matrix of correlating the learning outcomes of the educational program as a whole with the competencies being formed

	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11
BC 1		√			√						
BC 2		√									
BC 3				√							
BC 4				√							
BC 5				√							
BC 6						√					
BC 7							√	√			
BC 8								√			
PC 1	√										
PC 2			√								
PC 3			√								
PC 4			√								√
PC 5			√		√						
PC 6								√			
PC 7								√			
PC 8								√			
PC 9								√			
PC 10							√		√		

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PC 11						√					
PC 12										√	

4.3 Information about modules / disciplines (if there are modules, it is necessary to highlight them)

No.	Name of the discipline	Brief description of the discipline (30-50 words)	Number of credits	Formed competencies (codes)	Prerequisites
Cycle of basic disciplines **University component**					
1	"Academic Writing"	Studying the course will allow doctoral students to carry out professional activities related to searching for information in scientific databases, analyzing and summarizing texts, and working with various genres of academic writing.	5	BC-7,8 PC-12	No
2	Scientific research methods	The course presents for doctoral students the methodology of research in the field of intelligent systems. Course topics: the importance of research and some information technology research methodologies, ie formal method, prototyping, experiment and evaluation; methods for writing results, such as writing reports, writing articles, and writing abstracts; registration of research results; writing research proposals.	4	BC-3,4,5 PC-1,3,4,5	"Fundamentals of scientific research"
3	Big data processing	Course methods of storing data, effectively analyze them and extract business and socially relevant information. This course introduces PhD students to several key IT technologies that they can use to manipulate, store and analyze big data. The course covers MapReduce methods for parallel processing and Hadoop, an open source framework that allows us to cheaply and efficiently implement MapReduce in web tasks. Doctoral students will be able to develop highly scalable systems that can receive, store and analyze large amounts of unstructured data in batch and/or real-time.	4	BC-1,3,4,5 PC-1,2,3,4,5	Database management systems, Machine learning
Cycle of basic disciplines **Selectable Component**					
	Elective discipline - 1				
4	Actual problems in forecasting	In this discipline, doctoral students study the basic principles, construction features and scope of predictive models. The course provides a detailed overview and description of the classification and clustering of	4	BC-3,4,5,7,8 PC-1,6,7,8,9	Data mining in IS

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		forecasting, and focuses on the practical problems involved in forecasting. Doctoral students will implement predictive models using Python and machine learning, as well as implement innovative engineering projects to develop predictive models for various purposes using modern design methods. In the process of learning activities, software implementation of predictive models is carried out to solve practical problems from various fields of application.			
5	Data mining in IS	This course describes the fundamentals of data analysis methods such as classification, modeling and prediction methods based on the use of decision trees, artificial neural networks, genetic algorithms, evolutionary programming, associative memory, fuzzy logic. Doctoral students will study methods of data analysis, including statistical methods: descriptive analysis, correlation and regression analysis, factor analysis, analysis of variance, component analysis, discriminant analysis, time series analysis, survival analysis, relationship analysis.	4	BC-1,2,6,7 PC-1,10,11	Statistical data analysis
6	Information retrieval systems	This course will cover search engine technologies that play an important role in any data mining applications that use text data for two reasons. First, although the source data can be large, relatively small subsets of the data are often relevant, and a search engine is an important tool for quickly discovering a small subset of relevant text data in a large text. Second, search engines need analysts to interpret any patterns found in the data, allowing them to explore the relevant underlying text data. Doctoral students will study the basic concepts, principles of text search underlying search engines.	4	BC-3,4,5 PC-1,2,3,4,5	Database management systems , Data analysis
7	DevOPS-engineering	DevOps engineer automates assembly, testing, helps the company to quickly and safely implement changes to the code or launch a new product, supports the work of highly loaded services. The purpose of the training is to develop doctoral students' knowledge and skills in the DevOps methodology for the active interaction of specialists in the development of information technology service systems and the mutual integration of work processes to ensure product quality. During the course, the software life cycle (LC) is analyzed in detail, the role of a DevOps engineer in the LC, as well as DevOps software tools: Docker, Jenkins, Ansible, Kubernets and Prometheus.	4	BC-1 PC-5	Programming technology

