3. Educational program

Computer and mathematical modelling (Bachelor's degree). The Director of the educational program is A. V. Kulyk, PhD in Economics, Associate Professor, Associate Professor of the Department of Digital Economy and System Analysis

3.1. Profile of the educational program "Computer and mathematical modelling" specialty 113 "Applied mathematics"

1 – General information	
Full name of IHE and structural unit	State University of Trade and Economics, faculty of Information Technology, the Department of Digital Economy and System Analysis
The degree of higher education and the title of the qualification in the original language	Degree of higher education bachelor Subject area «Applied Mathematics»
The official name of the educational program	«Computer and mathematical modelling»
Compliance with the standard of higher education (SHE) MES of Ukraine	According to the SHE MES of Ukraine
Type of diploma and scope of the educational program	Bachelor degree, single, 240 ECTS credits, study period 3 years 10 months
Availability of accreditation	Initial accreditation is scheduled for 2027
Cycle/level	NQF of Ukraine – 6 level, FQ-EHEA – first cycle, EQF-LLL – 6 level
Prerequisites	Availability of a complete general secondary education
Language(s) of teaching	Ukrainian
The term of validity of the educational program	4 years
Internet address of the permanent placement of the description of the educational program	https://knute.edu.ua
2 – The aim of the educational program	
To provide students with the acquisition of theoretical knowledge and practical abilities and skills sufficient for the successful performance of professional duties and the educational and professional program: successful use of fundamental and applied mathematical methods, methods of forecasting, optimization and decision-making, artificial intelligence, machine learning, computer systems computer mathematics and software using modern information technologies, development and use of computer and mathematical models of complex processes, phenomena and systems of various nature to solve complex applied problems in various fields of science, technology, economy and finance, social and political spheres , ecology and security, regional and national economy, global and local problems of social development.	
3 - Characteristics of the educational program	
Subject area	Objects of study and activity: mathematical methods, models, algorithms and software designed for research, analysis, design of processes and systems in various specific subject areas. Training goals: training of specialists capable of:

<table>
<tr><td></td><td>- to formulate, solve and generalize practical problems using fundamental and special applied methods of mathematical and computer sciences;
- solve the problems of mathematical modelling of processes and phenomena in conditions of uncertainty and incomplete information regarding the functioning of the system of objects;
- build, research and apply mathematical models based on data and knowledge, create and operate software.
Theoretical content of the subject area: Mathematical methods used in science, engineering, business and industry, as well as algorithms and software tools for their implementation.
Methods, techniques and technologies:
- applied mathematical methods and algorithms;
- methods of solving engineering, scientific, socio-economic problems using specialized software tools;
- information technologies for conducting computer modelling and computing experiments, intellectual data analysis.
Tools and equipment:
- computer, computer and social networks, specialized software tools.</td></tr>
<tr><td>Orientation of the educational program</td><td>Educational and professional. Emphasis on readiness to work and acquire knowledge and skills in information technologies, computer and mathematical modelling of complex processes, phenomena and systems of various nature, forecasting, optimization, system analysis and decision-making, intellectual analysis.</td></tr>
<tr><td>The main focus of the educational program</td><td>Special education in the field of computer and mathematical modelling, information technologies, ability to intellectual analysis, forecasting, decision-making in complex systems of various nature.
Keywords: mathematics, applied mathematics, mathematical methods, computer modelling, mathematical modelling, information systems, information technologies, software tools, forecasting, optimization, decision making, artificial intelligence, expert systems, machine learning, data, databases, system approach, system analysis.</td></tr>
<tr><td>Features of the program</td><td>In-depth study and knowledge of promising areas of applied mathematics, computer and mathematical modelling, forecasting, optimization, artificial intelligence decision-making at various stages of creation and application of information systems.</td></tr>
<tr><td colspan="2">4 – Eligibility of graduates
to employment and further education</td></tr>
<tr><td>Suitability for employment</td><td>Jobs in the field of information technology, communication and IT project management: IT companies, financial companies, consulting companies, government institutions.
The list of types of economic activities that a bachelor can perform under the "Computer and Mathematical Modelling" educational program:
<table>
<tr><td>Code КВЕД ДК 009:2010</td><td>The name of the type of economic activity</td></tr>
<tr><td>62.02</td><td>Consulting on informatization</td></tr>
<tr><td>63.11</td><td>Data processing, posting of information on web sites and related activities</td></tr>
<tr><td>63.12</td><td>Web portals</td></tr>
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</table>

