# 3. Educational program

## 3.1. Profile of the educational program in the specialty 122 "Computer Science" (specialization "Computer Science")

*The head of the working group (guarantor of the educational program) – Candidate of Technical Sciences, Associated Professor of the Department of Computer Science and Information Systems Demidov P.G.).*

| 1 –General information | |
|---|---|
| **Full name of the institution of higher education and structural subdivision** | Kyiv National University of Trade and Economics<br>Faculty of Information Technologies<br>Department of Computer Science and Information Systems |
| **Higher education degree and the name of the qualification in the language of the original** | Degree of higher education: bachelor<br>Specialty "Computer Science"<br>Specialisation "Computer Science" |
| **The official name of the educational program** | "Computer Science" |
| **Type of diploma and volume of educational program** | Bachelor's degree diploma, initial, 120 ECTS credits, term of study: 1 year and 10 months |
| **Availability of accreditation** | Certificate of accreditation of the educational program № 1903<br>Date of issuance of the certificate of accreditation of the educational program: 30.06.2021<br>Validity of the certificate of accreditation of the educational program: 01.07.2026 |
| **Cycle / Level** | NQF of Ukraine – 6 th level<br>FQ for EHEA – the first cycle<br>EQF for LLL – 6th level |
| **Prerequisites** | Full secondary education |
| **Language (s) of teaching** | Ukrainian |
| **The duration of the educational program** | The educational program "Computer Science" is valid until July 1, 2024. |
| **Internet address of the permanent placing of the educational program** | https:// knute.edu.ua |
| 2 –The purpose of the educational program | |

Training of highly qualified specialists who have mastered modern achievements in the field of computer science, have theoretical knowledge and are able to formulate and solve practical problems in complex systems of various nature using fundamental and applied methods of computer science and technology, which allows you to effectively solve problems in their professional activities. To provide high-quality education in the field of information technology, competitive in the labor market, to prepare students with a special interest in problems in the field of computer science, ready to study in the magistracy.

## 3 - Characteristics of the educational program

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|---|---|
| **Subject area (branch of knowledge, specialty, specialization** (if any)) | Branch of Knowledge 12 "Information Technologies" Specialty 122 "Computer Science" Educational and professional program: "Computer Science" |
| **Orientation of the educational program** | Educational-professional, fundamental, applied. The main emphasis of the educational program is on the training of specialists capable of solving complex problems related to modeling, design, development, software implementation and maintenance of computer systems and technologies, including on the basis of distributed server systems and using intelligent mechanisms of analysis and data processing. |
| **The main focus of the educational program and specialization** | General education in the field of information technologies, educational and professional program "Computer Science". *Keywords:* programming, algorithmization, modeling, computer data processing, computing systems and technologies, fuzzy models, Machine Learning, Big Data Processing, C # programming, C ++, Python, Java, computer networks, distributed server systems, distributed and parallel computing, fuzzy models and networks, computational intelligence methods. |
| **Peculiarities of the program** | The presence of a variable component of professionally oriented disciplines for computer science; practical training in institutions, enterprises and organizations. A feature of the educational program "Computer Science" is its content, taking into account modern trends in the field of information technology associated with advances in data mining, machine learning, artificial intelligence and aimed at the development and implementation of intelligent control systems. In the mandatory components, the peculiarity of the educational program is determined by the disciplines "Artificial Intelligence", "Machine Learning", "Fuzzy Models and Networks", "Multiple Programming Methods", associated with the study of intelligent mechanisms for the presentation and processing of data. The selective part contains components related to the development and implementation of automated computing systems: "Intelligent systems", "Data analysis technologies", "Computer data visualization systems", "Computer-aided design systems". In graduation qualification projects, the subject area is explored related to the development of automated computing systems in various areas of trade and economic activity, including on the basis of intelligent data processing mechanisms. |

## 4 – Suitability of graduates for employment and further education

| Suitability for employment | According to the National Classification of Economic Activities DK 009: 2010, as well as taking into account the requirements of the labor market, the types of professional activity of the graduate are:<br>- activities in the field of informatization - 72;<br>- providing consultations on informatization - 72.1;<br>- software development and provision of relevant consultations - 72.2<br>A specialist with a bachelor's degree in Computer Science in accordance with the National Classification of Occupations DK 003: 2010 may be employed in positions with the following professional title:<br>3121.2 Information Technology Specialist;<br>3121.2 Software development and testing specialist;<br>3121.2 Specialist in computer program development;<br>2131.2 System Administrator. |
|---|---|
| **Further training** | Continuation of education at the second (master's) level of higher education in master's educational programs in the field of knowledge "Information Technology" and in interdisciplinary programs |

