# MINISTRY OF SCIENCES AND HIGHER EDUCATION OF THE REPUBLIC OF KAZAKHSTAN
## M.O. AUEZOV SOUTH KAZAKHSTAN UNIVERSITY

«APPROVED»
Chairman of the board -
Rector
Doctor of historical sciences,
Academician, Kozhamzharova D.P.
_____ 2023

# EDUCATIONAL PROGRAM

## 7M06140- «Mathematical and computer modeling»

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| Registration number | 7M06100009 |
| Code and classification of the field of education | 7M06 Information and Communication Technologies |
| Code and classification of areas of training | 7M061 Information and Communication Technologies |
| Group of educational programs | M094 Information technologies |
| Type of EP | acting |
| ISCE level | 7 |
| NQF level | 7 |
| IQF level | 7 |
| Language of instruction | Kazakh, Russian, English |
| The complexity of the EP | 120 credits |
| Distinctive features of the EP | - |
| Partner university (JEP) | - |
| Partner university (DDEP) | - |

Shymkent, 2023 y.

Developers:

| FULL NAME | Position | Signature |
|---|---|---|
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| 9. Abduvaliev Alisher Abduvakhitovich | General Director of IT INVEST LLP | Stamp |
| 10. Sarsenbi Abdizhakhan Manapovich | Director of the Scientific Center "Theoretical and Applied Mathematics" | Stamp |

The EP was considered in the direction of training  information and communication  technologies at a meeting of the academic committee, protocol № _7_  « _21_ » _02_  2023y.

Chairman of the Committee _____ Shertayev E.T.
Signature

The EP was considered and recommended for approval at Educational-methodical meeting of   M. Auezov SKU , protocol № _4_   «_22_»  _02_    2023 y.

Chairman of the EMC _____ Abisheva R. D.

The EP was approved by the decision of the Academic Council of the University
protocol № _13_  «_23_»  _02_   2023 y.

CONTENT

# 1 CONCEPT EP

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| **Mission of the University** | We are focused on generating new competencies, training a leader who translates research thinking and culture. |
| **University Values** | – Openness - open to change, innovation and cooperation. <br> – Creativity - generates ideas, develops them and turns them into values <br> – Academic freedom - free to choose, develop and act. <br> – Partnership - creates trust and support in a relationship where everyone wins. <br> – Social responsibility - ready to fulfill obligations, make decisions and be responsible for their results. |
| **Graduate Model** | – Deep subject knowledge, their application and continuous expansion in professional activity <br> – Information and digital literacy and mobility <br> – Research skills, creativity and emotional intelligence <br> – Entrepreneurship, independence and responsibility for their activities and well-being <br> – Global and national citizenship, tolerance to cultures and languages |
| **Uniqueness of the EP** | the program was developed in accordance with the Atlas of New Professions and Competencies, and is aimed at training competent specialists for transport and logistics and scientific and pedagogical structures who are able to organize and manage the activities of a structural enterprise, independently determine the goals of professional activity, choose and justify methods and means to achieve them. |
| **Academic Integrity and Ethics Policy** | The University has taken measures to maintain academic integrity and academic freedom, protection from any kind of intolerance and discrimination: <br> • Rules of academic integrity (Order No. 212-нқ dated 10.10.2022); <br> • Anti-Corruption Standard (Order No. 221-нқ dated 07.12.2021). <br> • Code of Ethics (order No. 212-нқ dated 10.10.2022). <br> • Anti-Corruption Policy of the NJSC "M. Auezov South Kazakhstan University." (order No. 144 нқ dated 07.14.2022). |
| **Regulatory and legal framework for the development of EP** | 1. Law of the Republic of Kazakhstan "On Education" No. 319-III dated July 27, 2007; <br> 2. Standard rules of activity of educational organizations implementing educational programs of higher and (or) postgraduate education, approved by Order of the Ministry of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595 <br> 3. State obligatory standards of higher and postgraduate education, approved by order of the Ministry of Education and Science of the Republic of Kazakhstan dated July 20.2022 No. 2; <br> 4. Rules for the organization of the educational process on credit technology of training, approved by the Order of the Ministry of Education and Science of the Republic of Kazakhstan dated April 20, 2011 No. 152; <br> 5. Qualification directory of positions of managers, specialists and other employees, approved by the Order of the Minister of Labor and Social Protection of the Population of the Republic of Kazakhstan on December 30, 2020 No. 553. <br> 6. Guidelines for the use of ECTS. <br> 7. Guidelines for the development of educational programs of higher and |

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| | postgraduate education, Appendix 1 to the order of the Director of the Central Research Institute No. 45 o/d dated June 30, 2021. |
| **Organization of the educational process** | – Implementation of the principles of the Bologna Process<br>– Student-centered learning<br>– Availability<br>– Inclusivity |
| **Quality assurance of EP** | – Internal quality assurance system<br>– Involvement of stakeholders in the development of the EP and its evaluation<br>– Systematic monitoring<br>– Updating the content (updating) |
| **Requirements for applicants** | They are established according to the Standard Rules of admission to training in educational organizations implementing educational programs of higher and postgraduate education Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 600 dated 31.10.2018 |
| **Conditions for the implementation of educational programs (EP) for persons with disabilities and special educational needs(SSN)** | For students with SEN (special educational needs) and persons with disabilities (PSI), tactile PVC tiles, specially equipped toilets, a mnemonic diagram, and shower bars have been installed in educational buildings and student dormitories. Special parking spaces have been created. Crawler lift installed. There are desks for people with limited mobility (PLM), signs indicating the direction of movement, ramps. In the educational buildings (main building, building No. 8) there are 2 rooms with six working places adapted for users with disorders of the musculoskeletal system (DMS).For visually impaired users, the SARA™ CE Machine (2 pcs.) is available for scanning and reading books. The library website is adapted for the visually impaired. There is a special NVDA audio program with a service. The JIC website http://lib.ukgu.kz/ is open 24/7.<br><br>An individual differentiated approach is provided for all types of classes and in the organization of the educational process. |

# 2 EP PASSPORT

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| **Purpose of the EP** | Training of specialists with conceptual, analytical and logical thinking, who are able to determine the strategy of the organization, who have a complex of new knowledge in the field of mathematical and computer modeling of processes occurring in various fields of human activity. |
| **Tasks of the EP** | - the formation of socially responsible behavior in society, understanding the importance of professional ethical standards and adherence to these standards;<br><br>- providing skills and abilities for lifelong learning that will allow them to successfully adapt to changing conditions in their careers;<br><br>- providing conditions for acquiring a high general intellectual level of development, mastering a competent and developed speech, culture of thinking and skills of scientific organization of labor in the field of modeling technological and natural processes based on information technologies;<br><br>- ensuring the implementation of the educational process based on the integration of education and science;<br><br>- the formation of students in-depth and modern knowledge in the field of mathematical and computer modeling of processes, as well as the methodology of teaching them;<br><br>- formation of skills to search for urgent and promising problems of world and domestic science, the use of modern mathematical modeling apparatus for solving a wide class of problems in science and technology;<br><br>- the formation of a high scientific culture, pedagogical and research experience, the ability to plan, develop, implement and coordinate scientific research by industry. |
| **Harmonization of EP** | • 7th level of the National Qualifications Framework of the Republic of Kazakhstan;<br>• Dublin descriptors of the 7th level of qualification;<br>• 2 cycle of a Framework for Qualification of the European Higher Education Area);<br>• 7th Level of European Qualification Framework for Life long Learning). |
| **Connection of the EP with the professional sphere** | **Professional standard: "Ensuring the security of information infrastructure and IT".** Appendix No. 4 to the Order of the Acting Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" No. 222 dated 05.12.2022.<br>**Professional standard: "Development of big data processing and storage systems".** Appendix No. 18 to the Order of the Acting Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" No. 222 dated 05.12.2022.<br>**Professional standard: "Creation and management of information technologies".** Appendix No. 40 to the order of the Deputy Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" dated 12/24/2019 No. 259.<br>**Professional standard: "Teacher (teaching staff) of the organization of higher and (or) postgraduate education"** (Appendix to the order of the Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" No. 133 dated 8 June 2017). |

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| **Name of the degree awarded** | After the successful completion of this EP, the graduate is awarded the degree of "Master of Engineering" in EP 7M06140 - "Mathematical and Computer Modeling". |
| **List of qualifications and positions** | Graduates can hold teaching positions in higher education institutions, engineers, designers and researchers in research institutes, in public and private companies, in education departments, in state and municipal structures, in the media, in industrial enterprises (analytical departments) using mathematical modeling of processes, computers and information and communication technologies, including a specialist in the field of geo information systems, interactive technologies in accordance with the qualification requirements of the National Classifier of the Republic of Kazakhstan (NKZ), approved by the order of the Committee technical regulation and metrology of the Ministry for Investment and Development of the Republic of Kazakhstan dated May 11, 2017 No. 130-od. |
| **Field of professional activity** | The sphere of professional activity is the fields of science and education, technologies of a different nature, branches of the real sector of the economy, management and business dealing with mathematical and computer modeling methods, processing statistical and experimental data, as well as with the search, storage, transmission, processing and protection of information. |
| **Objects of professional activity** | The objects of professional activity according to EP 7M06140- "Mathematical and Computer Modeling" are: <br> -mathematical modeling of chemical-technological, ecological, physical and economic processes; <br> - mathematical modeling of problems of mechanics, heat and mass transfer of external and internal flows; <br> - mathematical and computer modeling of new technological processes; <br> -system administration of operating systems, programming of production and scientific tasks; <br> - development and management of databases for scientific, industrial and economic problems. |
| **Subjects of professional activity** | -development of mathematical and computer models of physical, natural, chemical-technological, environmental and economic processes; <br> -development, use and management of databases; <br> -programming in high-level object-oriented languages; <br> -working with modern software packages for data analysis in the fields of science, engineering, economics and technology; <br> - the use of computer, computing and network technologies for solving problems of an applied nature; <br> - development of effective algorithms and programs for the implementation of mathematical models, the use of standard packages of computer mathematical systems; <br> -computer graphics and animation for architectural and design tasks, three-dimensional modeling and visualization of objects |
| **Types of professional activity** | Master in EP 7M06140- "Mathematical and Computer Modeling" can perform the following types of professional activities: <br> - research; |

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| | - pedagogical;<br>- design;<br>- production and technological;<br>- organizational and managerial;<br>- analytical. |
| **Learning outcomes** | **LO1** Possess written and oral communication in native and foreign languages, use information management skills<br>**LO2** Possess fundamental knowledge in modern areas of mathematics, mechanics, physics, computer science and information technology and the skills to apply them to applied problems.<br>**LO3** Be able to independently develop efficient algorithms and programs for computer modeling of natural and man-made processes.<br>**LO4** To know the methods of developing effective models and algorithms for solving applied problems of hydro-gas dynamics, heat and mass transfer, mechanics of continuous, multiphase and dispersed media, chemical and biotechnology, ecology and economics.<br>**LO5** To be able to analyze the stages of development of mathematical modeling of processes and analysis of the results of numerical experiments.<br>**LO6** Be able to apply the latest achievements of mathematical and computer modeling in science, in the banking sector, insurance companies and financial structures.<br>**LO7** Understand the need to work in a team to solve complex applied modeling tasks that require the coordination of efforts of several performers with knowledge of the specifics of applied tasks.<br>**LO8** The ability to plan and conduct numerical and full-scale experimental studies with the interpretation of the results obtained on the basis of modern methods of modeling, analysis, and processing in the field of economics, engineering, and technology.<br>**LO9** Critically analyze existing methods for developing mathematical models in various subject areas using information technology.<br>**LO10** Realize the need for and have the ability to independently learn and improve their qualifications throughout their lives. |

# 3 COMPETENCES OF THE EP GRADUATE

| SOFTSKILLS.Behavioral skills and personality qualities | |
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| SS1. Competence in managing one's own literacy | SS1.1.The abilityofself-learn, self-develop and constantly update theirknowledgewithinthechosentrajectory and in an interdisciplinaryenvironment.<br>SS1.2. The abilityto express thoughts, feelings, facts and opinions in the professional field.<br>SS1.3. The abilityformobility in the modern world and criticalthinking. |
| SS 2. Language competence | SS2.1.The abilitytobuildcommunicationprograms in thestate, Russian and foreignlanguages.<br>SS2.2. The abilityfor interpersonal social and professional communication in theconditionsofinterculturalcommunication. |
| SS 3. Mathematical Competence and Competenceinthe field of Science | SS3.1.The ability and willingnesstoapplytheeducational potential, experience and personal qualitiesacquiredduringthestudyofmathematical, naturalscience, technicaldisciplines at theuniversitytosolve professional problems. |
| SS 4. Digital competence, technologica lliteracy | SS4.1. The ability to demonstrate and develop information literacy through the mastery and use of modern information and communication technologies in all areas of their lives and professional activities.<br>SS4.2. The ability to use various types of information and communication technologies: Internet resources, cloud and mobile services for searching, storing, protecting and disseminating information. |
| SS 5. Personal, social and academic competencies | SS5.1.The ability for physical self-improvement and focus on a healthy lifestyle to ensure full-fledged social and professional activities through the methods and means of physical culture.<br>SS5.2. The aility to social and cultural development based on the manifestation of citizenship and morality.<br>SS5.3 The ability to build a personal educational trajectory throughout life for self-development, career growth and professional success.<br>SS5.4. The ability to successfully interact in a variety of socio-cultural contexts during study, work, home and leisure. |
| SS 6. Entrepreneurial competence | SS6.1. The abilitytobecreative and entrepreneurial in a varietyofenvironments.<br>SS6.2. The ability to work in a mode of uncertainty and rapidly changing task conditions, mak decisions, allocate resources and manage your time.<br>SS6.3. The ability to work with consumer requests. |
| SS 7. Cultural awareness and ability to express yourself | SS7.1. The ability to show world view, civil and moral positions.<br>SS7.2. The ability to be tolerant of the traditions and culture of othe rpeoples of the world, to have high spiritual qualities. |
| HARDSKILLS. | |
| Theoretical knowledge and practical skills specific to this field | PC1 - knows how to reason, argue and express his opinion in a foreign language. |
| | PC2 - is able to analyze the stages of development of mathematical modeling of the process and ways to improve the efficiency of the created mathematical and computer models |
| | PC3 - is able to independently develop effective algorithms and programs for the implementation of mathematical models with verification of the |

| | | adequacy of the results to the object of research |
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| | | PC4 - knows organizational forms, modern means, methods and technologies of teaching mathematics and methods of mathematical and computer modeling in educational and scientific institutions of various types |
| | | PC5-is able to develop a design strategy, determine goals, performance criteria, limitations of applicability, new methods, tools and methods of mathematical modeling using information technologies and systems |
| | | PC6-is able to develop mathematical and computer models of chemical-technological, hydrodynamic and environmental processes, heat and mass transfer |
| | | PC7 - knows holistic ideas about the processes and phenomena of technology, technology, animate and inanimate nature, social life; understands and owns the methods of cognition at the level necessary for solving problems, while performing professional functions. |