<table>
<tr><td></td><td>Positions that a bachelor can hold under the "Computer and Mathematical Modelling" educational program:
<table>
<tr><th>Code ДК 003:2010</th><th>The name of the profession</th></tr>
<tr><td>1226.2</td><td>Head of the structural unit (information protection area)</td></tr>
<tr><td>2121.2</td><td>Mathematician</td></tr>
<tr><td>2121.2</td><td>Mathematician (applied mathematics)</td></tr>
<tr><td>2121.2</td><td>Mathematician-analyst in operations research</td></tr>
<tr><td>2131.2</td><td>Database administrator</td></tr>
<tr><td>2131.2</td><td>Data administrator</td></tr>
<tr><td>2131.2</td><td>Computer data bank analyst</td></tr>
<tr><td>2149.2</td><td>Systems analyst</td></tr>
<tr><td>2412.2</td><td>Analytics of the field of professional employment</td></tr>
<tr><td>2412.2</td><td>Labor market analysis specialist</td></tr>
<tr><td>2414.2</td><td>Financial and economic security analyst</td></tr>
<tr><td>2419.2</td><td>Professional in economic cybernetics</td></tr>
<tr><td>2419.2</td><td>Specialist-analyst in commodity market research</td></tr>
<tr><td>2433.2</td><td>Analyst of consolidated information</td></tr>
<tr><td>2433.2</td><td>Scientific and technical information engineer</td></tr>
<tr><td>2441.2</td><td>Investment analyst</td></tr>
<tr><td>2441.2</td><td>Credit analyst</td></tr>
<tr><td>3121</td><td>Specialist in information technologies</td></tr>
</table></td></tr>
<tr><td>Further education</td><td>Continuation of studies at the second (master's) level of higher education under master's educational programs in the fields of knowledge "Mathematics and Statistics", "Information Technologies" and interdisciplinary programs close to applied mathematics.</td></tr>
<tr><td colspan="2">5 – Teaching and assessment</td></tr>
<tr><td>Teaching and learning</td><td>Problem-oriented learning, self-learning, learning through practical training.</td></tr>
<tr><td>Assessment</td><td>Current control, written exams, defense of coursework, defense of qualification work. The evaluation is carried out in accordance with the "Regulations on the evaluation of the results of students' and postgraduate studies at DTEU", "Regulations on the organization of the educational process of students"</td></tr>
<tr><td colspan="2">6 – Software competencies</td></tr>
<tr><td>Integral competence</td><td>The ability to solve complex specialized tasks and practical problems of applied mathematics, in professional activity or in the learning process, which involves the application of mathematical theories and methods, mathematical and computer modelling and is characterized by the complexity and uncertainty of conditions.</td></tr>
<tr><td>General competences</td><td>GC01. Ability to learn and master modern knowledge.
GC02. Ability to apply knowledge in practical situations.
GC03. Ability to generate new ideas (creativity).
GC04. The ability to be critical and self-critical.
GC05. Ability to conduct research at an appropriate level.
GC06. Ability to abstract thinking, analysis and synthesis.
GC07. Ability to search, process and analyze information from various sources.</td></tr>
</table>