| 5 –Teaching and evaluation ||
|---|---|
| **Teaching and training** | Lectures, practical classes, laboratory works, seminars, self-study with the use of textbooks, manuals and abstracts, consultations with teachers, preparation of the final qualification project.<br>Student-centric approach to learning. Credit-transfer system of training organization. Individual learning trajectory. Problem-oriented learning, self-learning (using the resources of the library and the Internet), learning through practical training. Distance learning using electronic resources in the Moodle system. |
| **Evaluation** | Current control, exams, defense of a final qualification work. Assessment is carried out in accordance with the "Regulations on the assessment of learning outcomes of students and graduate students", "Regulations on the organization of the educational process of students" |

| 6 – Program competencies ||
|---|---|
| **Integral competence** | The ability to solve complex specialized problems and practical problems in the field of computer science or in the learning process, which involves the application of theories and methods of *computer science* and is characterized by complexity and uncertainty of conditions. |
| **General competences (GC)** | GC 1. The ability to abstract thinking, analysis and synthesis.<br>GC 2. The ability to apply knowledge in practical situations.<br>GC 3. Knowledge and understanding of the subject area and understanding of professional activity.<br>GC 4. The ability to communicate in the state language both orally and in writing.<br>GC 5. The ability to communicate in a foreign language.<br>GC 6. The ability to learn and master modern knowledge.<br>GC 7. The ability to search, process and analyze information from various sources.<br>GC 8. The ability to generate new ideas (creativity).<br>GC 9. The ability to work in a team.<br>GC 10. The ability to be critical and self-critical.<br>GC 11. The ability to make informed decisions. |

| | GC 12. The ability to evaluate and ensure the quality of work performed. |
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| | GC 13. The ability to act on ethical considerations. |
| | GC 14. The ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine. |
| | GC 15. The ability to preserve and increase 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, techniques and technologies. active recreation and a healthy lifestyle. |
| **Special (professional, subject area) competences** | SC 1. The ability to mathematical formulation and research of continuous and discrete mathematical models, substantiation of the choice of methods and approaches for solving theoretical and applied problems in the field of computer science, analysis and interpretation |
| | SC2. The ability to detect statistical patterns of non-deterministic phenomena, the use of methods of computational intelligence, including statistical, neural network and fuzzy data processing, methods of machine learning and genetic programming, etc. |
| | SC3. The ability to think logically, build logical conclusions, use formal languages and models of algorithmic calculations, design, development and analysis of algorithms, evaluate their efficiency and complexity, solvability and unsolvability of algorithmic problems for adequate modeling of subject areas and creation of software and information systems . |
| | SC4. The ability to use modern methods of mathematical modeling of objects, processes and phenomena, to develop models and algorithms for numerical solution of mathematical modeling problems, to take into account the errors of approximate numerical solution of professional problems. |
| | SC5. The ability to provide a formalized description of operations research tasks in organizational, technical and socio-economic systems for different purposes, determine their optimal solutions, build models of optimal management taking into account changes in the economic situation, optimize management processes in different systems and hierarchies. |
| | SC6. The ability to systems thinking, application of systems analysis methodology to study complex problems of different nature, methods of formalization and solution of system problems that have conflicting goals, uncertainties and risks. |
| | SC 7. The ability to apply the theoretical and practical foundations of methodology and modeling technology to study the characteristics and behavior of complex objects and systems, to conduct computational experiments with processing and analysis of results. |
| | SC8. The ability to design and develop software using different programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of calculations, data structures and control mechanisms. |
| | SC9. The ability to implement a multi-tier computing model based on client-server architecture, including databases, knowledge and data |

| | warehouses, perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services.<br><br>SC10. The ability to apply methodologies, technologies and tools to manage the life cycle processes of information and software systems, information technology products and services in accordance with customer requirements.<br><br>SC 11. The ability to data mining based on methods of computational intelligence, including large and poorly structured data, their prompt processing and visualization of analysis results in the process of solving applied problems.<br><br>SC 12. The ability to ensure the organization of computational processes in information systems for various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.<br><br>SC 13. The ability to develop network software based on different topologies of structured cabling systems, using computer systems and data networks and analyzing the quality of computer networks.<br><br> SC 14. The ability to apply methods and means of support information security, develop and operate special software for protection of information resources of critical information infrastructure.<br><br>SC 15. The ability to analyze and functional modeling of business processes, construction and practical application of functional models of organizational, economic and production-technical systems, methods of risk assessment of their design.<br><br>SC 16. The ability to implement high-performance computing based on cloud services and technologies, parallel and distributed computing in the development and operation of distributed parallel information processing systems. |
|---|---|
| **7 –Program outcomes of the training** ||
| | POT 1. To apply knowledge of the basic forms and laws of abstract-logical thinking, the basics of the methodology of scientific knowledge, forms and methods of extraction, analysis, processing and synthesis of information in the subject area of computer science.<br><br>POT 2. To use a modern mathematical apparatus of continuous and discrete analysis, linear algebra, analytical geometry, in professional activities to solve problems of theoretical and applied nature in the design and implementation of information objects.<br><br>POT 3. To use knowledge of the laws of random phenomena, their properties and operations on them, models of random processes and modern software environments to solve problems of statistical data processing and construction of predictive models.<br><br>POT 4 To use methods of computational intelligence, machine learning, neural network and fuzzy data processing, genetic and evolutionary programming to solve problems of recognition, prediction, classification, identification of control objects, etc.<br><br>POT 5. To design, develop and analyze algorithms for solving computational and logical problems, evaluate the efficiency and complexity of algorithms based on the use of formal models of algorithms and computational functions. |