## 3.1 Matrix for correlating EP learning outcomes as a whole with the resulting competencies of the modules

| | LO1 | LO2 | LO3 | LO4 | LO5 | LO6 | LO7 | LO8 | LO9 | LO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| SS1 | + | | | | + | | | | | + |
| SS2 | + | | | + | | + | | | | |
| SS3 | | + | + | | | | + | | | + |
| SS4 | | | | + | | + | | + | | |
| SS5 | + | | | | | | | | + | |
| SS6 | | | + | | + | | | | + | |
| SS7 | + | | | | | | + | | + | |
| PC1 | | | | + | | + | | | | |
| PC2 | | + | | + | | + | + | + | | |
| PC3 | + | + | | | + | + | + | + | | |
| PC4 | | | + | | | | | + | | + |
| PC5 | | | | + | | + | | + | | |
| PC6 | | | | | | + | | | + | + |
| PC7 | | + | + | | | | + | | + | + |

# 4.MATRIX OF THE INFLUENCE OF DISCIPLINES ON THE FORMATION OF LEARNING OUTCOMES AND INFORMATION ON LABOR INTENSITY

| № | Module name | Cycle | Component name | Name of the discipline | Brief description of the discipline | Number of credits | LO 1 | LO 2 | LO 3 | LO 4 | LO 5 | LO 6 | LO 7 | LO 8 | LO 9 | LO 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Module of Scientific and Pedagogical Training | BD | HsC | History and philosophy of science | Purpose: Study of the problems of the phenomenon of science as a subject of special philosophical analysis, patterns, and trends in the development of special activities for the production of scientific knowledge taken in a socio-cultural context. The contents. Identification of the specifics and relationship of the main problems of history and philosophy of science. Study of the laws of the development of science and the structure of scientific knowledge, methods of scientific research. Knowledge of the main concepts and directions of the non-classical and post-classical stage of the development of science. Analysis of the realities of modern theory and practice based on understanding the methodology of natural science, socio-humanitarian and technical knowledge. Critical thinking as a prerequisite for the development and functioning of modern society. Technologies for the development of critical thinking: consideration and study of the logic of arguments. Formation of critical reflexive thinking and metacognitive abilities. | 4 | | | | v | | | | | | v |
| | | BD | HsC | Foreign language (professional) | The aim is systemic deepening of communicative competence within the framework of foreign language education"s international standards based on the further skills and abilities" active language proficiency development in the professional activities of the future master"s student The contents. Levels B2, C1 are presented in the form of a pragma-professional orientation for professional and academic aims at an advanced level: scientific information base, interpretation of scientific information, argumentation, persuasion, scientific controversy, academic writing. Use of innovative methods and technologies, and attraction of modern means (Internet resources). Demonstration of language material"s knowledge in any related | 4 | v | | | | | | | | | |

| № | Module | | | Discipline | Description | Credits | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | discipline. | | | | | | | | | | | |
| | | BD | HsC | Psychology of management | Purpose: to ensure the competence of a psychologist by mastering his knowledge in the field of psychological management, developing skills in managing the organization"s human resources. Content: methodological foundations of management psychology. Development of psychological theories of management. General theoretical questions of management psychology. Psychology of managerial communication. Psychological characteristics of the staff. Psychology of employee motivation. Technologies of human resource management of the organization. Psychological support of the personnel policy of the organization. Psychology of conflict in the organization. Technologies for preventing professional deformation of personality. Practical implementation in the form of creating diagnostic tools, developing digital methods for training leaders, and management consulting. | 4 | | | | | | | v | | | v |
| | | BD | HsC | Higher education pedagogy | The aim: formation of the foundations of the professional and pedagogical culture of a university teacher, general pedagogical competencies, familiarization of undergraduates with the theoretical and methodological foundations of higher education pedagogy. Technologies for planning, organizing and managing the educational process at a university. Content. Modern paradigms of education, history and latest trends in the development of higher professional education in the world and in Kazakhstan. Genesis and methodology of pedagogy of higher education, the competence of a university teacher. Problems of university didactics, problems of organizing educational work with students, management of a modern university. Modern approaches and methods of teaching and organization of educational activities of students, evaluation of educational achievements. | 4 | v | | | | | | | | | v |
| 2 | Methodical Fundamentals of Teaching | PD | HsC | Teaching Methods of Special Disciplines | Purpose: formation of basic knowledge and skills for teaching IT disciplines, formation of the ability to use the skills of effective application of new information technology tools in professional activity, education, as well as mastering the | 5 | | v | | | | | v | | | v |

| # | Module | | | Discipline | Purpose / Content | Credits | | | | | | | | | | | | |
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| | | | | | methodology of teaching information technology disciplines. Formation of a system of basic knowledge and skills for teaching IT disciplines among future specialists. Content: knowledge and use of the main provisions of the methodology of teaching professional disciplines: information systems in education; full knowledge of the activities of new information technologies; skills of effective use of new information technologies in professional activities; multimedia technologies in education and new telecommunication technologies; knowledge of the principles of building educational programs, active methods and forms of education, innovative methods, technology, and methods of organizing independent work, distance learning technologies. | | | | | | | | | | | | | | |
| | | | | Pedagogical Practice | Purpose: Formation of practical skills and teaching methods. Content: To have an idea of the professional competence of a higher school teacher; to know: the psychology of cognitive activity of students in the learning process; psychological methods and means of improving the effectiveness and quality of teaching; to apply knowledge of pedagogy and psychology of higher school in their teaching activities; to use interactive teaching methods; implementation of educational and pedagogical activities on credit technology of teaching; teaching methods professional disciplines; the use of modern information technologies in the educational process. | 4 | v | v | | | | | | | | | | v |
| 3 | Mathematical Modeling of Technological and Natural Processes | PD | EC | Mathematical Modeling in Scientific Research | Purpose: Knowledge and practical skills of the student in the field of organization of scientific activity, the content of methods of analysis, experimental and combined research, the basics of mathematical and computer modeling, planning, design and management. Contents: Mathematical foundations of scientific research. Determination of the direction and applied problems of scientific research. Methodologies and mathematical models in scientific research. Mathematical models and their classification. Consideration of inertial properties and uncertainties in mathematical models. Mathematical apparatus for modeling objects. Methods of constructing a deterministic and stochastic mathematical model. | 6 | | | | | v | 3 | v | | |

| | | | | Description | | | | | | | | | | | | |
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| | | | | Mathematical models for optimizing decision-making. Nonlinear programming. | | | | | | | | | | | | |
| | | PD | EC | Mathematical and Computer Modeling of Economic Processes | Purpose: The study of linear programming models, the transport problem, mastering the structure and methods of computing, the study of game theory and models of operations research and models of network planning and management. Content: Linear programming. Linear programming problems. Economic and mathematical models. The concept of the model. Types of modeling. Graphical methods of linear programming problems. Important properties of the line level of a linear function. Simplex method. Simplex, artificial basic methods for solving linear programming problems. The method of adjacent directions. Distribution method. The northwest corner method. The method of potentials. Transport task. Function interpolation. Approximate integral method. Numerical solution of ordinary differential equations. Game theory. The main theorem of matrix games. | | v | | v | | | v | | | |
| | | BD | EC | Modeling the Consequences of Man-made Disasters | Purpose: Formation of students" complex of knowledge on mathematical and computer modeling, forecasting and assessment of the consequences of man-made disasters. Contents: Classification of disasters: information about natural and man-made disasters. Modeling of the distribution of the concentration of harmful gases in the atmosphere during salvo emissions. Forecasting the consequences of man-made disasters based on mathematical modeling. Differential equations for the process of distribution of the concentration of gas emissions in a three-dimensional formulation. Physical interpretation of initial and boundary conditions on the Earth"s surface. Classical models of the distribution of the concentration of gases in the atmosphere. Splitting method for concentration equations. Checking the adequacy of the simulation results. | 5 | | v | | | | v | | | |
| | | BD | EC | Numerical Methods for Flow Models | Purpose: To understand the features of the implementation of numerical methods of fluid and gas flow models, and the implementation of the process through mathematical and computer modeling. Content: methods of constructing two systems of equations to describe the flows of a viscous | | v | | v | v | | | | | |

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| | | | | | compressible gas - quasi-gasdynamic and quasi-hydrodynamic (QGD) systems of equations; finite-difference numerical algorithms based on equations of mathematical physics and examples of numerical calculations to ensure stability and convergence. | | | | | | | | | | |
| | | | | Research Practice | Purpose: To familiarize with the latest theoretical, methodological and technological achievements of domestic and foreign science, with modern methods of scientific research, processing, and interpretation of experimental data. Contents: To know the methodology of scientific cognition; principles and structure of the organization of scientific activity; to be able to use the acquired knowledge for the original development and application of ideas in the context of scientific research; to critically analyze existing concepts, theories, and approaches to the analysis of processes and phenomena; to integrate knowledge gained within different disciplines to solve research problems in new unfamiliar conditions; by integrating knowledge, make judgments and make decisions based on incomplete or limited information. | 6 | | v | | | | v | v | | | v |
| 4 | Mathematical modeling of mechanical processes | BD | EC | Modern Methods of Mathematical Modeling | Purpose: To understand different forms of differential and nonlinear equations, variants of initial and boundary conditions, various types of finite difference schemes used in mathematical and computer modeling; Contents: Scientific concepts, computational technologies, methods of physical, mathematical and numerical modeling of flows of viscous heat-conducting media in systems using modern achievements of computational mechanics and mathematical optimization. Modern methods of implementation of mathematical models and visualization of numerical results. | 5 | | | | | v | v | | | v | |
| | | BD | EC | Mathematical and Computer Modeling in Scientific Study of Complex Systems | Purpose: To understand the methods of mathematical modeling as a method of scientific research of complex processes. Content: Planning and conducting numerical experiments with mathematical models. Methods of developing mathematical models, information technologies and methods of processing simulation results. Establishing the adequacy of mathematical models of deterministic and stochastic processes in the general | | | | | | v | | v | | | |

| | | PD | EC | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | formulation and in solving scientific and practical problems. | | | | | | | | | | | | | |
| | | PD | EC | Applied Boundary Value Tasks | Purpose: Familiarization with the statements of applied boundary value problems; construction and application of numerical algorithms; the ability to competently apply analytical methods and numerical algorithms to applied boundary value problems; Contents: Definition and formulation of the boundary value problem; Methods of solving problems and their definition; The concept of numerical integration of the Cauchy problem. Steps for solving the boundary value problem by the superposition method. The problem of an isothermal tubular reactor. The problem of a three-layer beam. The concept of the run-through method. The problem of heat dissipation on an infinite plate with a heat source. The method of conjugate operators. Magnetohydrodynamic Couette flow. Unsteady gas flow in a finely porous medium. Nonlinear dynamic problem. Basic laws of fluid and gas mechanics. Wave propagation in media. Sound and shock waves in gas. | 6 | | v | | v | | | | | | | | |
| | | PD | EC | Boundary Problems of Mechanics | Purpose: Familiarization with the formulation of boundary value problems of mechanics; the construction of numerical algorithms; the ability to competently apply numerical algorithms to boundary value problems of mechanics; Content: Statement of boundary value problems in mechanics; Review of methods for integrating differential equations. The concept of numerical integration. Solving the problem by Euler and Runge-Kutta methods; Adams-Moulton methods. Iterative numerical methods. Nonlinear dynamic problem. Finite difference method. Algorithms for solving applied boundary value problems by the finite difference method. Boundary value problems of the second order. Initial and boundary conditions. The Sturm-Liouville equation and its relation to boundary value problems of mechanics. Eigenvalues. Own functions. Classification of the solution by eigenfunctions. Boundary value problems of higher-order mechanics. Three-point tasks. The problem of a three-layer beam. Solving second-order differential equations. Modeling and numerical investigation of fluid and gas flows. | | | v | | v | | | | | | v | | |

| 4 | Mathematical Modeling in Natural Science | BD | EC | Workshop on Solving Experimental Tasks in Mathcad Prime | Purpose: mastering the basic techniques of working with the Mathcad Prime mathematical package and developing the ability to use the package when performing tasks in various disciplines Contents: math packages. General characteristics of the MathCad package. The program window of the MathCad package. Ribbon interface of the MathCAD package. Ways to work with MathCAD documents. Constants, variables, assignment and output operators. MathCAD arithmetic operations. Built-in functions and custom functions. Mathematical analysis operators. Definition and description of arrays in the MathCAD package. Creating arrays in the MathCAD package. Selection of columns and rows of the matrix. Creating tables and working with them in the MathCAD package. Basic array processing functions | 5 | | v | | | | | | | | v | |
| | | BD | EC | Modeling and Calculation of Hydrodynamics in Channels | Purpose: Knowledge and understanding of the features of modeling the movement of liquids and gases in the contact devices of technological devices. Content: Algorithms for engineering calculation of heat and mass transfer in devices with different shapes; algorithms for constructing finite-difference and finite-element grids for calculating hydrodynamic and heat and mass transfer characteristics in contact devices of technological devices. | | | v | v | v | | | | | | | |
| | | PD | EC | Mathematical Models of Dispersed Systems | Purpose: To familiarize undergraduates with the basics of models of dispersed systems and to instill in them the skills of applying the received basic education to applied problems of mechanics of dispersed systems and physics. Contents: Classification of dispersed systems. Monodisperse systems. Polydisperse systems. Models of dispersed systems. Dispersed systems occurring in nature. Aerosols. Bubble systems. Suspensions. Emulsions. Polydisperse systems found in industry. Mathematical description of dispersed systems. Kinetic theory. Thermal conductivity in dispersed systems. The resistance of the medium. Newton's and Navier-Stokes' laws. Model of flotation in dispersed systems. Modeling of deposition and sedimentation processes in suspensions. | 4 | | v | | v | | | | | | | |
| | | PD | EC | Mathematical | Purpose: To familiarize undergraduates with the basics of | | | v | | v | | | | | | v | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Modeling in Physics | mathematical modeling of physical processes and to form a system of basic knowledge and skills for future specialists to study problems of mechanics and physics. Content: Physical phenomena. Mathematical modeling of physical phenomena. Basic laws of physics. The law of conservation of mass. The law of conservation of momentum. The law of conservation of energy. Newton's views on physical phenomena. Absolute space. Absolute time. Electromagnetic fields. Maxwell's equations. Electromagnetic induction. Simulation of Faraday experiments. Hertz's laws. The speed of light. Wave-particle dualism. Modeling Jung's experience. Photo effect model. Modeling of Brownian motions. Einstein's theory. Determination of the size of molecules. Fundamentals of the theory of relativity. Lorentz's transformations. Reduction of length and time. Minkowski space. Four-dimensional vectors. Geodesic lines. Curved spaces. | | | | | | | | | | |
| | | PD | EC | Applied Models of Multiphase Media | Purpose: To familiarize undergraduates with the basics of mathematical models of mechanics of multiphase media and to instill in them the skills of applying the received basic education to the study of applied problems of mechanics of multiphase media. Contents: General and particular equations describing the laws of mechanics of multiphase media; Modeling of motion of multiphase mixtures; Equations of conservation of masses, pulses and energy of multiphase media; Modeling of interphase mass and heat exchange processes; Stress tensor in a multiphase medium; Equations of joint deformation of phases. Laws of phase interaction. Stokes formula; Simplest models of multiphase media; Equations of dynamics of gas-dispersed media; Modeling of sound and shock waves in two-phase media; Modeling and research of some applied problems of mechanics of two-phase media; Study of the influence of determining parameters on the behavior of a multiphase system. | 5 | | v | | v | | | | | v | |
| | | PD | EC | Simulation of Deposition Processes in | Purpose: The purpose of the discipline is to familiarize masters with the basics of mathematical modeling of precipitation processes in chemical technology and to instill in them the | | | v | | v | | | | v | | |

