3. Educational program

Computer and mathematical modeling (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 modeling" in Subject Area 113 "Applied mathematics"

1 – General information	
Full name of IHE and structural unit	State University of Trade and Economics, Faculty of Information Technology, Department of Digital Economy and System Analysis
Degree of higher education and title of the qualification in the original language	Higher Education Degree- Bachelor's degree Subject area "Applied mathematics"
The official name of the educational program	"Computer and mathematical modeling"
Compliance with the standard of higher education of the Ministry of Education and Culture of Ukraine	Corresponds to the SHE MES of Ukraine
Type of diploma and scope of the educational program	Bachelor's 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 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 purpose 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: - to formulate, solve and generalize practical problems using fundamental and special applied methods of mathematical and computer sciences; - to solve the problems of mathematical modeling 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 with the help of specialized software tools; - information technologies for conducting computer modeling and computing experiments, intellectual data analysis. Tools and equipment: - computer, computer and social networks, specialized software tools.
Orientation of the educational program	Educational and professional. Emphasis on readiness to work and acquire knowledge and skills in information technologies, computer and mathematical modeling of complex processes, phenomena and systems of various nature, forecasting, optimization, system analysis and decision-making, intellectual analysis.
The main focus of the educational program	Special education in the field of computer and mathematical modeling, information technologies, ability to intellectual analysis, forecasting, decision-making in complex systems of various nature. *Keywords*: mathematics, applied mathematics, mathematics methods, computer modeling, mathematical modeling, information systems, information technologies, software tools, forecasting, optimization, decision-making, artificial intelligence, expert systems, machine learning, data, databases, system approach, system analysis.
Features of the program	In-depth study and knowledge of promising areas of applied mathematics, computer and mathematical modeling, forecasting, optimization, artificial intelligence decision-making at various stages of creation and application of information systems.
4 – Eligibility of graduates to employment and further education	
Suitability for employment	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 Modeling" educational program:

	<table><tr><td>Code KVED DC 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></table> Positions that a bachelor can hold under the "Computer and Mathematical Modeling" educational program: <table><tr><td>DC code 003:2010</td><td>The name of the profession</td></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>
Further education	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 under interdisciplinary programs close to applied mathematics.
5 – Teaching and assessment	
Teaching and assessment	Problem-oriented learning, self-learning, learning through practical training.
Assessment	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"»

6 – Program competencies	
Integral competence	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 modeling and is characterized by the complexity and uncertainty of conditions.
General competences	GC01. Ability to learn and master modern knowledge. GC02. Ability to apply knowledge in practical situations. GC03. Ability to generate new ideas (creativity). GC04. Ability to be critical and self-critical. GC05. Ability to conduct research at the appropriate level. GC06. Ability to abstract thinking, analysis and synthesis. GC07. Ability to search, process and analyze information from various sources. 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 an understanding of 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, modeling, 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. The ability to conduct mathematical and computer modeling, data analysis and processing, computational experiments, solving formalized problems with the help of 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. 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 a 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, computer mathematics systems and analytical platforms.*
7 – Program learning outcomes	
	PLO01. Demonstrate knowledge and understanding of basic concepts, principles, theories of applied mathematics and use them in practice. PLO02. 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. PLO03. 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. PLO04. Perform mathematical description, analysis and synthesis of discrete objects and systems, using the concepts and methods of discrete mathematics and the theory of algorithms. PLO05. 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. PLO06. 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. PLO07. Be able to conduct practical research and find solutions to incorrect problems. PLO08. Combine mathematical and computer modeling methods with informal procedures of expert analysis to find optimal solutions. PLO09. 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. PLO10. 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. PLO11. To be able to apply modern technologies of programming and software development, software implementation of numerical and symbolic algorithms. PLO12. Solve individual engineering problems and/or problems arising in at least one subject area: in sociology, economics, ecology, and medicine. PLO13. To use specialized software products and software systems of computer mathematics in practical work. PLO14. Demonstrate the ability to self-study and continue professional development. PLO15. To be able to organize one's own activities and obtain a result within a limited time. PLO16. Demonstrate the skills of interaction with other people, the ability to work in a team. PLO17. Be able to collect, process, analyze, systematize scientific and technical information, while avoiding academic dishonesty. PLO18. Communicate effectively about information, ideas, problems and solutions with specialists and society in general. PLO19. Collect and interpret relevant data and analyze complexities within their specialization to make judgments that reflect relevant social and ethical issues. PLO20. Demonstrate professional communication skills, including oral and written communication in Ukrainian and at