	GC08. Knowledge and understanding of the subject area and understanding of professional activity. GC09. Ability to communicate with representatives of other professional groups at different levels (with experts from other fields of knowledge/types of economic activity). GC10. Skills in the use of information and communication technologies. GC11. Ability to work in an international context. GC12. Determination and persistence in relation to assigned tasks and assumed responsibilities. GC13. Interpersonal skills. GC14. The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine. GC15. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.
Special (professional, subject) competences	**Activity on the application of mathematical methods** PC01. Ability to use and adapt mathematical theories, methods and techniques to prove mathematical statements and theorems. PC02. Ability to perform tasks formulated in mathematical form. PC03. The ability to choose and apply mathematical methods for solving applied problems, modelling, analysis, design, management, forecasting, decision-making. **Design activity** PC04. Ability to develop algorithms and data structures, software tools and software documentation. PC05. Ability to design databases, information systems and resources. **Technological activity** PC06. The ability to solve professional tasks using computer equipment, computer networks and the Internet, in the environment of modern operating systems, using standard office applications. PC07. Ability to operate and maintain software of automated and information systems for various purposes. PC08. Ability to use modern programming and software testing technologies. PC09. Ability to conduct mathematical and computer modelling, data analysis and processing, computational experiments, solving formalized problems using specialized software tools. **Organizational and managerial activity** PC10. Ability to create established reporting documents, use regulatory and legal documents. PC11. Ability to organize the work of a team of performers, make appropriate and economically justified organizational and management decisions, ensure safe working conditions.

	Research activity PC12. The ability to search, systematically study and analyze scientific and technical information, domestic and foreign experience related to the application of mathematical methods for the study of various processes, phenomena and systems. PC13. The ability to understand the statement of the task, formulated in the language of a certain subject area, to search and collect the necessary initial data. PC14. The ability to formulate a mathematical statement of a problem, based on the statement in the language of the subject field, and to choose a method of its solution, which ensures the required accuracy and reliability of the result. PC15. The ability to participate in the preparation of scientific reports from the performed scientific research works and in the implementation of the results of the conducted research and development. PC16. Ability to effective professional written and oral communication in Ukrainian and one of the official languages of the EU. *PC17. Ability to develop mathematical models of processing and analysis of big data.* *PC 18. Ability to build, test, and interpret computer models of complex systems using advanced programming technologies, computational mathematics systems, and analytical platforms.*
7 – Program learning outcomes	
	LR01. Demonstrate knowledge and understanding of basic concepts, principles, theories of applied mathematics and use them in practice. LR02. To have basic principles and methods of mathematical, complex and functional analysis, linear algebra and number theory, analytical geometry, theory of differential equations, in particular partial differential equations, probability theory, mathematical statistics and random processes, numerical methods. LR03. Formalize tasks formulated in the language of a specific subject area; formulate their mathematical statement and choose a rational solution method; to solve the obtained problems by analytical and numerical methods, to evaluate the accuracy and reliability of the obtained results. LR04. Perform mathematical description, analysis and synthesis of discrete objects and systems, using the concepts and methods of discrete mathematics and the theory of algorithms. LR05. Be able to develop and use in practice algorithms related to approximation of functional dependencies, numerical differentiation and integration, solution of systems of algebraic, differential and integral equations, solution of boundary value problems, search for optimal solutions. LR06. To have the basic methods of developing discrete and continuous mathematical models of objects and processes, analytical research of these models for the existence and uniqueness of their solutions. LR07. Be able to conduct practical research and find solutions to incorrect problems.