| | | | | Chemical Engineering | skills to apply the received basic education to the study of applied problems of chemical technology. Content. Classification of two-phase systems in chemical technology. Models of two-phase systems. Gas-dispersed systems. Suspensions. Monodisperse and polydisperse systems. Mathematical description of two phase systems. Kinetic theory. Medium resistance. Newton's laws. Navier-Stokes laws. Mass Conservation Equations for Two-Phase Media. Phase motion equations. The law of conservation of energy in two-phase systems. Concretization of the laws of interaction of phases. Filtration laws. Darcy's law. Simulation of sedimentation and sediment formation processes in suspensions. Obtaining analytical solutions in the simplest cases of sedimentation of a solid phase in suspension. Settling rate. The influence of defining parameters on the behavior of the system. | | | | | | | | | | | |
| 5 | Mathematical Modeling of Applied Problems | PD | EC | Applied Models of Continuum Mechanics | Purpose: To acquaint undergraduates with models of continuum mechanics and to form a system of basic knowledge and skills for future specialists to study applied problems of mechanics and physics. Contents: Assumptions and methods of continuum mechanics. Scalar and vector fields. Fundamentals of tensor computing. Theory of deformations. Helmholtz's theorems. Dynamic equations. The stress tensor. Navier-Stokes laws. Models of ideal and viscous liquid. Fundamentals of thermodynamics. Laws of thermodynamics. Isothermal and adiabatic processes. Two-parameter environments. A model of an ideal liquid. Euler's equations. The continuity equation. Equations of motion of continuous media. The system of Navier-Stokes equations. Theory of elasticity. Hooke's law. Model of elastic bodies. Young's module. Coefficient of elongation. | 5 | | v | | v | | | | | v | |
| | | PD | EC | Theory of Boundary Layer | Purpose: to acquaint undergraduates with the basics and models of boundary layer theory, and to form a basic system of knowledge and skills for future specialists to study applied problems of mechanics and physics. Contents: Models of fluid motion. The ideal gas model. An incompressible fluid model. The system of Navier-Stokes equations. The continuity | | | v | | v | | | | | | |

| | | | | Name | Content | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | equation. Speed divergence. Vector-gradient. The law of conservation of mass. The law of conservation of momentum. The amount of movement. The viscosity coefficient. The Laplace operator. Assumptions about the boundary layer. Self-similar variables. The Blasius formula. Prandtl's equations. Equations of motion in the boundary layer. Fluid movement along the plate. Fluid movement along the wedge. The speed of the transverse movement. Reynolds number. | | | | | | | | | | |
| | | PD | EC | Hydrodynamics of Flows in Technological Devices | Purpose: Formation of knowledge and skills in mathematical modeling of the dynamics of flows and processes of heat and mass transfer in technological devices of the gas-liquid system. Content: Features of mathematical modeling of chemical technology processes taking into account modern trends of technical progress. Modeling of hydrodynamics and processes of heat and mass transfer in column apparatuses. Simulation of flow motion during chemical transformation within a single phase or at a separated phase boundary. Information on chemical kinetics. Simulation of the chemical reaction rate. Simulation of flows in technological devices in the gas-liquid system using the similarity theory. Modeling of processes organized by the separation of liquid into droplets. Application of analytical and numerical solutions of the Navier-Stokes equations in modeling flows in apparatuses. | 6 | | v | v | v | | | | | v | |
| | | PD | EC | Mathematical Modeling of the Extraction Process in the System "Solid - State" | Purpose: To form students" knowledge on mathematical modeling of extraction processes in the solid-liquid system and skills in processing experimental data. Contents: Classification of extraction processes in chemical technology. Stages of mathematical modeling of extraction processes in the solid-liquid system. Modeling of the effect of solid particle sizes on extraction efficiency. Comparison of different methods of modeling the effect of process parameters on mass transfer in the system. Analysis and processing of experimental data on mass transfer in the extraction process. Methods of numerical solution of model equations. Establishing the adequacy of models: methods of using the average value of the factor and conducting parallel experiments. | | | v | | v | | | | v | | |

| 6 | Mathematical Modeling of Biotechnological Processes and Graphic Visualization | PD | EC | Mathematical Modeling of Biotechnological Processes | Objective: To form students' system knowledge on the development, adequacy testing, implementation and practical use of mathematical models of biotechnological processes. Contents: Basic principles of construction of mathematical models of processes of different nature. Information about modern biotechnological processes. Features of modeling biotechnological processes. Mathematical and kinetic models of biotechnological processes. The main types of multifactor equations. Models of the exponential growth phase of cell cultures. A model of the kinetics of cell growth in a transitional state. Mathematical modeling of biogas production from plant raw materials. Methods of realization of models of anaerobic fermentation of biomass. Methodology of implementation of models of biotechnological processes. | 5 | | | v | v | | | v | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PD | EC | Advanced Particles Mathematical Modeling of Modern Technological Processes | Purpose: Formation of student's knowledge on modern methods of mathematical modeling of technological processes. Modeling of nanotechnology processes. Content: Analysis of new processes of Chemical Technology. Features of mathematical modeling of new processes of Chemical Technology, taking into account modern trends in technical progress. Nanotechnology. Modeling the process of catalytic pyrolysis to obtain nanoparticles from natural gas. Influence of gas flow temperature and catalyst material on mass transfer efficiency in catalytic process. Analytical and numerical solution of the system of differential equations for the concentration of transition radicals in the process of catalytic pyrolysis of methane. | | v | | v | | | | v | |
| | | PD | EC | Computer Modeling and Visualization in Graphic Packages | Purpose: as a result of studying the discipline, undergraduates form undergraduates training in methods of constructing drawings of various levels and creating their three-dimensional images in the AutoCAD program Contents: to know and understand: the technology of working with AutoCAD commands; the creation of AutoCAD objects; tools for ensuring accuracy; the development of basic graphical primitives and the basics of three-dimensional modeling in the Autodesk AutoCAD environment; the possibilities of three- | 5 | | | | | v | | v | |

| № | Module name | PD | EC | Course name | Purpose / Contents | Credits | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | dimensional modeling to visualize the results of numerical modeling of objects; work with coordinate systems in three-dimensional models. Formation of the ability to interpret methods of mathematical analysis and modeling for solving applied problems in the field under study. | | | | | | | | | | | | | |
| | | PD | EC | Development of Software Packages for Calculating Internal Currents | Purpose: Knowledge and understanding of the UniHUB technology platform for numerical modeling and calculations of fluid flows using free OpenFOAM and ParaView application computing packages; Contents: Applied computing packages OpenFOAM and ParaView; setting of complex boundary conditions using the built-in and extended utilities of the OpenFOAM package; methods for calculating turbulence parameters in problems of flow around nozzles in channels using software packages. | | | | v | | | v | | v | | | | |
| 8 | Module of scientific-research work and Final Certification | | | Research work of a master student, including passing an internship and completing a master's thesis | Purpose: Mastering the skills of problem statement, its decomposition and synthesis. Contents: Conduct bibliographic work; formulate and solve problems; choose the necessary research methods; apply modern information technologies in conducting scientific research; process the results obtained, analyze and present them in the form of completed research developments; possess modern problems in the field of ICT; have specific specific knowledge on a scientific problem; carry out scientific research and experimental work; work with software products and Internet resources | 24 | v | | | | v | | | | | | | v |
| | | | | Execution and Defense of Master`s Thesis | Purpose: Obtaining the skills of registration of completed work. Content: To reveal the scientific potential, to show the ability to organize and conduct independent research in the field of ICT; to argue and develop sound recommendations; to reveal the level of scientific qualifications; to demonstrate the internal unity of work and display the progress and results of the development of the chosen topic; to apply the rules of registration and defense of a master's thesis; to find out the readiness to work in an educational or research institution by profile. | 8 | v | | | | | | | | | v | v | v |
| | Total | | | | | 120 | | | | | | | | | | | | |

**5.SUMMARY TABLE SHOWING THE VOLUME OF LOANS DISBURSED BY MODULES EDUCATIONAL PROGRAMS**

| Course of study | Academic period | Number of modules to be mastered | Number of subjects studied | | | Number of credits KZ | | | | | Total in hours | Total credits KZ | Количество | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | OK | BK | KB | Theoretical training | Pedagogical practice | Research practice | SRWM | Registration and defense of a master's thesis | | | exam | diff.test |
| 1 | 1 | 4 | | 5 | 1 | 27 | | | 3 | | 900 | 30 | 5 | 2 |
| | 2 | 7 | | 1 | 5 | 25 | 4 | | 1 | | 900 | 30 | 4 | 3 |
| 2 | 3 | 4 | | - | 2 | 10 | | 6 | 4 | | 600 | 20 | 2 | 2 |
| | 4 | 2 | | - | 3 | 16 | | | 4 | | 600 | 20 | 3 | 1 |
| | 5 | 1 | | - | - | - | | | 12 | 8 | 600 | 20 | | |
| Total | | 11 | - | 6 | 11 | 78 | 4 | 7 | 24 | 8 | 3600 | 120 | 14 | 8 |

22

## 6 STRATEGIES AND METHODS OF TRAINING, MONITORING AND EVALUATION

| | |
|---|---|
| **Learning Strategies** | Student-centered learning: the learner is the center of teaching/learning and an active participant in the learning and decision-making process.<br>Practice-oriented learning: focus on the development of practical skills. |
| **Teaching methods** | Conducting lectures, seminars, practical and laboratory work with:<br>• application of innovative technologies:<br>• problem learning;<br>• case study;<br>• work in a group;<br>• discussions and dialogues, intellectual games, competitions, quizzes;<br>• software development;<br>• presentations;<br>• rational and creative use of information sources:<br>• multimedia educational programs;<br>• electronic textbooks;<br>• virtual laboratory work;<br>• digital resources.<br>Organization of independent work of students, individual consultations. |
| **Monitoring and assessing the achievability of learning outcomes** | Current control on each topic of the discipline, control of knowledge in classroom and extracurricular activities (according to the syllabus). Assessment Forms:<br>• survey in the classroom;<br>• testing on the topics of the academic discipline;<br>• test papers;<br>• protection of independent works;<br>• discussions;<br>• trainings;<br>• colloquia;<br>• essays, etc.<br>Midterm control at least two times during one academic period within the same academic discipline.<br>Intermediate certification is carried out in accordance with the working curriculum, academic calendar.<br>Conduct forms:<br>• exam in the form of testing;<br>•oral exam;<br>•a written exam;<br>• combined exam;<br>• defense of term papers;<br>• protection of practice reports.<br>Final examination. |

# 7 TRAINING AND RESOURCE SUPPORT OF THE EP

| | |
|---|---|
| **Information Resource Center** | The structure of the EIC includes 6 subscriptions, 16 reading rooms, 2 electronic resource centers (ERC). The basis of the network infrastructure of the JRC is 180 computers with Internet access, 110 workstations, 6 interactive whiteboards, 2 video doubles, 1 video conferencing system, 3 scanners of A-4 format, 3. The software of the JRC is AIBS "IRBIS-64" under MS Windows ( basic set of 6 modules), stand-alone server for uninterrupted operation in the IRBIS system. |
| | The library fund is reflected in the electronic catalog available to users on the site http://lib.ukgu.kz on-line 24 hours 7 days a week. |
| | Thematic databases of their own generation have been created: "Almamater", "Proceedings of SKSU scientists", "Electronic archive". Online access from any device in 24/7 mode via an external link http://articles.ukgu.kz/ru/pps. |
| | Working with catalogs in electronic form. EC consists of 9 databases: "Books", "Articles", "Periodicals", "Proceedings of the teaching staff of SKSU", "Rare Books", "Electronic Fund", "SKSU in Print", "Readers" "SKU". |
| | The JIC provides its users with 3 options for accessing its own electronic information resources: from the "Electronic Catalog" terminals in the catalog hall and in the JIC subdivisions; through the information network of the university for faculties and departments; remotely on the library website http://lib.ukgu.kz/. |
| | Open access to international and republican resources: "SpringerLink", "Polpred", "Web of Science", "EBSCO", "Epigraph", to electronic versions of scientific journals in the public domain, "Zan", "RMEB", "Adebiet" , Digital library "Aknurpress", "Smart-kitar", "Kitar.кz", etc. |
| | For people with special needs and disabilities, the library website has been adapted to the work of visually impaired users |
| **Material and technical base** | Specialized Audiences: Computer classes and lecture halls equipped with modern functional and presentation equipment. Modern hardware and licensed software are installed in computer classes. All laboratory rooms are equipped with new generation computers that are in working order, allow for scientific and laboratory work, and are used in full. Computers are united in a local network and connected to the high-speed network of the university. Lecture halls are equipped with computers, multimedia projectors, which allow teaching at a high level. Laboratory instruments and installations Standard kit - "Molecular Physics" (Processing the results of multiple direct measurements, Maxwell's Pendulum) - Installation "Electricity and magnetism" (Modeling, Determination of the specific charge of the Electron by the magnetron method, Hall effect) Standard kit - "Optics" (Dispersion, Diffraction, Polarization, Interference) - Installation for studying the electric hole transition - Installation for studying the external photoelectric effect - Installation for determining the resonant potential of an atom of an inert gas (mercury) with an oscilloscope - Installation for determining the width of the sealing layer of the P-n junction and the concentration of impurities in the region of avalanche breakdown - Devices and equipment |

# AGREEMENT SHEET
## on the Educational program
### 7M06140- «Mathematical and computer modeling»
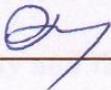
Director of DAA _____ Naukenova A.S.
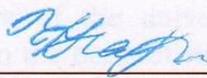
Director of DASc _____ Nazarbek U. B.
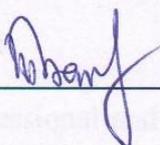
Director of DE&C _____ Bazhirov T. S.