	least one of the official languages of the EU. *PLO21. To solve applied problems of mathematical modeling in the field of economics and business, to master the methods of modeling business processes.* *PLO22. Analyze and process big data, in particular, by modeling neural networks using machine learning technologies.*
8 – Resource support for program implementation	
Staff support	Specialists training bachelors under the "Computer and Mathematical Modeling" educational program must have specialized knowledge and professional skills in the field of computer and mathematical modeling, 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 is specialized computer laboratories with modern hardware and software resources, which ensure high-quality training of bachelors under the educational program "Computer and Mathematical Modeling".
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 provide for student training, the issuance of a double diploma, etc.
Education of foreign students of higher education	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 EP components

Code n/a	Components of the educational program (educational subjects, course projects (works), practices, qualification exam, graduation thesis)	Number of credits
Compulsory EP components		
CC 1	Linear algebra and analytic geometry	6
CC 2	Linear algebra and analytic geometry	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	KR on methods of optimization and decision-making	1
CC 15	Modeling of neural networks	9
CC 16	Applied mathematical modeling	12
CC 16.1	CW on applied mathematical modeling	
CC 17	Modeling 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
	Internship 1	3
	Internship 2	6
	Preparation for certification	3
	Preparation of qualifying work and defense	6
The total volume of mandatory components:		
Selective EP components		
SC 1	Algorithms and data structures	6
SC 2	Safety of life	6
SC 3	Business technologies	6
SC 4	Economic and mathematical modeling	6
SC 5	Economic analysis	6
SC 6	Engineering and computer graphics	6
SC 7	Intellectual Property	6
SC 8	Internet technologies in business	6
SC 9	Information law	6
SC 10	Information wars	6
SC 11	Information systems and technologies in the economy	6
SC 12	History of Ukraine	6
SC 13	History of Ukrainian Culture	6

Code n/a	Components of the educational program (educational subjects, course projects (works), practices, qualification exam, graduation thesis)	Number of credits
SC 14	Computer networks	6
SC 15	Computer data visualization systems	6
SC 16	Computer technologies of data processing	6
SC 17	Computer technologies of data processing and visualization	6
SC 18	Cultural heritage of Ukraine	6
SC 19	Mathematical logic and theory of algorithms	6
SC 20	Mathematical methods of sociological data processing	6
SC 21	Data models and structures	6
SC 22	Data modeling under conditions of uncertainty	6
SC 23	Fuzzy models and networks	6
SC 24	Public speaking	6
SC 25	Organization of computer networks	6
SC 26	Fundamentals of cyber security	6
SC 27	Forecasting of socio-economic processes	6
SC 28	Psychology	6
SC 29	Religious studies	6
SC 30	WoPLOd culture	6
SC 31	Number theory	6
SC 32	Web application development technologies	6
SC 33	Design and administration technology of databases and data warehouses	6
SC 34	Technology for creating distributed databases and knowledge	6
SC 35	Ukrainian language (by professional purpose)	6
SC 36	Financial mathematics	6
SC 37	Functional and logical programming	6
SC 38	Cloud and GRID technologies	6
SC 39	Digital systems and technologies	6
SC 40	Numerical methods of programming	6
SC 41	Digital technologies in business	6
SC 42	Java tools for distributed data processing	6
SC 43	Target communicative English language course	6
The total amount of sample components:		
GENERAL SCOPE OF THE EDUCATIONAL PROGRAM		

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 higher education students

Attestation is carried out in the form of public defense of qualification work.

The qualification work should involve solving 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 papers 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					+		+	+	+				+			+	+	+		+		+
GC 11					+																	+
GC 12															+			+			+	
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															+			+	+		+	
PC 11															+			+			+	
PC 12	+	+		+		+				+	+			+	+		+	+	+			+
PC 13				+		+								+	+		+	+	+			+
PC 14				+		+							+	+	+		+	+	+			
PC 15															+			+				
PC 16					+										+			+			+	
PC 17						+			+							+				+		+
PC 18							+	+					+			+	+	+				+