	LR08. Combine mathematical and computer modelling methods with informal procedures of expert analysis to find optimal solutions. LR09. Build algorithms that are effective in terms of calculation accuracy, stability, speed, and system resource consumption for numerical research of mathematical models and solving practical problems. LR10. To know the methods of choosing rational methods and algorithms for solving mathematical problems of optimization, operations research, optimal management and decision-making, data analysis. LR11. To be able to apply modern technologies of programming and software development, software implementation of numerical and symbolic algorithms. LR12. Solve individual engineering problems and/or problems arising in at least one subject area: in sociology, economics, ecology, and medicine. LR13. To use specialized software products and software systems of computer mathematics in practical work. LR14. Demonstrate the ability to self-study and continue professional development. LR15. To be able to organize one's own activities and obtain a result within a limited time. LR16. Demonstrate the skills of interaction with other people, the ability to work in a team. LR17. Be able to collect, process, analyze, systematize scientific and technical information, while avoiding academic dishonesty. LR18. Communicate effectively about information, ideas, problems and solutions with specialists and society in general. LR19. Collect and interpret relevant data and analyze complexities within the scope of their specialization to make judgments that reflect relevant social and ethical issues. LR20. Demonstrate professional communication skills, including oral and written communication in Ukrainian and at least one of the official languages of the EU. *LR21. To solve applied problems of mathematical modelling in the field of economics and business, to master the methods of modelling business processes.* *LR22. Analyze and process big data, in particular, by modelling neural networks using machine learning technologies.*
8 – Resource support for program implementation	
Staff support	Specialists training bachelors under the "Computer and Mathematical Modelling" educational program must have specialized knowledge and professional skills in the field of computer and mathematical modelling, data analysis, and modern information technologies. The participation of foreign specialists and practitioners in the teaching of professional training disciplines is possible.
Material and technical support	The basis of material and technical support consists of specialized computer laboratories with modern hardware and software resources that ensure high-quality training of bachelors under the educational program "Computer and Mathematical Modelling".

Informational and educational and methodological support	General scientific and special sources of information on system analysis and data analysis, educational and methodological and monographic literature, information resources of the distance learning system and the Internet.
9 – Academic mobility	
National credit mobility	National credit mobility is carried out in accordance with concluded agreements on academic mobility.
International credit mobility	International credit mobility is implemented through the conclusion of agreements on international academic mobility (Erasmus+), on double graduation, on long-term international projects that involve student training, the issuance of a double diploma, etc.
Education of foreign students	Conditions and features of the educational program in the context of studying foreign citizens: knowledge of the Ukrainian language at a level not lower than B1.