# REVIEW
of the Master's degree program specialty
<u>7M06140- "Mathematical and computer modeling"</u>
(code and name)
developed in the NJSC  M. Auezov SKU, Shymkent

## 1. Brief description of the company and the profile of its activities

NAO "M. Auezov South Kazakhstan University" is a leading multidisciplinary university of the Turkestan region. In the structure of the university there is a Higher School of "Information Technologies and Energy", on the basis of which the proposed OP is supposed to be implemented. The graduating department "Information Systems and Modeling" has been identified as responsible for the implementation of the OP.

## 2. Relevance and relevance of the EP

The OP program is focused on professional and social order through the formation of professional competencies related to the necessary types of research, practical and entrepreneurial activities, adjusted to meet the requirements of the future place of work.

The uniqueness of OP 7M06140-"Mathematical and computer modeling" lies in the clear structuring of modules and the selection of elective disciplines that meet modern requirements in the field of information and communication technologies (hereinafter - ICT), where the main tools are mathematical and computer methods of modeling the processes under study.

The OP clearly states the purpose, objectives, qualification characteristics of the graduate of the educational program, indicates the future sphere of professional activity, objects and subjects

professional activity. Taking into account the specifics of the specialty, the developers of the OP focused on the following types of professional activity: research; pedagogical; project; production and technological; organizational and managerial and analytical. Thus, the OP is aimed at training specialists with conceptual, analytical and logical thinking, who are able to determine the strategy of the organization, who have a complex of new knowledge in the field of mathematical and computer modeling of processes.

The tasks of the OP directly related to the activities of our organization are: ensuring the implementation of the educational process based on the integration of education and science; providing lifelong learning skills that will allow them to successfully adapt to changing conditions in their career.

## 3. Learning outcomes and competencies, their relationship to the demands of the labor market

The learning outcomes and competencies embedded in the OP, the theoretical knowledge, practical skills and professional skills provided fully comply with the modern qualification requirements for specialized specialists of the master's qualification.

## 4. Availability of components that develop practical skills

The OP includes disciplines corresponding to the goals and objectives, including new ones, such as "Mathematical and computer modeling of biotechnological processes", "Additional sections of mathematical modeling of modern technological processes", etc.

## 5. Content of the educational program (modules, disciplines)

The proposed educational program contains all the necessary elements for the effective organization of the educational process - regulates the goals, expected results, content, conditions and technologies for the implementation of the educational process, assessment of the quality of training of a specialist with a bachelor's degree. It includes: curriculum, work programs of training courses, modules and disciplines, related materials: practical training programs, academic calendar, educational and methodological complexes of disciplines.

The distribution of disciplines by academic periods is rationally and logically verified. All types of educational activities are provided for the preparation of highly qualified specialists with the skills of research work - theoretical training, practice, registration and defense of dissertations. The planned volume and time resource for academic disciplines and types of training meet the qualification requirements for the level of graduates.

In the OP it is planned that masters will be able to apply the latest achievements of mathematical and computer modeling in science, in the banking sector, insurance companies and financial structures, understand the need to work in a team to solve modeling problems that require coordination of efforts of several performers in different directions.

## 6. Quality of the modular guide

The composition of educational modules covers all relevant areas of training of specialists in the field of mathematical and computer modeling. The content of the modular reference book of the educational program corresponds to the accepted competence model of the graduate.

## 7. Conclusion on the EP

I believe that the Master's degree program in the specialty 7M06140-"Mathematical and computer modeling" fully meets the requirements of future activities in organizations and enterprises of a wide profile, will promote the career growth of graduates and can be introduced into the educational process.

Director of «Innova Corporation Company» LLP        Zh.K.Turdaliev

**Expert opinion**
on the educational program
of the master's degree specialty
7M06140 - "Mathematical and computer modeling"

### 1. Relevance of the OP

The development of information and telecommunication technologies is impossible without appropriate staffing. Recently, there has been a significant shortage of specialists capable of creating and successfully operating modern ICTs in the field of mathematical and computer modeling. The dynamism of the industry development causes the rapid obsolescence of knowledge, therefore, constant updating and optimization of educational programs in the field of information and communication technologies is required.

Further development of the direction in the field of information and telecommunication technologies depends on the correct choice of the concept of training specialists of higher professional education.

### 2. Compliance of the OP with the formulated goals consistent with the mission of the university, the requests of employers and students

The purpose of the peer-reviewed educational program (OP) is to prepare the intellectual elite of the country with advanced knowledge and entrepreneurial skills, a creative approach to professional activity, able to work in a national and international team, assimilating a lifelong learning strategy. The OP is harmonized with the 7th level of the National Qualifications Framework of the Republic of Kazakhstan, with the Dublin Descriptors, the 2nd cycle of the Qualification Framework of the European Higher Education Area.

The reviewed OP is intended for the training of masters of Technical Sciences in the specialty 7M06140-"Mathematical and computer modeling" at the M.Auezov South Kazakhstan State University. The OP program is focused on professional and social order through the formation of professional competencies related to the necessary types of research, practical and entrepreneurial activities, adjusted to meet the requirements of the future place of work.

### 3. Compliance with the National Qualification Framework of the Republic of Kazakhstan

The objectives and content of the OP correspond to level 6 of the National Qualification Framework of the Republic of Kazakhstan.

### 4. Reflection in the OP of learning outcomes and competencies based on Dublin descriptors embedded in professional standards/industry frameworks

The OP is harmonized with the Dublin Descriptors, the 2nd cycle of the Qualification Framework of the European Higher Education Area (A Framework for Qualifications of the European Higher Education Area), the 6th level of the European Qualification Framework for Lifelong Learning (The European Qualifications Framework work for Lifelong Learning).

### 5. Compliance with the classifier of training areas with higher education

The structure and content of the OP meet the requirements of the classifier of training areas with higher education of the educational program 7M06140-"Mathematical and computer modeling"

## 6. The structure and content of the OP, the application of the modular principle of their construction

The OP is clearly structured according to modules and the selection of elective disciplines that meet modern requirements in the field of information and communication technologies (ICT), where the main tools are mathematical and computer methods of modeling the processes under study.

## 7. The presence of components in the OP for training for professional activity, developing key competencies, intellectual and academic skills, reflecting the changing requirements of society, including the implementation of the presidential program for mastering three languages: Kazakh, Russian and English

The OP clearly states the purpose, objectives, qualification characteristics of the graduate of the educational program, indicates the future sphere of professional activity, objects and subjects of professional activity, in particular in the field of ICT. In particular, the disciplines "Mathematical modeling in engineering and technology", "Mathematical and computer modeling of biotechnological processes", "Additional sections of mathematical modeling of modern technological processes", etc., which expand the possibilities of future activities in scientific and design and technological organizations, are included in the OP for the first time. In the OP, a special place is given to mathematical and computer modeling of chemical-technological, environmental, physical and economic processes, problems of mechanics, heat and mass transfer of external and internal flows, new technological processes; programming of production and scientific tasks; development and management of databases for scientific, production and economic tasks. One of the important results of the OP training is the ability to critically analyze existing methods of developing mathematical models in various subject areas using ICT.

## 8. Logical sequence of disciplines and reflection of basic requirements in curricula and training programs

The distribution of disciplines by academic periods is rationally and logically verified. All types of educational activities are provided for the preparation of highly qualified specialists with the skills of research work - theoretical training, industrial practice, writing and defending a thesis. The planned volume and time resource for academic disciplines and types of training meet the qualification requirements for the level of graduates.

The structural parts of the educational program are interrelated, continuous, aimed at achieving the planned comprehensive result and are disclosed in depth and in full.

Methodological equipment of the educational program contributes to the successful solution of tasks in key areas of training, education and development of students.

## 9. Reflection in the OP of the system of accounting for the academic load of students and teachers in loans, its compliance with the parameters of the credit system of education.

The content of the OP fully complies with the requirements of the credit technology of education, including in terms of accounting for the academic load of teachers and students in loans. It is planned to study 120 credits.

The content of the EP fully complies with the requirements of Credit Technology of training, including in terms of credit accounting of the academic load of teachers and undergraduates. It is planned to study 120 credits.

## 10. availability in industrial practice programs to consolidate the theoretical material specified in the training load with a credit

To consolidate the theoretical material, the EP provides for two types of undergraduate practice: research and pedagogical. The established deadlines for passing the practice and their division into academic stages of training are justified. The complexity of experiments is manifested by credits

## 11. Information about teaching staff participating in the implementation of the EP

The EP contains information about the teaching staff involved in its implementation. The qualification requirements for teaching staff are observed.

## 12. Qualification obtained as a result of mastering the EP

As a result of the implementation of the EP 7M06140-"Mathematical and computer modeling", the graduate is provided with the academic degree "Master of technical sciences" in the direction of training information and communication technologies.

## 13. Recommendations

Based on the foregoing, I believe that the EP 7M06140-"Mathematical and computer modeling" satisfies the qualification requirements for the training of masters of technical sciences in the direction of 7M061-Training of Information and communication technologies. Recommended for the introduction of EP.

Professor of the department "Computer engineering and software"
, doctor of technical sciences:                                    Brener A.M.

# Professional Standards

| | |
|---|---|
| | **Application No. 4**<br><br>**to the order of the Acting Chairman of the Board of the National Chamber of Entrepreneurs**<br><br>**Republic of Kazakhstan "Atameken"**<br><br>**No. 222 dated 12/05/2022** |

| Professional standard: "Ensuring the security of information infrastructure and IT" |
|---|

**Glossary**

The following terms and definitions apply in this professional standard:

**Information system (IS)**- an organizationally ordered set of information and communication technologies, service personnel and technical documentation that implement certain technological actions through information interaction and are designed to solve specific functional problems.

**Information technology (IT, IT)**is a process that uses a set of means and methods for collecting, processing and transmitting data to obtain information of a new quality about the state of an object, process or phenomenon. Information technology (IT, from the English. Information technology, IT) is a class of areas of activity related to technologies for managing and processing a huge flow of information using computer technology.

**IT infrastructure**is a complex structure that combines all information technologies and resources used by a particular organization or company. The information technology infrastructure includes all computers, installed software, communication systems, information centers, networks and databases.

**IS maintenance**- ensuring the use of the IS put into commercial operation in accordance with its purpose, including measures to correct, modify and eliminate software defects, without upgrading and implementing additional functional requirements and subject to maintaining its integrity.

**Information system architecture**- a concept that defines the model, structure, functions performed and the relationship of the components of the information system.

**Database (DB)**- a set of data organized according to a conceptual structure that describes the characteristics of this data, as well as the relationships between their objects.

**Software -**a set of programs, program codes, as well as software products with technical documentation necessary for their operation.

**Software interface -**a system of unified links intended for the exchange of information between the components of a computing system, specifying a set of necessary procedures, their parameters and methods of handling.

**Software -**an independent program or a piece of software that is a product, which, regardless of its developers, can be used for the intended purposes in accordance with the system requirements established by the technical documentation.

**ICT**– Information and communication technologies;

**BY**- Software;

**ISCED**– International Standard Classification of Education

| 1. Professional Standard Passport | |
|---|---|
| Name of the Professional Standard: | Ensuring the security of information infrastructure and IT |
| Professional Standard Number: | |
| The names of the section, section, group, class, and subclass according to OKED: | J Information and communication<br>62 Computer programming, consulting and other related services<br>62.0 Computer programming, consulting and other related services<br>62.01 Computer programming activities<br>62.02 Computer consulting services<br>62.02.0 Computer consulting services |

| Brief description of the PS: | Ensuring the security of information in computer systems and networks in the face of threats to their information security | |
|---|---|---|