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

Components / Competences	EC 1	EC 2	EC 3	EC 4	EC 5EC 6	EC 7	EC 8	EC 9	EC 10	EC 11	EC 12	EC 13	EC 14	EC 15	EC 16	EC 17	EC 18	EC 19	EC 20	EC 21EC 22	EC 23	EC 24	EC 25	EC 26	EC 27	EC 28	EC 29	EC 30	EC 31	EC 32	EC 33	EC 34	EC 35	EC 36	EC 37	EC 38	EC 39	EC 40	EC 41	EC 42	EC 43
GC 01	+		+	+	+ +	+	+		+	+			+	+	+	+		+	+	+ +	+		+	+	+				+	+	+	+		+	+	+	+	+	+	+	+
GC 02		+	+	+	+		+			+				+	+				+						+					+	+	+		+			+	+	+	+	
GC 03			+	+	+		+			+				+	+	+			+						+					+									+	+	
GC 04		+							+		+											+				+																
GC 05			+	+	+		+			+				+	+	+			+						+																+
GC 06	+			+										+		+		+		+ +	+									+		+										
GC 07	+		+	+			+	+	+	+			+	+	+	+			+						+									+	+		+				
GC 08	+			+										+	+	+		+	+	+																					
GC 09						+																+				+							+								
GC 10				+	+		+			+			+	+	+	+			+				+	+	+					+	+	+			+	+	+	+	+	+	
GC 11					+			+	+															+																	
GC 12				+						+									+						+																
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		+				+		+																																	
PC 11		+																						+		+														
PC 12			+	+	+	+			+																																+
PC 13			+	+										+	+	+					+				+					+									+		
PC 14				+																+					+															
PC 15						+		+																																	
PC 16					+																	+											+							+
PC 17														+	+	+			+	+	+										+	+							+		

																			+																						
PC 18				+	+					+				+	+	+			+	+																	+		+		+	

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

Components / Program learning outcomes	CC1	CC2	OK3	CC 4	CC 5	CC 6	CC 7	CC 8	OK 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
PLO 01	+	+		+		+	+			+	+					+	+	+				
PLO 02	+	+		+		+				+	+		+				+	+				
PLO 03	+	+		+		+				+	+		+	+	+		+	+				
PLO 04		+						+	+													
PLO 05	+			+			+			+	+		+	+	+		+	+		+		
PLO 06		+		+													+	+				
PLO 07				+			+						+							+		+
PLO 08								+						+	+		+	+				
PLO 09													+				+	+				
PLO 10							+							+	+							
PLO 11								+	+				+						+			
PLO 12												+		+	+		+	+			+	
PLO 13							+							+	+		+	+				
PLO 14			+												+			+			+	
PLO 15															+			+			+	
PLO 16															+			+			+	
PLO 17															+			+				
PLO 18			+		+										+			+				
PLO 19																	+	+				+
PLO 20					+										+			+			+	
PLO 21								+									+	+	+		+	+
PLO 22								+								+	+	+		+		+

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

Components Program learning outcomes	EC 1	EC 2	EC 3	EC 4	EC 5EC 6	EC 7	EC 8	EC 9	EC 10	EC 11	EC 12	EC 13	EC 14	EC 15	EC 16	EC 17	EC 18	EC 19	EC 20	EC 21EC 22	EC 23	EC 24	EC 25	EC 26	EC 27	EC 28	EC 29	EC 30	EC 31	EC 32	EC 33	EC 34	EC 35	EC 36	EC 37	EC 38	EC 39	EC 40	EC 41	EC 42	EC 43
PLO01				+															+						+																
PLO 02																		+	+	+								+										+			
PLO 03				+															+	+					+									+							
PLO 04	+																	+		+ +														+							
PLO 05															+	+				+	+				+												+				
PLO 06				+														+	+	+ +	+				+										+						
PLO 07				+															+	+	+				+											+			+		
PLO 08				+						+				+	+	+														+				+	+	+	+		+	+	
PLO 09	+																	+													+	+				+		+			
PLO 10				+															+	+					+														+		
PLO 11					+								+	+	+	+													+	+	+			+			+		+	
PLO 12			+	+					+										+						+									+							
PLO 13					+		+			+				+	+	+			+		+			+	+				+	+	+		+	+	+	+	+	+	+	
PLO 14			+										+													+														
PLO 15		+				+		+					+													+														
PLO 16								+	+			+										+					+	+	+				+							
PLO 17					+ +	+		+											+	+			+			+				+	+	+								+
PLO 18					+			+	+		+	+					+					+					+	+	+				+							+
PLO 19								+	+		+	+					+										+	+	+				+							
PLO 20					+																	+					+						+							+
PLO 21				+			+												+						+									+				+		
PLO 22															+	+	+				+									+	+	+							+	