3.2. List of components of the educational program and their logical sequence

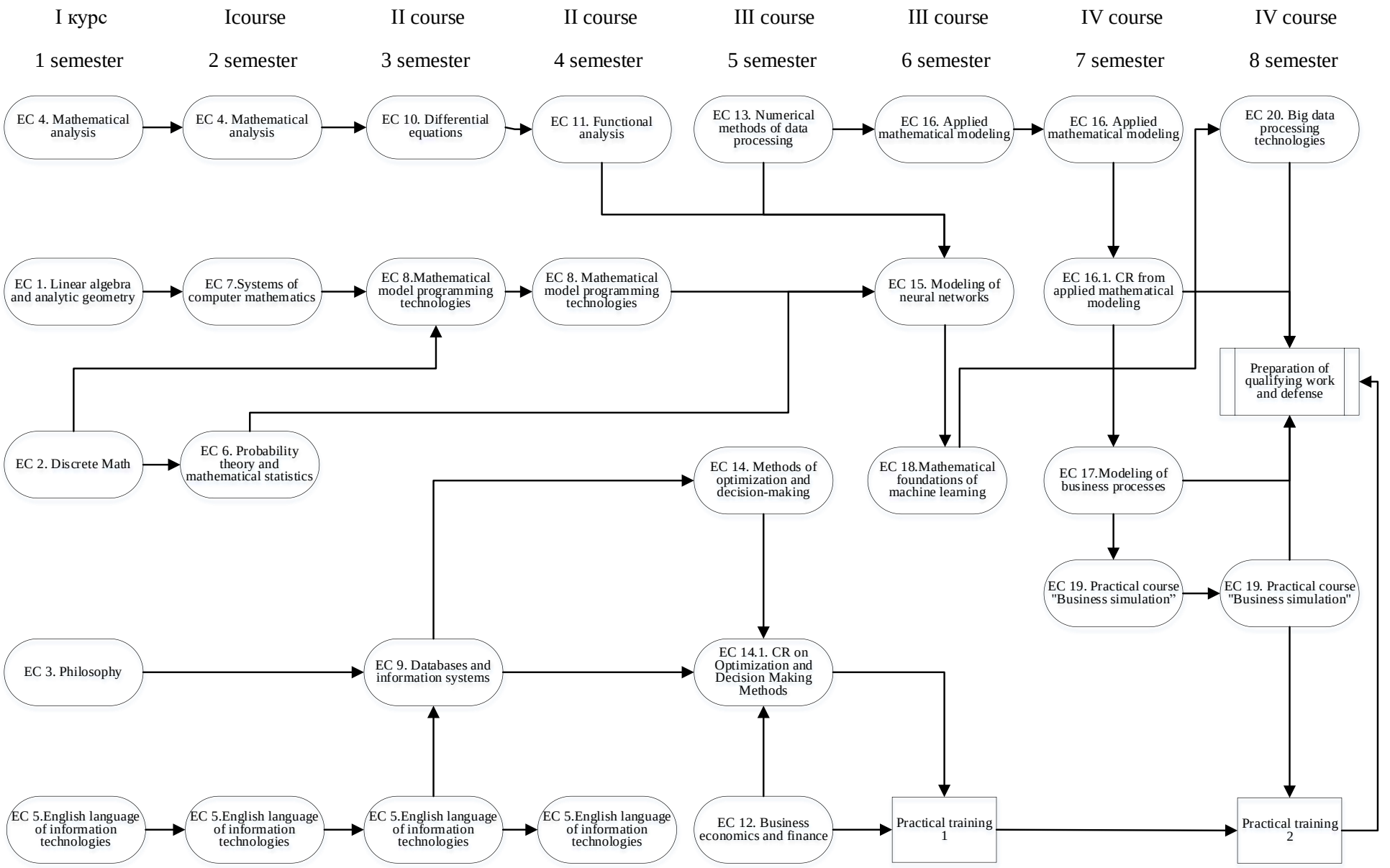
3.2.1. List of components of the EP

Код н/д	Components of the educational program (educational subjects, course projects (works), practices, qualification exam, graduation thesis)	Number of credits
Compulsory components EP		
CC 1	Linear algebra and analytic geometry	6
CC 2	Discrete Math	6
CC 3	Philosophy	6
CC 4	Mathematical analysis	12
CC 5	English language of information technologies	24
CC 6	Probability theory and mathematical statistics	6
CC 7	Systems of computer mathematics	6
CC 8	Mathematical model programming technologies	12
CC 9	Databases and information systems	6
CC 10	Differential equations	6
CC 11	Functional analysis	6
CC 12	Business economics and finance	6
CC 13	Numerical methods of data processing	6
CC 14	Methods of optimization and decision-making	5
CC 14.1	CR on methods of optimization and decision-making	1
CC 15	Modelling of neural networks	9
CC 16	Applied mathematical modelling	12
CC 16.1	CR on applied mathematical modelling	
CC 17	Modelling of business processes	6
CC 18	Mathematical foundations of machine learning	6
CC 19	Practical course "Business simulation"	9
CC 20	Big data processing technologies	6
The total volume of compulsory components:		**162**
Elective EP components		
EC 1	Algorithms and data structures	6
EC 2	Safety of life	6
EC 3	Business technologies	6
EC 4	Economic and mathematical modelling	6
EC 5	Economic analysis	6
EC 6	Engineering and computer graphics	6
EC 7	Intellectual Property	6
EC 8	Internet technologies in business	6
EC 9	Informational law	6
EC 10	Information wars	6
EC 11	Information systems and technologies in the economy	6
EC 12	History of Ukraine	6
EC 13	History of Ukrainian Culture	6
EC 14	Computer networks	6
EC 15	Computer data visualization systems	6
EC 16	Computer technologies of data processing	6
EC 17	Computer technologies of data processing and visualization	6
EC 18	Cultural heritage of Ukraine	6