<table>
<tr><td colspan="3" align="center">2.  Occupation cards</td></tr>
<tr><td rowspan="4">List of profession cards</td><td>Security Specialist (ICT)</td><td>5th-7th levels of ORC</td></tr>
<tr><td>Information protection specialist</td><td>5th-7th levels of ORC</td></tr>
<tr><td>Digital Forensic Specialist</td><td>6th-7th levels of ORC</td></tr>
<tr><td>Data Encryptor</td><td>5th-7th levels of ORC</td></tr>
</table>

| PROFESSION CARD: SECURITY SPECIALIST (ICT) | | |
|---|---|---|
| Code: | 2524-0-005 | |
| Group code: | 2524-0 | |
| Profession: | Security Specialist (ICT) | |
| Other possible names professions | Technician for the protection of infocommunication systems<br>Information security engineer of infocommunication systems<br>Information security expert | |
| Qualifying level according to the ORC | 7 | |
| primary goal activities | Countering the harmful effects of software and hardware impact on subsystems, devices, elements and channels of infocommunication systems | |
| Labor functions: | Mandatory labor functions | 1. Assessing the security level of computer systems and networks |
| | | 2. Development of a security system for computer systems and networks |
| | Additional labor functions | - |
| **Labor function 1:**<br>Assessing the level of security of computer systems and networks | **Task 1:**<br>Carrying out control checks of the operability and effectiveness of the applied software and hardware information protection tools | **Skills:**<br>Determine the parameters of the functioning of software and hardware information protection<br>Develop methods for assessing the security of software and hardware information protection<br>Evaluate the effectiveness of information protection<br>Apply the developed methods for assessing the security of software and hardware information protection<br>Analyze software and hardware protection tools in order to determine the level of security and trust they provide<br><br>**Knowledge:**<br>Principles of building computer systems and networks<br>Methods and techniques for assessing the security of software and hardware information protection<br>Principles of building software and hardware information protection<br>Principles of building information protection subsystems in computer systems<br>Methods for evaluating the effectiveness of a security policy implemented in software and hardware for information protection<br>Methods and tools for assessing the correctness and effectiveness of software implementations of information |

| | | security algorithms |
|---|---|---|
| | | Methods for analyzing program code in order to search for potential vulnerabilities and undocumented features |
| | | Methods for analyzing the methods and means of information protection used for compliance with the security policy |
| | | National, interstate and international standards in the field of information security |
| | | Normative legal acts in the field of information protection |
| | | Organizational measures to protect information |
| | **Task 2:**<br>Formation of security policies for computer systems and networks | **Skills:** |
| | | Analyze a computer system to determine the required level of security and trust |
| | | Develop security profiles for computer systems |
| | | Formulate tasks for the security of computer systems |
| | | Perform security analysis of computer systems and develop recommendations for the operation of information security systems |
| | | **Knowledge:** |
| | | Principles of building computer systems and networks |
| | | Computer systems security models |
| | | Types of security policies for computer systems and networks |
| | | Principles of construction of means of cryptographic protection of information |
| | | National, interstate and international standards in the field of information security |
| | | Possibilities of used and planned to use means of information protection |
| | | Normative legal acts in the field of information protection |
| | | Organizational measures to protect information |
| | **Task 3:**<br>Conducting security analysis of computer systems | **Skills:** |
| | | Analyze a computer system to determine the level of security and trust |
| | | Predict possible ways of developing the actions of an information security violator |
| | | Analyze the security policy for adequacy |
| | | Monitor, analyze and compare the effectiveness of software and hardware information protection tools in operating systems |
| | | Compile and draw up an analytical report based on the results of the analysis |
| | | Develop proposals to eliminate identified vulnerabilities |
| | | **Knowledge:** |
| | | Principles of building computer systems and networks |
| | | Vulnerabilities of computer systems and networks |
| | | Cryptographic methods of information protection |
| | | Principles of building database management systems |
| | | Configuration analysis tools |
| | | National, interstate and international standards in the field of information security |
| | | Normative legal acts in the field of information protection |
| | | Guidelines and methodological documents of the |

| | | authorized federal executive authorities for information protection |
| --- | --- | --- |
| | | Organizational measures to protect information |
| **Labor function 2:**<br>Development of a security system for computer systems and networks | **Task 1:**<br>Development of requirements for software and hardware information protection of computer systems and networks | **Skills:** |
| | | Summarize scientific and technical literature, regulatory and methodological materials in the field of information security |
| | | Form threat models and models of the violator of the security of computer systems |
| | | Identify the most appropriate approaches to ensuring the protection of computer system information |
| | | Develop private computer system security policies, including access and information flow control policies |
| | | Apply national, interstate and international standards in the field of information security to assess the security of a computer system |
| | | Apply the current legal framework in the field of computer security |
| | | Read and understand regulatory and methodological documents on information security in English |
| | | Make decisions on the need to use software and hardware information protection tools |
| | | **Knowledge:** |
| | | The procedure for organizing work on information protection |
| | | Methods and means of obtaining, processing and transmitting information in operating systems, database management systems and computer networks |
| | | Methods for analyzing the security of computer systems |
| | | Types of attacks and mechanisms for their implementation in computer systems |
| | | Methods for identifying information leakage channels |
| | | Methods and means of information protection in computer networks, operating systems and database management systems |
| | | Principles of building information security tools for computer systems |
| | | Formal access control models |
| | | Cryptographic algorithms and features of their software implementation |
| | | Normative legal acts in the field of information protection |
| | | Organizational measures to protect information |
| | | National, interstate and international standards in the field of information security |
| | **Task 2:**<br>Design of software and hardware for information protection of computer systems and networks | **Skills:** |
| | | Conduct research to find the most appropriate practical solutions to ensure information security |
| | | Apply domestic standards in the field of information security for the design of information security tools for a computer system |
| | | Develop the architecture and interfaces of information protection tools, procedures for restoring the operability of protection tools and systems after failures |
| | | Select and summarize scientific and technical literature, |

| | | methodological materials on software and hardware and methods of information protection, including in English |
|---|---|---|
| | | **Knowledge:** |
| | | Methods and means of obtaining, processing and transmitting information in operating systems, database management systems and computer networks |
| | | Types of attacks and mechanisms for their implementation in computer systems |
| | | Methods and means of information protection in computer networks, operating systems and database management systems |
| | | Principles of building information protection systems for computer systems, including anti-virus software |
| | | Methods for analyzing the security of computer systems |
| | | Number-theoretic methods and algorithms used in information security tools |
| | | Formal access control models |
| | | Principles and methods of software and hardware design |
| | | Software Development Methodologies and Technologies |
| | | Principles and methods of project management in the field of information security |
| | | Cryptographic algorithms and features of their software implementation |
| | | Normative legal acts in the field of information protection |
| | | Organizational measures to protect information |
| | | National, interstate and international standards in the field of information security |
| Requirements for personal competencies | Analytical thinking, Critical analysis, Responsibility Organization, Systems thinking, Ability to solve non-standard problems, Attention to detail | |
| Relationship with other professions within the OQF | 5 | Information protection specialist |
| | 6 | Information protection specialist |
| | 7 | Information protection specialist |
| Link to ETKS or KS or other job directories | KS | 185. Programming Technician 140 Software Engineer |

| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies | Qualification: Master in ICT |
|---|---|---|---|

| **PROFESSION CARD: INFORMATION PROTECTION SPECIALIST** | | |
|---|---|---|
| Code: | 2524-0-006 | |
| Group code: | 2524-0 | |
| Profession: | Information protection specialist | |
| Other possible names professions | Information Security Technician Information security engineer | |
| Qualifying level according to the ORC | 7 | |
| primary goal activities | Administration of IP information protection systems | |
| Labor functions: | Mandatory labor functions | 1. Development of IP information protection systems |
| | Additional labor functions | - |

| | | Skills: |
|---|---|---|
| **Labor function 1:** Development of IP information protection systems | **Task 1:** Development of design solutions for the protection of information in IS | Apply the current regulatory framework in the field of information security |
| | | Apply regulatory documents on countering technical intelligence |
| | | Classify protected information by type of secret and degree of confidentiality |
| | | Define types of access subjects and access objects that are objects of protection |
| | | Define access control methods, types of access and rules for restricting access to access objects to be implemented in the IS |
| | | Select information security measures to be implemented in the IP information security system |
| | | Determine the types and types of information security tools that ensure the implementation of technical information security measures |
| | | Determine the structure of the IP information protection system in accordance with the requirements of regulatory legal documents in the field of IP information protection |
| | | **Knowledge:** |
| | | Normative legal acts and national standards for licensing in the field of ensuring the protection of state secrets and certification of information security tools |
| | | Principles of construction and operation, examples of implementations of modern local and global computer networks, and their components |
| | | Features of information protection in IS process control |
| | | Criteria for evaluating the effectiveness and reliability of information security tools for IS software |
| | | Principles of organization and structure of information security systems of IS software |
| | | The main characteristics of technical means of protecting information from leaks through technical channels |
| | | Principles of information security policy formation in IS |
| | **Task 2:** Development of operational documentation for IP information protection systems | **Skills:** |
| | | Define measures (rules, procedures, practices, guidelines, methods, tools) for the protection of information in IS |
| | | Develop terms of reference for the creation of IS information security subsystems |
| | | Design information security subsystems taking into account the current regulatory and methodological documents |
| | | Develop models of IP and IP information protection systems |
| | | Explore IP models and IP security protection systems |
| | | Analyze software, architectural, technical and circuit solutions of IS components in order to identify potential vulnerabilities of IS information protection systems |
| | | Assess information risks in IS and determine the information infrastructure and information resources to be protected |
| | | Conduct a feasibility study of design solutions for software and hardware to ensure the protection of |

| | | |
|---|---|---|
| | | information in IS in order to ensure the required level of security |
| | | To study the effectiveness of design solutions for software and hardware to ensure the protection of information in IS in order to ensure the required level of security |
| | | Conduct comprehensive testing and debugging of hardware and software information security systems |
| | | **Knowledge:** |
| | | Basic methods of information security management |
| | | Basic concepts of automata theory, mathematical logic, algorithm theory and graph theory |
| | | Basic methods of project management in the field of information security |
| | | National, interstate and international standards in the field of information security |
| | | Basic measures to protect information in IP |
| | | Features of information protection in IS process control |
| | | Security threats, information impacts, security assessment criteria and methods for protecting information in IS |
| | | Methods, methods, means, sequence and content of the stages of development of IP and information security systems of IP |
| | | Software and hardware for ensuring information security in IS software |
| | | Basic tools, methods and principles of building IP information protection systems |
| | | Normative legal acts in the field of information protection |
| | **Task 3:** Development of the architecture of the IP information protection system | **Skills:** |
| | | Define a set of measures to ensure the security of information in IS |
| | | Identify vulnerabilities of information technology resources of IP |
| | | Develop proposals for improving the IP information protection management system |
| | | Conduct a selection of software and hardware to ensure the security of information for use as part of the IS in order to ensure the required level of IS security |
| | | Classify and evaluate information security threats to IP |
| | | Determine the information infrastructure and information resources of IP to be protected |
| | | Develop models of information security threats and violators in IS |
| | | Determine the effectiveness of the use of informatization tools |
| | | **Knowledge:** |
| | | Basic information technologies used in IS |
| | | Ways and means of protecting information from "leakage" through technical channels and monitoring the effectiveness of information protection |
| | | Basic means and methods of ensuring information security, principles of building information security systems |
| | | Software and hardware to ensure the protection of IP information |

| | | Principles of building means of protecting information from "leakage" through technical channels |
| --- | --- | --- |
| | | National, interstate and international standards in the field of information security |
| | | Testing and debugging methods, principles of organization of development documentation, software maintenance process |
| Requirements for personal competencies | Analytical thinking, Critical analysis, Responsibility Organization, Systems thinking, Ability to solve non-standard problems, Attention to detail | |
| Relationship with other professions within the OQF | 5 | Security Specialist (ICT) |
| | 6 | Security Specialist (ICT) |
| | 7 | Security Specialist (ICT) |
| Link to ETKS or KS or other job directories | KS | 185. Programming Technician 140 Software Engineer |

| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies | Qualification: Master in ICT |
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| **PROFESSION CARD: DATA CRYPTOMER** | | |
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| Code: | 2524-0-009 | |
| Group code: | 2524-0 | |
| Profession: | Data Encryptor | |
| Other possible names professions | encoder | |
| Qualifying level according to the ORC | 7 | |
| primary goal activities | Development and operation of data encryption systems | |
| Labor functions: | Mandatory job functions: | 1. Development of software, software and hardware data encryption systems |
| | Additional labor functions: | - |
| | | **Skills:** |
| **Labor function 1:** Development of software, software and hardware data encryption systems | **Task 1:** Development of design solutions for data encryption systems | Apply the current regulatory framework in the field of functioning of data encryption systems |
| | | Apply regulatory documents on countering technical intelligence |
| | | Classify protected information by type of secret and degree of confidentiality |
| | | Define types of access subjects and access objects that are objects of protection |
| | | Define access control methods, access types and rules for restricting access to access objects to be implemented in data encryption systems |
| | | Determine the structure of data encryption systems in |

| | | accordance with the requirements of regulatory legal documents in the field of data encryption |
|---|---|---|
| | | **Knowledge:** |
| | | Normative legal acts and national standards for licensing in the field of ensuring the protection of state secrets and certification of information security tools |
| | | Principles of construction and operation, examples of implementations of modern data encryption systems |
| | | Criteria for evaluating the effectiveness and reliability of data encryption tools |
| | | Principles of organization and structure of data encryption systems |
| | | The main characteristics of technical means of data encryption |
| | | The device and functioning of modern data encryption systems |
| | | Requirements for the preservation of state and commercial secrets |
| | **Task 2:** Implementation of software, software and hardware data encryption systems | **Skills:** |
| | | Assess the complexity of cryptographic algorithms and calculations |
| | | Develop terms of reference for the creation of data encryption systems, taking into account the requirements of regulatory documents, ESKD and ESPD |
| | | Analyze software, architectural, technical and circuit solutions of the components of data encryption systems in order to identify potential security vulnerabilities in data encryption systems |
| | | Conduct comprehensive testing of hardware and software |
| | | **Knowledge:** |
| | | Professional and cryptographic terminology in the field of information security and data encryption |
| | | Basic information technologies and technical means used in data encryption systems |
| | | Means and methods for ensuring information security, principles for building data encryption systems |
| | | Basic cryptographic methods, algorithms, protocols used in data encryption systems |
| | | Modern programming technologies |
| | | Reference model of interaction of open systems, basic protocols, sequence and content of the stages of construction and operation of modern local and global computer networks |
| | | Principles of operation of elements and functional units of electronic equipment, typical circuit solutions for the main units and blocks of electronic equipment |
| | | Principles of organizing documentation of development and maintenance of software and hardware |
| | | Methods for testing and debugging software and hardware |

| | | | |
|---|---|---|---|
| | | ).     Normative legal acts in the field of information protection |
| | | 1.     Requirements for the preservation of state and commercial secrets |
| | **Task 3:**<br>Testing of developed data encryption systems | **Skills:** |
| | | Write the program code of the software health check procedures in the chosen programming language |
| | | Apply testing methods and tools |
| | | Use the selected programming environment to develop procedures for checking the functionality of software in the selected programming language |
| | | Development and design of test cases for checking the functionality of the software |
| | | Preparing datasets used in the software health check process |
| | | **Knowledge:** |
| | | Methods for automatic and automated software health checks |
| | | The main types of diagnostic data and ways to present them |
| | | Languages, utilities and programming environments, and tools for batch execution of procedures |
| | | Methods for creating and documenting test cases and test datasets |
| | | Rules, algorithms and technologies for creating test data sets |
| | | Requirements for the structure and storage formats of test data sets |
| | | Cryptographic algorithms and features of their software implementation |
| | | The main tools of artificial intelligence |
| | **Task 4:**<br>Development of operational documentation for data encryption systems | **Skills:** |
| | | Define measures (rules, procedures, practices, guidelines, methods, tools) for data encryption systems |
| | | Develop terms of reference for the creation of information security subsystems of data encryption systems |
| | | Design subsystems of data encryption systems, taking into account the current regulatory and methodological documents |
| | | Analyze software, architectural, technical and circuit solutions of the components of data encryption systems in order to identify potential vulnerabilities in data encryption systems |
| | | Assess information risks in data encryption systems and determine the information infrastructure and information resources to be protected |
| | | Conduct a feasibility study of design solutions for software and hardware in data encryption systems in order to ensure the required level of security |
| | | To study the effectiveness of design solutions for software and hardware in data encryption systems in order to ensure the required level of security |

| | | Knowledge: |
|---|---|---|
| | | Basic concepts of automata theory, mathematical logic, algorithm theory and graph theory, cryptography |
| | | Basic project management methods in the field of data encryption systems |
| | | National, interstate and international standards in the field of information security |
| | | Security Threats, Informational Impacts, Security Assessment Criteria and Information Protection Methods in Data Encryption Systems |
| | | Methods, methods, means, sequence and content of the stages of development of data encryption systems |
| | | Basic tools, methods and principles for building data encryption systems |
| | | Normative legal acts in the field of information protection |
| | | Requirements for the preservation of state and commercial secrets |
| Requirements for personal competencies | Structural thinking. Perseverance and attentiveness. Analytical mind. Ability for self-learning. Responsibility. Mathematical ability | |
| Relationship with other professions within the OQF | - | - |
| Link to ETKS or KS or other job directories | KS | 185. Programming Technician |
| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies | Qualification: Master in ICT |

| 3.Professional standard technical data | |
|---|---|
| Designed by: | Limited Liability Partnership "System Research Company "Factor" Project manager: Gabbasov M.B. Contact details of the head: Mars0@mail.ru +7 701 908 25 11 Project executors and contact details of executors: Abdeshov H.U. habdeshov@rambler.ru +7 777 2505831 Uvaleev Zh.E. zh_uali@mail.ru 87015228028 Baydeldinov M.U. Make3508@gmail.com +77013918037 Approved by the order of the Deputy Chairman of the Board of the National Chamber of Entrepreneurs Republic of Kazakhstan "Atameken" dated December 24, 2019 No. 259 |
| The expertise is provided by: | Organisation: 10Tech LLP Experts and contact details of experts: Deputy General Director Boldyrev V.A. |