		Cycle of major disciplines University Component/Elective Component			
8	Data Analysis Tools	This discipline studies the basic principles, features, technologies, methods, models and tools for data analysis and evaluation of the effectiveness of analytics systems. Doctoral students are exploring the possibilities of analytical platforms. The course consists of theoretical and practical parts. The practical part provides for the tasks of analysis, processing, visualization and interpretation in various subject areas using analytical platforms and tools.	4	BC1, BC4, BC7, PC1, PC3	Data analysis
	Elective discipline - 2				
9	Modern management theory	Management theory is an applied scientific discipline that uses the results of research and development in other branches of science. The management theory course is connected with a number of humanitarian, general professional and special disciplines. The development of management theory takes place in close interaction with such scientific disciplines as: philosophy, sociology, organization theory, psychology, management, personnel management and many others. At the same time, the results of scientific research in the field of management theory are used in such disciplines as the public administration system, municipal management, personnel management, etc.	4	BC6, PC1, PC3, PC6, PC11	Project management
10	Theoretical computer engineering	The course is a challenging introduction to the basic ideas of theoretical computer engineering. In the course, doctoral students will become familiar with the most important areas and tools of modern computer engineering, along with the theory of algorithms, which includes the development and analysis of computational procedures; and complexity theory, which includes attempts to prove that there are no efficient algorithms in certain cases, and which investigates a classification system for computational problems. Time, memory, randomness, and concurrency are typical measures of computational cost. The course covers propositional logic, Turing machines and computability, finite automata, Gödel's theorems, efficient algorithms and reducibility, NP-completeness, P versus NP problems, decision trees and other specific computational models, power of randomness, cryptography and one-way functions, computational learning theories, interactive evidence and quantum computing and the physical limits of computing.	4	BC2, PC2, PC7, PC10	"Database Management Systems", "Programming Technology", "Decision Theory", "Software Engineering"
11	Advanced	The course focuses on outcomes and methods	4	LO7	Data

	software architecture	that help the doctoral student to gain confidence in architectural design. This includes architectural patterns, qualitative and quantitative assessment of architectures, quantitative modelling using architecture description languages such as AADL and MARTE, and qualitative architecture evaluation methods, e.g., ATAM. Finally, the course will also address the specific challenges related to scale, dynamics, and heterogeneity as found in system of systems, and ultra-large-scale systems, blockchain systems, smart contracts systems (Solidity language). Extend the knowledge of participants in the key concepts: what is software architecture, and what is the way to build and maintain architecture.			Structures (C++, Java), Advanced Programming Techniques
12	Deep learning methods	The course covers deep learning methods, training and deployment of neural networks. During the training, doctoral students will experiment with data, training parameters, neural network structure and other parameters to improve the performance and capabilities of neural networks, and deploy neural networks to solve real-world problems. Upon completion of the course, students will be able to solve their own problems using deep learning algorithms.	4	BC-3,4,5,6,7,8 PC-1,6,7,8,9,11	"Machine learning", "Methods of automatic text processing", "Analysis and processing of unstructured data", "Neural networks"