Код н/д	Components of the educational program (educational subjects, course projects (works), practices, qualification exam, graduation thesis)	Number of credits
EC 19	Mathematical logic and theory of algorithms	6
EC 20	Mathematical methods of sociological data processing	6
EC 21	Data models and structures	6
EC 22	Data modelling under conditions of uncertainty	6
EC 23	Fuzzy models and networks	6
EC 24	Public speaking	6
EC 25	Organization of computer networks	6
EC 26	Fundamentals of cyber security	6
EC 27	Forecasting of socio-economic processes	6
EC 28	Psychology	6
EC 29	Religious studies	6
EC 30	World culture	6
EC 31	Number theory	6
EC 32	Web application development technologies	6
EC 33	Design and administration technology of databases and data warehouses	6
EC 34	Technology for creating distributed databases and knowledge	6
EC 35	Ukrainian language (by professional direction)	6
EC 36	Financial mathematics	6
EC 37	Functional and logical programming	6
EC 38	Cloud and GRID technologies	6
EC 39	Digital systems and technologies	6
EC 40	Numerical methods of programming	6
EC 41	Digital technologies in business	6
EC 42	Java tools for distributed data processing	6
The total amount of elective components:		**60**
Practical training		
Practical training 1		3
Practical training 2		6
Together		**9**
Certification		
Preparation for certification		3
Preparation of qualifying work and defense		6
Together		**9**
GENERAL VOLUME OF THE EDUCATIONAL PROGRAM		**240**

For all components of the educational program, the form of final control is an exam.

3.2.2. Structural and logical scheme of the educational program



3.3. Form of attestation of students

Attestation is carried out in the form of public defense of qualification work.
The qualification work should involve the solution of a complex specialized task of applied mathematics, characterized by complexity and/or uncertainty of conditions, using mathematical methods and/or software tools.
There can be no academic plagiarism, falsification, or plagiarism in the qualification work.
The qualifying work must be made public on the official website of the higher education institution or its division, in which the work was performed, or in the repository of the higher education institution.
Publication of qualification works containing information with limited access shall be carried out in accordance with the requirements of current legislation.

3.4. Matrix of correspondence of program competences compulsory components of the educational program

Components / Competences	CC 1	CC 2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9	CC 10	CC 11	CC 12	CC 13	CC 14	CC 14.1	CC 15	CC 16	CC 16.1	CC 17	CC 18	CC 19	CC 20
GC 01			+		+										+			+			+	
GC 02					+										+			+			+	
GC 03			+												+			+			+	
GC 04			+												+			+			+	
GC 05															+			+				+
GC 06	+	+	+	+						+	+					+				+		
GC 07									+				+		+			+				+
GC 08	+	+		+		+	+	+	+	+	+		+	+		+	+		+	+		+
GC 09			+		+							+									+	
GC 10					+		+	+	+				+			+	+	+		+		+
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GC 13			+		+																	
GC 14			+																			
GC 15			+																			
PC 01	+	+		+		+				+	+			+	+							
PC 02	+	+		+		+	+			+	+		+	+	+		+	+		+		
PC 03																+	+	+	+		+	+
PC 04		+					+		+				+			+	+	+	+	+		+
PC 05									+				+		+							+
PC 06							+	+	+				+	+		+	+	+	+	+	+	+
PC 07							+	+	+							+			+			+
PC 08								+	+				+			+				+	+	+
PC 09							+	+	+				+	+	+	+	+	+	+	+	+	+
PC 10															+			+	+		+	
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PC 12	+	+		+		+				+	+			+	+		+	+	+			+
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PC 14				+		+							+	+	+		+	+	+			
PC 15															+			+				
PC 16					+										+			+			+	
PC 17						+			+							+				+		+
PC 18							+	+					+			+	+	+				+