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|---|---|
| Version number and year of release: | Version 1, 2018 |
| Date of indicative revision: | 30.12.2022 |
| Updated: | CIB ICRIAP RK |
| The expertise is provided by: | Organization: ALE "Kazakhstan Information Security Association"<br>Experts and contact details of experts:<br>General Director Pokusov V.V.<br>+7 771 716 18 16 |
| Version number and year of release: | Version 2, 2022 |
| Date of indicative revision: | 2025 |

**Professional Standard:"Development of systems for processing and storing big data"**

**Glossary**

The following terms and definitions apply in this professional standard:

**Information system (IS)**- an organizationally ordered set of information and communication technologies, service personnel and technical documentation that implement certain technological actions through information interaction and are designed to solve specific functional problems.

**Information technology (IT, IT)**is a process that uses a set of means and methods for collecting, processing and transmitting data to obtain information of a new quality about the state of an object, process or phenomenon. Information technology (IT, from the English. Information Technology, IT) is a class of areas of activity related to technologies for managing and processing a huge flow of information using computer technology.

**IS maintenance**- ensuring the use of the IS put into commercial operation in accordance with its purpose, including measures to correct, modify and eliminate software defects, without upgrading and implementing additional functional requirements and subject to maintaining its integrity.

**Database (DB)**- a set of data organized according to a conceptual structure that describes the characteristics of this data, as well as the relationships between their objects.

**Deep Learning** (English Deep learning is a set of machine learning methods (with a teacher, with partial involvement of a teacher, without a teacher, with reinforcement) based on learning representations (English feature / representation learning), and not specialized algorithms for specific tasks.

**Artificial neural networks (neural networks) -**mathematical model, as well as its software or hardware implementation, built on the principle of organization and functioningbiological neural networks— networksnerve cellsliving organism.

**Machine learning**(Machine Learning) is an extensive subsection of artificial intelligence that studies methods for constructing algorithms that can learn.

**Data Warehouse (HD)** –subject-oriented informationdatabase, specially designed and intended for the preparation of reports and business analysis in order to support decision-making in an organization.

**Computational linguistics**(mathematical or computational linguistics,Englishcomputational linguistics) - a scientific direction in the field of mathematical and computer modeling of intellectual processes in humans and animals

| | | |
|---|---|---|
| when creating systems<u>artificial intelligence</u>, which aims to use<u>mathematical models</u>for description<u>natural languages</u>. | | |

**computer vision -**technology for creating machines that can detect, track and classify objects.

**NLP**(Natural Language Processing) - natural language processing

**ICT**– Information and communication technologies

**DBMS -**Database management system

### 1. Professional Standard Passport

| | |
|---|---|
| Name of the Professional Standard: | Development of big data processing and storage systems |
| Professional Standard Number: | |
| The names of the section, section, group, class, and subclass according to OKED: | J Information and communication<br>62 Computer programming, consulting and other related services<br>62.0 Computer programming, consulting and other related services<br>62.01 Computer programming activities<br>62.01.1. Software development. |
| Brief description of the Professional Standard: | This occupational standard describes the roles of data managers and NPLs.<br>Data scientists discover and interpret rich data sources, manage large volumes of data, combine data sources, ensure dataset consistency, and create visualizations to help understand data. They build mathematical models using data and represent it. NPL specialists work in the field of computer science, and more specifically in the field of natural language processing. They aim to bridge the translation gap between accurate human translations for machine translators. They analyze texts, compare and display translations, and improve the linguistics of translations through programming and code. |

### 2. Occupation cards

| | | |
|---|---|---|
| List of profession cards | Data Mining Specialist | 6th - 7th levels of ORC |
| | Neural network specialist | 6th - 7th levels of ORC |
| | machine specialist learning | 6th - 7th levels of ORC |
| | NLP Engineer (Computational Linguistics Specialist) | 6th - 7th levels of ORC |
| | Computer vision programmer | 6th - 7th levels of ORC |

### PROFESSION CARD: DATA MINING SPECIALIST

| | | |
|---|---|---|
| Code: | | |
| Group code: | | |
| Profession: | Data mining specialist | |
| Other possible job titles: | - | |
| Qualification level for ORK: | 7 | |
| The main purpose of the activity: | Creation of software tools for big data analysis and business process forecasting | |
| Labor functions: | Mandatory job functions: | 1. Analysis of huge amounts of information. |
| | | 2. Development and management of software tools for automating the processing of big data |
| | Additional labor functions: | - |
| **Labor function 1:** Carrying out the analysis of huge arrays of information. | **Task 1:** Organization of big data processing | **Skills:**<br>1. Determine the ways and methods of work to extract previously unknown data to gain knowledge<br>2. Build SQL queries for knowledge extraction.<br>4. Apply methods of classification, clustering, regression, association, analysis of deviations, sequential pattern when processing data.<br>5.Develop methods for conducting data analysis that are used to |

| | | develop enterprise systems and applications to obtain knowledge and information that improve business processes.<br>6. Make mathematical calculations to extract knowledge. |
|---|---|---|
| | | **Knowledge:** |
| | | 1. Mathematical statistics, mathematical logic<br>2. Tools for working with SQL and the SQL language<br>3. The methodology of analytical research and forecasting methods in marketing (sales, competitiveness, and so on). |
| **Labor function 2:** Development and management of software tools for automating the processing of big data | **Task 1:** Ensuring big data storage | **Skills:** |
| | | 1. Conduct a needs assessment<br>2. Define decision-making steps in key business processes<br>3. Define business processes for analysis<br>4. Collect data and analyze data using intelligent systems<br>1. Determine ways of working and methods for extracting previously unknown data to gain knowledge<br>2. Apply SQL queries to extract knowledge<br>3. Carry out cluster analysis of big data<br>5.Develop methods for conducting data analysis that are used to develop enterprise systems and applications to obtain knowledge and information that improve business processes |
| | | **Knowledge:** |
| | | 1. Mathematical statistics, mathematical logic, machine learning<br>2. Methods and types of forecasting<br>3. Intelligent data analysis systems |
| | **Task 2:** Creation of data processing software | **Skills:** |
| | | 1. Solve big data analysis problems using a programming language.<br>2. Use metadata to work when creating database files or tables<br>3. Apply artificial intelligence methods in programming. |
| | | **Knowledge:** |
| | | 1. Modern applications for data mining,<br>2. Modern methods and technologies of artificial intelligence. |
| Requirements for personal competencies | Responsibility. performance. Logical, analytical, mathematical thinking. Result orientation. Organization Creativity. Autonomy in problem solving. | |
| Relationship with other professions within the OQF | 6 - 7 | Neural network specialist |
| | 6 - 7 | Machine learning specialist |
| | 6 - 7 | NLP Engineer (Computational Linguistics Specialist) |
| | 6 - 7 | Computer vision programmer |
| Link to ETKS or KS or other job directories | KS | 140. Software Engineer<br>96. Project manager |

| Relationship with the system of education and qualifications | Level of education: postgraduate (ISCED level 7) | Direction: Information and Communication Technologies | Qualification: Master of Engineering and Technology / Master of Science |
|---|---|---|---|

## PROFESSION CARD: NEURAL NETWORKS SPECIALIST

| Code: | | |
|---|---|---|
| Group code: | | |
| Profession: | Neural network specialist | |
| Other possible job titles: | | |
| Qualification level for ORK: | 7 | |
| The main purpose of the activity: | Development of algorithms for solving complex problems based on neural networks | |
| Labor functions: | Mandatory job functions: | 1. Preparation of data for use in neurosystems |
| | | 2. Application of neural networks in solving complex |

| | | |
|---|---|---|
| | | problems in data processing |
| | Additional labor functions: | - |

| Labor function 1:<br>Preparing data for use in neurosystems | Task 1:<br>Create a reference database | **Skills:**<br>1. Explore ways to solve the problem using a neural network<br>2. Download, collect, select data for work<br>3. Carry out cluster analysis of data on the output parameters of the neural network |
|---|---|---|
| | | **Knowledge:**<br>1. Mathematical statistics, discrete mathematics, mathematical logic<br>2. Fundamentals of algorithmization, data structures and programming. |
| | Task 2:<br>Modeling systems using neural networks | **Skills:**<br>1. Apply neural network computing processes<br>2. Describe the data and their interaction in the system to develop its model<br>3. Determine the applicable model type for the implemented system.<br>4. Explore the types of data representation models<br>5. Apply deep learning method |
| | | **Knowledge:**<br>1. Modern software applications<br>2. Deep learning methods in a neural network<br>3. Basic concepts of modeling and types of models |
| Labor function 2:<br>The use of neural networks in solving complex problems in data processing | Task 1:<br>Development of programs based on neural networks | **Skills:**<br>1. Develop a project for the implementation of a program for processing graphic and visual information<br>2. Determine the mathematical model of the program<br>3. Develop an algorithm and methods for implementing computing systems with neural networks.<br>4. Use ready-made neural network algorithms (software), libraries for data processing<br>5. Choose a programming language for working with neural networks<br>6. Use tools with neural network technology to process text, sound, graphic data |
| | | **Knowledge:**<br>1. Principles of parallel data processing of information systems<br>2. Neural network recognition of text characters by multilayer perceptrons.<br>3. Modern tools with the implementation of neural network technology<br>4. Architecture of neural networks |

| Requirements for personal competencies | Responsibility. performance. Logical, analytical, mathematical thinking. Result orientation. Organization. Creativity. Independence in decision making. | | |
|---|---|---|---|
| Relationship with other professions within the OQF | 6 - 7 | Data Mining Specialist | |
| | 6 - 7 | Machine learning specialist | |
| | 6 - 7 | NLP Engineer (Computational Linguistics Specialist) | |
| | 6 - 7 | Computer vision programmer | |
| Link to ETKS or KS or other job directories | KS | 140. Software Engineer<br>96. Project manager | |
| Relationship with the system of education and qualifications | Level of education: postgraduate (ISCED level 7) | Direction:<br>Information and Communication Technologies | Qualification:<br>Master of Engineering and Technology / Master |

| | | of Science |
|---|---|---|

**PROFESSION CARD: MACHINE LEARNING SPECIALIST**

| Code: | |
|---|---|
| Group code: | |
| Profession: | Machine learning specialist |
| Other possible job titles: | - |
| Qualification level for ORK: | 7 |
| The main purpose of the activity: | Development of algorithms for the implementation of machine learning methods |

| Labor functions: | Mandatory job functions: | | 1. Logic system design for machine learning |
|---|---|---|---|
| | | | 2. Drawing up algorithms for data analysis |
| | Additional labor functions: | | - |

| **Labor function 1:** Design and implementation of systems using machine learning | **Task 1:** Building a model of machine learning systems | **Skills:** |
|---|---|---|
| | | 1. Define algorithms for creating a model: naive bayes classification, decision tree, least squares, support vector machine (SVM) and others |
| | | 2. Prepare the processed data to create a training model |
| | | 3. Conduct an assessment of data quality and prepare an analytical report based on the results of the work. |
| | | **Knowledge:** |
| | | 1. Algorithms used in machine learning. |
| | | 2. Modern systems with implemented machine learning technology. |
| | | 3. Discrete mathematics, statistical data analysis, probability theory. |
| | **Task 2:** Application of developed technologies for machine learning and development of software tools for data analysis | **Skills:** |
| | | 1. Process and prepare data for machine learning. |
| | | 2. Choose algorithms for data processing through machine learning. |
| | | 3. Choose a programming language to implement the program. |
| | | **Knowledge:** |
| | | 1. Machine learning algorithms for data processing |
| | | 2. Programming languages for data analysis and data processing |
| | | 3. Mathematical logic, mathematical statistics and discrete mathematics |
| | **Task 3:** Building a strategic assessment model, data management in artificial intelligence | **Skills:** |
| | | 1. Define algorithms for data classification |
| | | 2. Develop a decision program |
| | | 3. Apply types of machine learning when analyzing data |
| | | 4. Make a lot of calculations and comparisons with data |
| | | 5. Apply precedent learning, or inductive learning based on the identification of empirical patterns in data and deductive learning. |
| | | 6. Transfer the knowledge base of experts to the database. |
| | | **Knowledge:** |
| | | 1. Algorithms for processing big data |
| | | 2. Clustering and data classification |
| | | 3. Methods of artificial intelligence |
| | | 4. Mathematical statistics, numerical methods, optimization methods, probability theory, graph theory, techniques for working with data in digital form. |

| Requirements for personal competencies | Responsibility. performance. Logical, analytical, mathematical thinking. Result orientation. Organization. Creativity. Independence in decision making. | |
|---|---|---|
| Relationship with other professions within the OQF | 6-7 | Data Mining Specialist |
| | 6-7 | Neural network specialist |

| | 6-7 | NLP Engineer (Computational Linguistics Specialist) |
|---|---|---|
| | 6-7 | Computer vision programmer |
| Link to ETKS or KS or other job directories | KS | 140. Software Engineer<br>96. Project manager |

| Relationship with the system of education and qualifications | Level of education: postgraduate (ISCED level 7) | Direction:<br>Information and Communication Technologies | Qualification:<br>Master of Engineering and Technology / Master of Science |
|---|---|---|---|