5. Curriculum of the educational program

Discipline Code	Name of disciplines	Total loans	Semester	Total hours	including				SRO			number of weeks					
					classroom	lectures	practical	laboratory	Total	SRSP	SRS (extra-audit)	15 1 2020-2021	15	15 2 2021-2022	15	15 3 2022-2023	15
I.	**Theoretical training**																
1.1	**1.1 The cycle of basic disciplines (DB)**																
1)	**1) Mandatory component (VC)**																
LAN8001A	Academic writing	5	1	150	45	15	30		105	15	90	5					
RM8001	Scientific research methods	4	1	150	45	15	30		105	15	90	4					
ANL8102	Big data processing	4	1	120	30	15	15		90	15	75	4					
1.1	**Total OOD OK**	**13**	1	**390**	**105**	**45**	**60**		**285**	**45**	**240**	**13**					
2)	**2) Component of choice (CV)**																
DV 1	**Elective discipline - 1**	4	1	120	30	15	15		90	15	75	4					
SFT8100	Actual problems in forecasting																
ANL8105	Information retrieval systems																
ANL8101	Data mining in IS																
SFT8104	DevOPS-engineering																
PP8100	**Teaching practice**	10	2	300					300	15	285		10				
	Total OOD VK	**14**		**420**	**135**	**60**	**75**		**375**	**60**	**315**	**17**	**10**				
	Total OOD OK, VK	**27**	1	**810**	**135**	**60**	**75**		**675**	**75**	**600**	**17**	**10**				
2	**2. Cycle of major disciplines (PD)**																
1)	**1) University component (VC)**																

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ANL8100	Data Analysis Tools	4	1	120	30	15	15		90	15	75	4				
	Total database for VK	4	1	120	30	15	15		90	15	75	4				
2)	**2) Component of choice (CV)**															
DV 2	**Elective discipline - 2**	4	1	120	30	15	15		90	15	75	4				
SFT8101	Theoretical computer engineering															
SFT8102	Deep learning methods															
SFT8103	Modern management theory															
SFT8105	Advanced software architecture															
PP8101	Research practice	10	2	300					300	15	285		10			
2.2	**Total DB KV**	14		420	30	15	15		390	30	360	8	10			
2	**Total DB VK, KV**	**18**	1	**540**	**30**	**15**	**15**		**480**	**45**	**435**	**8**	**10**			
II	**II. Research work (PD)**	115														
1	**NIRM**	123														
NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	5	1	150					150	15	135	5				
NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	10	2	360					360	90	270		10			

NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	30	3	540					540	90	450			30			
NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	30	4	900					900	90	810				30		
NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	30	5	900					900	90	810					30	
NIRD	Research work of a doctoral student, including an internship and a doctoral dissertation	18	6	600					600	90	510						18
3.1	**Total PD OK**	**123**	**21**	**3450**					**3450**	**465**	**2985**	**5**	**10**	**30**	**30**	**30**	**18**
3	**Total PD for VC and VC**	**123**	**21**	**3450**					**3450**	**465**	**2985**	**5**	**10**	**30**	**30**	**30**	**18**
4	**4 Additional types of training (VET)**																
4.1	**4.1 Component of choice (EC)**																
4	**Total DVO KV**																
5	**5 Final State certification:**	12															
OZMD	Registration and defense of a doctoral dissertation (OiZDD)	12	6	360					360	90	270						12
5	**Total for IGA**	**12**		**360**					**360**	**90**	**270**						**12**
1+2+3+4+5	**TOTAL**	**180**		**5400**	**300**	**90**	**210**		**5205**	**579**	**4626**	**30**	**30**	**30**	**30**	**30**	**30**

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6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	documents on the results of the development of additional educational programs (Minor)
Advanced programming in .NET	4	1	
Advanced programming in Java EE	4	1	
Machine learning	4	1	
Applied robotics	4	1	
Probability forecasting	4	1	
Data visualization	4	1	

7. Developer approval sheet

Name of the educational program: 8D06103 "Information systems"

No. p/p	Position, scientific or academic degree and Surname I.O. educational program developer	date	painting	Note
1	Head of the PhD Section of the Information Systems Department, Professor, Doctor of Technical Sciences Naizabayeva L.K.	11.0 3.2023		
2	Professor of the Department of Information Systems, Doctor of Technical Sciences Sinchev B.K.	11.0 3.2023		
3	Senior lecturer of the Department of Information Systems, Myrzakerimova A	11.0 3.2023		
4	Senior lecturer of the Department of Information Systems, Auezova A.	11.0 3.2023		
5	Lecturer of the Department of Information Systems, Elle V.	11.0 3.2023		

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