3.5. Matrix of correspondence of program competences elective components of the educational program

Components / Competences	EC 1	EC 2	EC 3	EC 4	EC 5	EC 6	EC 7	EC 8	EC 9	EC 10	EC 11	EC 12	EC 13	EC 14	EC 14.1	EC 15	EC 16	EC 16.1	EC 17	EC 18	EC 21	EC 22	EC 23	EC 24	EC 25	EC 26	BK 27	EC 28	EC 29	EC 30	EC 31	EC 32	EC 33	BK 34	EC 35	EC 36	EC 37	EC 38	EC 39	EC 40	EC 41	EC 42
GC 01	+		+	+	+	+	+	+		+	+			+	+	+	+		+	+	+	+	+		+	+	+				+	+	+	+		+	+	+	+	+	+	+
GC 02		+	+	+		+		+			+				+	+				+							+				+	+	+		+	+			+	+	+
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GC 05			+	+	+			+			+				+	+	+			+							+														
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GC 07	+		+	+				+	+	+	+			+	+	+	+			+							+									+	+		+		
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PC 05	+													+							+				+						+	+	+					+			+
PC 06				+	+			+		+	+				+	+	+								+	+	+				+	+	+		+	+	+	+	+	+	+
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PC 09				+		+		+			+				+	+	+					+	+				+									+		+			+	
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PC 18				+		+					+				+	+	+			+		+																+		+		+

3.6. Matrix of provision of program learning outcomes corresponding compulsory components of the educational program

Components Program learning results	CC 2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9	CC 10	CC 11	CC 12	CC 13	CC 14	CC 14.1	CC 15	CC 16	CC 16.1	CC 17	CC 18	CC 19	CC 20	CC 2
LR 01	+	+		+		+	+			+	+					+	+	+				
LR 02	+	+		+		+				+	+		+				+	+				
LR 03	+	+		+		+				+	+		+	+	+		+	+				
LR 04		+						+	+													
LR 05	+			+			+			+	+		+	+	+		+	+		+		
LR 06		+		+													+	+				
LR 07				+			+						+							+		+
LR 08								+						+	+		+	+				
LR 09													+				+	+				
LR 10							+							+	+							
LR 11								+	+				+						+			
LR 12												+		+	+		+	+			+	
LR 13							+							+	+		+	+				
LR 14			+												+			+			+	
LR 15															+			+			+	
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LR 18			+		+										+			+				
LR 19																	+	+				+
LR 20					+										+			+			+	
LR 21								+									+	+	+		+	+
LR 22								+								+	+	+		+		+

3.7. Matrix of provision of program learning results corresponding elective components of the educational program

Components / Program learning results	EC 1	EC 2	EC 3	EC 4	EC 5	EC 6	EC 7	EC 8	EC 9	EC 10	EC 11	EC 12	EC 13	EC 14	EC 14.1	EC 15	EC 16	EC 16.1	EC 17	EC 18	EC 21	EC 22	EC 23	EC 24	EC 25	EC 26	BK 27	EC 28	EC 29	EC 30	EC 31	EC 32	EC 33	BK 34	EC 35	EC 36	EC 37	EC 38	EC 39	EC 40	EC 41	EC 42
LR 01				+																+							+															
LR 02																			+	+		+								+										+		
LR 03				+																+		+					+									+						
LR 04	+																		+		+	+															+					
LR 05																+	+					+	+				+													+		
LR 06				+															+	+	+	+	+				+										+					
LR 07				+																+		+	+				+											+			+		
LR 08				+							+				+	+	+														+				+	+	+	+		+	+	
LR 09	+																		+													+	+					+		+		
LR 10				+	+															+		+					+									+				+		
LR 11						+								+	+	+	+														+	+	+			+			+		+
LR 12			+	+	+					+										+							+									+						
LR 13						+		+			+				+	+	+			+			+			+	+				+	+	+		+	+	+	+	+	+	+
LR 14			+											+														+								+	+	+	+	+	+	+
LR 15		+					+		+					+														+														
LR 16									+	+			+											+					+	+	+				+							
LR 17					+	+	+		+											+		+			+		+					+	+	+								
LR 18									+	+		+	+					+						+					+	+	+				+							
LR 19									+	+		+	+					+											+	+	+				+							
LR 20																								+					+						+							
LR 21				+	+			+												+							+									+					+	
LR 22																+	+	+					+								+	+	+									+