### PROFESSION CARD: NLP ENGINEER (COMPUTER LINGUISTICS SPECIALIST)

| Code: | |
|---|---|
| Group code: | |
| Profession: | NLP Engineer (Computational Linguistics Specialist) |
| Other possible job titles: | |
| Qualification level for ORK: | 7 |
| The main purpose of the activity: | Development of text information processing algorithms |

| Labor functions: | Mandatory job functions: | 1. Processing of text information by means of computing means and technology |
|---|---|---|
| | Additional labor functions: | - |

| Labor function 1:<br>Processing of text information by means of computing means and technology | Task 1:<br>Preparing dictionaries for data processing | **Skills:** |
|---|---|---|
| | | 1. Conduct analytical processes with text data<br>2. Determine the suitability of text data,<br>3. Apply text data processing methods<br>4. Apply computational linguistics algorithms in text processing |
| | | **Knowledge:** |
| | | 1. Analyze text data<br>2. Determine the suitability of text data<br>3. Apply text data processing methods<br>4. Study algorithms used in computational linguistics |
| | Task 2:<br>Development of optimal algorithms for working with text data | **Skills:** |
| | | 1. Explore methods for developing algorithms for fast natural language processing<br>2. Develop applications for semantic, syntactic, morphological analysis of natural language<br>3. Compare and analyze the effectiveness of the developed algorithms |
| | | **Knowledge:** |
| | | 1. Technology for developing modern applications for natural language processing<br>2. Modern programming languages.<br>3. Algorithms for natural language processing |
| | Task 3:<br>Development of programs for processing text information | **Skills** |
| | | 1. Apply deep learning, neural networks to solve text processing problems.<br>2. Apply pipelines of vectorization and text corpus transformation<br>3. Cluster data to identify similarities in the text. |
| | | **Knowledge** |
| | | 1. Porter's algorithm for compiling a dictionary from the basics of words<br>2. Neural networks, deep learning, machine learning<br>3. Types of data clustering |

| Requirements for personal competencies | Responsibility. performance. Logical, analytical, mathematical thinking. Result orientation. Organization. Creativity. Independence in decision making. | |
|---|---|---|
| Relationship with other professions within the OQF | 6-7 | Data Mining Specialist |
| | 6-7 | Neural network specialist |
| | 6-7 | Machine learning specialist |
| | 6-7 | Computer vision programmer |
| Link to ETKS or KS or other job directories | KS | 140. Software Engineer<br>96. Project manager |
| Relationship with the system of education and qualifications | Level of education: postgraduate (ISCED level 7) | Direction:<br>Information and Communication Technologies | Qualification:<br>Master of Engineering and Technology / Master of Science |

### PROFESSION CARD: COMPUTER VISION PROGRAMMER

| | | |
|---|---|---|
| Code: | | |
| Group code: | | |
| Profession: | Computer vision programmer | |
| Other possible job titles: | | |
| Qualification level for ORK: | 7 | |
| The main purpose of the activity: | Creation of software for computer vision | |
| Labor functions: | Mandatory job functions: | 1. Data preparation and development of programs for processing video and graphic images |
| | | 2. Computer vision application and hardware management |
| | Additional labor functions: | - |

| **Labor function 1:**<br>Data preparation and development of programs for processing video and graphic images | **Task 1:**<br>Graph data sampling | **Skills:** |
|---|---|---|
| | | 1. Analyze the scope of the system for computer vision<br>2. Conduct research and develop algorithms in the areas of: technical vision, 3D reconstruction from images, scene analysis and recognition, image processing<br>3. Apply image analysis and dense motion analysis algorithms. |
| | | **Knowledge:** |
| | | 1. Devices for computer vision<br>2. Computer vision software<br>3. Algorithms for developing computer vision applications<br>4. Image analysis methods and dense motion analysis algorithms (Horn-Schank, Lucas-Kanady, VBPW, optical flow calculations). |
| | **Task 2:**<br>Development of programs for computer vision | **Skills**: |
| | | 1. Design the architecture of a computer vision system<br>2. Prototype computer vision software<br>3. Perform 3D reconstruction of images |
| | | **Knowledge:** |
| | | 1. Modern software applications<br>2. Software modeling tools<br>3. Methods and principles of software design<br>4. Fundamentals of stereoscopic vision, photometric method for analyzing stereo images |
| **Labor function 2:**<br>Computer vision application and hardware management | **Task 1:**<br>Maintenance of software and devices for | **Skills:** |
| | | 1. Determine the installation location of video data recording cameras<br>2. Ensure the operability of the computer vision program and |

| | computer vision | system, monitor the system. 3. Detect errors and make changes, replace computer vision software |
|---|---|---|
| | | **Knowledge:** |
| | | 1. Fundamentals of IoT systems 2. Devices for computer vision 3. Methods and principles of operation of computer vision devices |
| Requirements for personal competencies | Responsibility. performance. Logical and analytical thinking. Flexibility of thinking. Result orientation. Organization. Creativity. Independence in decision making. | |
| Relationship with other professions within the OQF | 6-7 | Data Mining Specialist |
| | 6-7 | Neural network specialist |
| | 6-7 | Machine learning specialist |
| | 6-7 | NLP Engineer (Computational Linguistics Specialist) |
| Link to ETKS or KS or other job directories | KS | 140. Software Engineer 96. Project manager |

| Relationship with the system of education and qualifications | Level of education: postgraduate (ISCED level 7) | Direction: Information and Communication Technologies | Qualification: Master of Engineering and Technology / Master of Science |
|---|---|---|---|

| **3.Professional standard technical data** |
|---|

| Designed by: | Limited Liability Partnership "System Research Company "Factor" Project manager: Gabbasov M.B. Contact details of the head: Mars0@mail.ru +7 701 9082511 Project executors and contact details of executors: Isin N.K. info@itk.kz +7 701 1111871 Abdeshov H.U. habdeshov@rambler.ru +7 777 2505831 Akanova A.S. akerkegansaj@mail.ru +77054480680 Approved by the order of the Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" No. 259 dated December 24, 2019 |
|---|---|
| The expertise is provided by: | Organization: Digital Citizen LLP Experts and contact details of experts: General Director Basheev M.A. 8 707 805 04 60 |
| Version number and year of release: | Version 1, 2019 |
| Updated: | ALE "International Association for Certification and Development of Information Technologies Master-It" Chairman: Omarov Zh.B. Artists: Kaisenov K.K. master_it_rk@mail.ru +7 701 2140195 Danilov M.S. marymasterit@mail.ru +7 777 8151000 |

| | |
|---|---|
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| Expertise provided by: | ALE "International Association for Certification and Development of Information Technologies Master-It"<br>Chairman: Omarov Zh.B.<br>master_it_rk@mail.ru<br>+7 777 8151000 |
| Version number and year of release: | Version 2, 2022 |
| Date of indicative revision: | 12/30/2025 |

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| Appendix No. 40<br>to the order of the Deputy Chairman of the Board of the<br>National Chamber of Entrepreneurs<br>Republic of Kazakhstan "Atameken"<br>dated December 24, 2019 No. 259 |
| **professional standard**<br>**"Creation and management of information technologies"** |
| **Glossary**<br>The following terms and definitions apply in this professional standard:<br>**Information system (IS)**- an organizationally ordered set of information and communication technologies, service personnel and technical documentation that implement certain technological actions through information interaction and are designed to solve specific functional problems.<br>**Information technology (IT, IT)**is a process that uses a set of means and methods for collecting, processing and transmitting data to obtain information of a new quality about the state of an object, process or phenomenon. Information technology (IT, from the English. Information technology, IT) is a class of areas of activity related to |

technologies for managing and processing a huge flow of information using computer technology.

**IT infrastructure** is a complex structure that combines all information technologies and resources used by a particular organization or company. The information technology infrastructure includes all computers, installed software, communication systems, information centers, networks and databases.

**IS maintenance** - ensuring the use of the IS put into commercial operation in accordance with its purpose, including measures to correct, modify and eliminate software defects, without upgrading and implementing additional functional requirements and subject to maintaining its integrity.

**Information system architecture** - a concept that defines the model, structure, functions performed and the relationship of the components of the information system.

**Database (DB)** - a set of data organized according to a conceptual structure that describes the characteristics of this data, as well as the relationships between their objects.

**Software -** a set of programs, program codes, as well as software products with technical documentation necessary for their operation.

**Software interface -** a system of unified links intended for the exchange of information between the components of a computing system, specifying a set of necessary procedures, their parameters and methods of handling.

**Software -** an independent program or a piece of software that is a product, which, regardless of its developers, can be used for the intended purposes in accordance with the system requirements established by the technical documentation.

**ICT** – Information and communication technologies;

**BY** - Software;

| 1. Professional Standard Passport | |
|---|---|
| PS name: | Creation and management of information technology |
| PS number: | |
| The names of the section, section, group, class, and subclass according to OKED: | J Information and communication<br>62 Computer programming, consulting and other related services<br>62.0 Computer programming, consulting and other related services<br>62.01 Computer programming activities<br>62.01.1. Software development |
| Brief description of the PS: | Development of technical documentation and methodological support for products in the field of information technology (IT), creation and management of information resources on the Internet, project management in the field of information technology (IT) |

| 2. Occupation cards | | |
|---|---|---|
| List of profession cards | Technical Documentation Specialist (Technical Writer) | 6th-7th levels of ORC |
| | Specialist in the creation and management of information resources (content manager) | 6th-7th levels of ORC |
| | Information Technology Project Manager | 7th-8th levels of ORC |

**PROFESSION CARD**
**"SPECIALIST FOR THE DEVELOPMENT OF TECHNICAL DOCUMENTATION (TECHNICAL WRITER)"**

| | | |
|---|---|---|
| Code: | 2529-0-002 | |
| Group code: | 2529-0 | |
| Profession: | Technical Documentation Specialist (Technical Writer) | |
| Other possible job titles: | Technical documentation engineer<br>Head of technical documentation department | |
| Qualifying ORC level: | 7 | |
| The main purpose of the activity | Development of technical documentation for products in the field of IT, development of technical documents for information and methodological purposes, management of technical information | |
| Labor functions: | Mandatory job functions: | Leading a working group of technical documentation specialists in IT (technical writers) |
| | | Technological support for the preparation of technical publications |
| | Additional labor functions: | - |
| **Labor function 3:** | **Task 1:** | **Skills:** |
| Leading a working group of technical documentation specialists in IT (technical | Designing a set of technical documentation | Conduct surveys of experts and analyze the information received<br>Analyze the target audience of a set of technical |

| writers) | | documentation |
|---|---|---|
| | | Develop requirements for a set of technical documentation |
| | | Develop technical document requirements |
| | | Experience in requirements management systems |
| | | **Knowledge:** |
| | | The main types of technical documents and their features |
| | | The practice of documenting hardware, software, complexes, systems |
| | | Standards containing requirements for technical documentation |
| | | Requirements Management Fundamentals |
| | | Typical composition of requirements for a set of technical documentation |
| | | Typical composition of requirements for a technical document |
| | | General requirements for the structure of a technical document |
| | | The main formats of electronic documents and their features |
| | | Standard online help formats and their features |
| | | List of the currently most common technical documentation development tools, their main functionality and technical characteristics |
| | | Tools: word processors, test bench, requirements management tools |
| | **Task 2:** Cost estimate for the development of a set of technical documentation | **Skills:** |
| | | Decompose the process of developing a technical document into separate tasks |
| | | Estimate labor costs for the development of a technical document |
| | | Estimate the development time of a technical document |
| | | Read and understand network charts and Gantt charts |
| | | Create network diagrams using spreadsheets |
| | | Create network diagrams using specialized software tools |
| | | **Knowledge:** |
| | | Project Management Fundamentals |
| | | The meaning of network charts and Gantt charts, the scope of their application |
| | | Possession of the concepts of "metrics", "labor", "labor", "rationing" |
| | | List of the most commonly used standards currently containing requirements for the development and maintenance of technical documentation |
| | | Methods for estimating labor costs for the development of technical documentation |
| | | Influence of the used technical documentation development tools on the complexity of documentation |
| | | Typical risks in terms of quality and timing in the development of technical documentation |
| | **Task 3:** Management of the development of a set of technical documentation | **Skills:** |
| | | Estimate the costs (including labor costs) for the creation of a set of technical documentation |
| | | Set tasks for performers with clear decision criteria |
| | | Draw up work instructions, rules, memos |
| | | Check and evaluate the work of performers |
| | | Maintain a glossary of terminology at the project level |
| | | Write a style guide at the project level |
| | | Establish productive cooperation with the authors of texts and perform literary editing of the latter |
| | | Conduct business communications, including correspondence |
| | | **Knowledge:** |
| | | The practice of implementing projects in the field of |

| | | |
|---|---|---|
| | | information technology<br>The main factors affecting the timing of projects in the field of information technology<br>The most common methods currently used to motivate developers in projects<br>The order of work of a technical writer, the rules of his interaction with other specialists of the organization, factors that affect the ability of a technical writer to perform his duties, typical for most organizations<br>Methods of working on the text, the basics of literary editing<br>Terminology management basics<br>Basics of business etiquette<br>Tools: word processors, spreadsheets, project management tools |
| | **Task 4:**<br>Managing the functioning of the technical documentation department | **Skills:** |
| | | Justify budget and management decisions<br>Prepare organizational and administrative documentation, including provisions and regulations<br>Participate in corporate document management<br>Conduct business communications, including correspondence<br>Manage projects (in relation to projects in the field of information technology)<br>Carry out projects in the field of information technology<br>Formulate requirements for products in the field of information technology<br>Describe business processes and requirements for their execution order |
| | | **Knowledge:** |
| | | The main approaches, methods, technologies, hardware and software currently used in the field of information technology<br>The current state of the technical communication industry<br>Approaches, methods, technologies, software tools currently used in the development of technical documentation<br>The practice of technical documentation at other enterprises and in other organizations<br>Fundamentals of Management<br>Labor legislation of the Republic of Kazakhstan<br>Tools: word processors, slideshow preparation tools<br>Estimation of costs (including labor costs) for the creation of a set of technical documentation<br>Understanding the practice of a technical writer<br>An idea of the factors affecting the development time in the field of information technology.<br>Regulatory framework for standardization in those countries where the enterprise or organization operates<br>Systems and Software Engineering Standards<br>Standards for technical documentation and documentation processes |
| **Labor function 1:**<br>Technological support for the preparation of technical publications | **Task 1:**<br>Finding ways to improve the quality of issued technical documentation | **Skills:** |
| | | Explore software tools on a test bench |
| | | Collect, analyze and systematize available information |
| | | Prepare slideshows and handouts |
| | | Prepare technical articles |
| | | Create demo or tutorial videos |
| | | Conduct business communications, including in English |
| | | **Knowledge:** |
| | | The main methods, technologies, hardware and software currently used in the field of information technology<br>Fundamentals of technical communication |

| | | Main profile publications, resources<br>The main types of technical documentation development tools, a list of leading software products and technological platforms for the development of technical documentation, methods of their application, functionality and technical characteristics, advantages and disadvantages<br>The main tasks to be solved in the development, maintenance, publication and distribution of technical documentation, approaches to automating their solution, a list of software tools used to automate documentation, examples of successful documentation automation<br>Fundamentals of systems and software engineering<br>Fundamentals of software and systems development methodologies<br>Fundamentals of quality management<br>Methods for assessing the quality of technical documentation<br>Approaches to the evaluation of development processes in the field of information technology<br>Familiarity with classic samples of technical documentation |
|---|---|---|
| | **Task 2:**<br>Implementation at the enterprise or in the organization of documentation automation tools | **Skills:** |
| | | Formulate requirements for software and automated systems |
| | | Plan and organize your work, draw up network schedules |
| | | Develop work instructions, rules, memos |
| | | Describe technical solutions from the point of view of specialists in the field of information technology |
| | | Work in requirements management systems |
| | | Work in version control systems |
| | | **Knowledge:** |
| | | The most important approaches, methods, technologies, hardware and software currently used in the field of information technology<br>Standards for automated systems, standards for the processes of creating and operating automated systems<br>The order of design, production, supply and implementation, application, operation, disposal of documented products<br>The main types of technical documents, their features<br>Standards for the design of text documents<br>Fundamentals of typography and printing culture<br>Standard reference formats and their features<br>Main graphic file formats and their features<br>The most common methods of software licensing today |
| | **Task 3:**<br>Technical support for developers of technical documentation | **Skills:** |
| | | Find, study, compare and select software tools<br>Mark up documents according to the rules of a given markup language<br>Compose CSS styles and debug them<br>Compose styles in extensible stylesheet language transformations (XSLT) and debug them<br>Write programs in scripting languages and debug them |
| | | **Knowledge:** |
| | | Functionality of major word processors<br>The purpose and basic principles of the Document Object Model (DOM), options for implementing this model in various development tools and runtime environments<br>Used tools for developing technical documentation<br>Programming in the scope of a specialized university course<br>Fundamentals of client web technologies, HTML, CSS, JavaScript<br>Fundamentals of XML technologies, DTD languages, XML Schema, XSLT, XPath |

| | | Standard online help formats and features of their use<br>The main formats of graphic files and features of their use |
|---|---|---|
| Requirements for personal competencies | Analytical thinking, Responsibility, Organization, Learnability, Ability to work in a team, Systems thinking | |

| | | |
|---|---|---|
| Relationship with other professions within the OQF | - | - |
| Communication with ETKS or KS | Not represented | - |

| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies | Qualification: Master in ICT |
|---|---|---|---|

## PROFESSION CARD
## "SPECIALIST IN CREATING AND MANAGING INFORMATION RESOURCES (CONTENT MANAGER)"

| | |
|---|---|
| Code: | 2529-0-003 |
| Group code: | 2529-0 |
| Profession: | Specialist in the creation and management of information resources (content manager) |
| Other possible job titles: | Content editor<br>Information Resource Manager |
| Qualifying<br>ORC level: | 7 |
| The main purpose of the activity | Dissemination of information, advertising of goods and services, information support for business processes of organizations, improving the efficiency of communications with consumers of products and the development of e-commerce |
| Labor functions: | Mandatory job functions: | Management (management) of information resources |
| | Additional labor functions: | - |

| | | |
|---|---|---|
| **Labor function 1:**<br>Management (management) of information resources | **Task 1:**<br>Organization of work on creating, editing content | **Skills:** |
| | | Draw up work plans, evaluate their content and the complexity of implementation, depending on qualifications |
| | | Maintain project and work documentation |
| | | Work effectively with content management system (CMS) |
| | | Restructure the site and move web pages, database information blocks |
| | | Document information about the processes and results of work performed by various performers |
| | | **Knowledge:** |
| | | Basic principles and technologies of project management<br>Content and methods for solving problems of creating and editing content<br>Principles of operation of CMS and file storage systems, information blocks |
| | **Task 2:**<br>Management of information from various sources and control over the content of the site | **Skills:** |
| | | Own software and hardware for regular communication, monitoring of information on the Internet |
| | | Analyze and summarize information obtained from various sources |
| | | Generate requests and receive information from employees of the organization |
| | | Carry out an overall assessment of the significance and priority of the information received |
| | | **Knowledge:** |
| | | Structure of the organization, areas of responsibility and functions of departments<br>Internal rules for approval and approval of documents<br>Work with news aggregators, electronic subscriptions, social |

| | | networks, forums<br>Knowledge in the subject area of the site, allowing to assess the relevance and completeness of information materials |
|---|---|---|
| | **Task 1**<br>Analysis of the information needs of site visitors | **Skills:** |
| | | Analyze structured and unstructured information |
| | | Own popular services for assessing site traffic and audience characteristics |
| | | Own the functions of CMS and social networks to evaluate attendance |
| | | Determine the general characteristics of the site audience |
| | | Analyze the evaluation, comments, complaints and suggestions of site visitors |
| | | Develop solutions (recommendations) for filling the site with content |
| | | **Knowledge:** |
| | | Terminology and key parameters of web statistics<br>Basic principles and methods for collecting website traffic statistics<br>Popular services for collecting web statistics |
| | **Task 2**<br>Site reporting preparation | **Skills:** |
| | | To carry out documentation of work on the management (management) of information resources of the site<br>Be proficient in a text editor for reporting<br>Analyze and summarize information<br>Realizecollection of additional materials |
| | | **Knowledge:** |
| | | Requirements for the preparation of documentation, reports<br>High level of knowledge of languages (spelling, punctuation, style)<br>Text editors |
| | **Task 3**<br>Support for site modernization and promotion processes | **Skills:** |
| | | Formulate requirements for the structure and services of the website<br>Model (describe) business processes<br>Test site functionality<br>Carry out trial operation of the website |
| | | **Knowledge:** |
| | | Basic processes and methods of website development<br>Basic concepts and methods of search engine optimization |
| Requirements for personal competencies | Analytical thinking, Critical analysis<br>Responsibility, Organization, Learnability, Ability to work in a team, Systems thinking, Ability to solve non-standard tasks | |
| Relationship with other professions within the OQF | 6 | Web page developer |
| | 7 | webmaster |
| Communication with ETKS or KS | KS | 157. Programmer (web master, web designer) |
| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies    Qualification: Master in ICT |

| PROFESSION CARD<br>"PROJECT MANAGER IN THE FIELD OF INFORMATION TECHNOLOGIES" | |
|---|---|
| Code: | 2529-0-004 |
| Group code: | 2529-0 |
| Profession: | Information Technology Project Manager |
| Other possible job titles: | Project Manager Assistant<br>Project manager |
| Qualifying<br>ORC level: | 7 |
| The main purpose of the activity | Project management in the field of IT (planning, organization of execution, control and analysis of deviations) for the effective achievement of project goals within the |

| | | requirements, budget and deadlines approved by the customer |
|---|---|---|
| Labor functions: | Mandatory job functions: | Organization of work on IT projects |
| | | Coordination of work on projects in the field of IT |
| | Additional labor functions: | - |
| **Labor function 1:** Organization of work on IT projects | **Task 1:** IT project management | **Skills:** |
| | | Estimate the necessary resources to complete the work |
| | | Rationally allocate resources during the project |
| | | Develop a work schedule by stages |
| | | Develop a list of work in stages |
| | | Develop a project charter |
| | | Form a project team |
| | | Distribute work within the project team |
| | | Provide training for project implementers |
| | | Participate in the preparation of project documentation for the development of an information system |
| | | Provide working conditions in accordance with the tasks performed |
| | | Own practical methodologies for managing project and process activities |
| | | Analyze the efficiency of business processes |
| | | Form recommendations to improve the efficiency of business processes |
| | | Optimize business processes |
| | | Model business processes |
| | | Manage project resources |
| | | Manage project schedule |
| | | Manage project content |
| | | Manage project quality |
| | | Manage project integration |
| | | Manage project contracts |
| | | Manage project risks |
| | | Manage project budget |
| | | Use specialized project management software |
| | | **Knowledge:** |
| | | Modern approaches to building and improving organization management systems |
| | | Principles of organization of information technology infrastructure |
| | | Organization management methodology |
| | | Methodology and standards of organization automation |
| | | Organization Systems Theory |
| | | Theory of systems analysis |
| | | Control theory |
| | | Methodology for describing and modeling business processes |
| | | Business process modeling tools |
| | | OS |
| | | Project management technologies in the field of information technology |
| | | IT project integration management |
| | | Project management |
| | | Project Management Standards |
| | | Phases of the project life cycle |
| | | Project Management Processes |
| | | Project Budget Management Principles |
| | | Principles of project personnel management |
| | | Principles of project time management |
| | | Project Risk Management Principles |
| | | Project Resource Management Principles |
| | | Project Quality Management Principles |

| | | Project Integration Management Principles<br>Documentation of project activities<br>Technology for the formation and management of a team of project performers<br>Planning software<br>Project management software<br>Labor protection requirements |
|---|---|---|
| | **Task 2:**<br>Interaction with customers/suppliers of products and services | **Skills:**<br>Develop methods for analyzing customer needs in the field of informatization<br>Work with different types of source data in the subject area<br>Distribute work in areas between related departments<br>Develop technical specifications for the performance of work<br>Coordinate technical documentation<br>Organize work on system integration<br>Draw up conclusions on the documentation of related organizations<br>Organize and prepare technical meetings<br>Analyze user needs |
| | | **Knowledge:**<br>Capabilities of external organizations<br>Organization Automation Needs Assessment Methodology<br>Principles of financial management<br>Methods for calculating the economic efficiency of information systems<br>Decision-making methods<br>System analysis<br>Rules for issuing tender/competitive documentation<br>Rules for the development of technical specifications for the performance of work<br>Information Technology Development Trends<br>Business communication, ethics<br>Fundamentals of psychology and conflictology<br>Foreign language |
| | **Task 3:**<br>Coordination of the work of system analysts, programmers and other specialists | **Skills:**<br>Assign tasks to system analysts, programmers and other specialists<br>Explain the algorithm of interaction between system analysts, programmers and other specialists<br>Analyze the problems of interaction between system analysts, programmers and other specialists<br>Assess and justify the complexity and timing of analytical work<br>Develop recommendations for adjustments to computer systems during development testing and implementation<br>Analyze project risks<br>Plan, organize and control the work of system analysts, programmers and other specialists<br>Negotiate<br>Own practical methods for managing project and process activities<br>Analyze technological and architectural solutions in the field of informatization<br>Organize an examination |
| | | **Knowledge:**<br>Principles of building and managing organizations<br>Job descriptions of system analysts, programmers and other specialists<br>Planning principles<br>Fundamentals of organization personnel management<br>Organizational resource management principles<br>Fundamentals of Pedagogy |

| | | Methodology for modeling processes, interconnections of data, systems, objects<br>Fundamentals of system analysis<br>Information technology standards<br>Domestic and international experience in professional activities<br>Information Technology Architecture Classification<br>Structure, composition, tasks and significance of the organization's IT infrastructure<br>Basic processes of IT infrastructure<br>Methodology for building and managing the organization's IT infrastructure<br>Classification and characteristics of hardware and software<br>Information Technology Application Standards<br>Factors that determine the reliability and efficiency of information systems<br>Methods for organizing maintenance and operation of information systems<br>Principles and methods of auditing information systems<br>Methods and systems for managing the organization's IT infrastructure |
|---|---|---|
| **Labor function 2:**<br>Coordination of work on projects in the field of IT | **Task 1**<br>Project control | **Skills:** |
| | | Plan, organize and control work in accordance with the schedule<br>Supervise the execution of work in accordance with the terms of reference<br>Provide the necessary resources to complete the work<br>Analyze the results of the work<br>Control the allocation of resources during the project<br>Conduct meetings and negotiations<br>Supervise the work of suppliers and subcontractors<br>Monitor compliance with labor protection requirements<br>Monitor compliance with fire safety requirements<br>Analyze and form performance indicators of the organization for strategic and operational management |
| | | **Knowledge:** |
| | | Principles and approaches to control the activities of the project team<br>Project Cost Management Principles<br>Project Time Management Principles<br>Project Management Knowledge Areas<br>Management control principles<br>The main business processes of the organization<br>Methods for the formation and analysis of performance indicators of the organization<br>Labor protection requirements<br>fire safety requirements |
| | **Task 2**<br>Monitoring the completion of the necessary documentation | **Skills:** |
| | | Verify the correctness and timeliness of completing the necessary documentation<br>Check the developed documentation for compliance with the standards of the organization<br>Coordinate regulations and procedures for maintaining and updating documentation<br>Control the schedules of checks of technical documentation, regulations, instructions<br>Justify decisions on adjusting and amending regulatory operational documents, instructions and technical documentation<br>Check the knowledge of staff in filling out the necessary documentation |
| | | **Knowledge:** |

| | Documentation Organization Standards |
|---|---|
| | State and industry standards |
| | Regulations, instructions for the development and execution of documentation |
| | Operating conditions of equipment and information systems |
| | Business principles |

| | | |
|---|---|---|
| Requirements for personal competencies | Analytical thinking, Critical analysis, Stress resistance, Responsibility, Organization, Learnability, Ability to work in a team | |
| Relationship with other professions within the OQF | - | - |
| Communication with ETKS or KS | KS | 96. Project manager |
| Relationship with the system of education and qualifications | The level of education: Postgraduate (6M ISCED code) | Direction of training: Information and communication technologies | Academic degree: Master of Engineering and Technology in the specialty: "Computer Engineering and Software", "Information Systems" "Computer science" |

| 3.Professional standard technical data | |
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