| | POT 6. To use methods of numerical differentiation and integration of functions, solution of usual differential and integral equations, features of numerical methods and possibilities of their adaptation to engineering problems, to have skills of program realization of numerical methods. |
| --- | --- |

POT 7. Tio understand the principles of modeling organizational and technical systems and operations; use methods of operations research, solving one- and multi-criteria optimization problems of linear, integer, nonlinear, stochastic programming.

POT 8. To use the methodology of system analysis of objects, processes and systems for the tasks of analysis, forecasting, management and design of dynamic processes in macroeconomic, technical, technological and financial objects.

POT 9. To develop software models of subject environments, choose a programming paradigm from the standpoint of convenience and quality of application for the implementation of methods and algorithms for solving problems in the field of computer science.

POT 10. To use tools for developing client-server applications, design conceptual, logical and physical models of databases, develop and optimize queries to them, create distributed databases, repositories and showcases of databases, knowledge bases, including cloud services, using web languages -programming.

POT 11 To have the skills to manage the life cycle of software, products and services of information technology in accordance with the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, terms of reference, business plan, agreement, contract, contract).

POT 12. To apply methods and algorithms of computational intelligence and data mining in the problems of classification, forecasting, cluster analysis, search for associative rules using software tools to support multidimensional data analysis based on technologies DataMining, TextMining, WebMining.

POT 13. Know the system programming languages and methods of program development that interact with the components of computer systems, know network technologies, computer network architectures, have practical skills in computer network administration technology and their software.

POT 14.To know the languages of system programming and methods of program development that interact with the components of computer systems, know network technologies, computer network architectures, have practical skills in the technology of computer network administration and their software.

POT 15. To apply knowledge of methodology and CASE-tools for designing complex systems, methods of structural analysis of systems, object-oriented design methodology in the development and study of functional models of organizational-economic and production-technical systems.

POT 16. To understand the concept of information security, the principles of secure software design, ensure the security of computer networks in conditions of incomplete and uncertain source data.

POT 17. To perform parallel and distributed calculations, apply numerical methods and algorithms for parallel structures, parallel

| | programming languages in the development and operation of parallel and distributed software. |
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| **8 – Resource support for the implementation of the program** | |
| **Personnel support** | The implementation of the educational program is provided by teachers who have the degrees of candidate and doctor of sciences. The participation of foreign specialists and practical specialists in teaching disciplines of the training cycle is possible. |
| **Material and technical support** | The basis of material and technical support includes specialized computer laboratories with modern hardware and software resources that provide quality training for junior bachelors in the educational program "Computer Science". Students are fully provided with material resources for teaching and research. At their disposal are:<br>- more than 30 thousand m2 of educational buildings;<br>- dormitories;<br>- 470 seats in the reading rooms of KNUTE, including in the multimedia library of KNUTE, where the access to scientometric databases SCOPUS, Web of Science is provided;<br>- 2000 PC workstations with Internet access + WiFi. All computer equipment is provided with basic software, special software is installed on the computers in the laboratories of the departments, necessary for classes and tasks by students;<br>- Moodle distance learning system, which houses 966 educational courses;<br>- electronic platform for student communication based on Microsoft Office 365, etc. |
| **Information and educational and methodical support** | Full provision of educational and methodical complexes of disciplines and other types of educational and methodical materials. Documents governing the procedures for admission and study at KNTEU are on the official website. Open access of higher education applicants to information and educational resources through information systems for educational process management and other web-services:<br>-system of distance learning MOODLE (966 educational courses, provides independent and individual training, control),<br>- free access to the Internet and e-mail;<br>- information systems "Dean's Office", "Load-schedule", management of WEB-resources KNTEU;<br>- library fund management system - almost 1.5 million items of educational and scientific literature in the library of KNTEU;<br>- electronic document management system "OPTiMA - WorkFlow";<br>- corporate information environment in the form of a "personal account" of the user of the KNTEU web portal.<br>Ensuring publicity of information about educational programs, degrees of higher education and qualification: implementation of information policy of KNTEU education ";<br>Ensuring an effective system of prevention and detection of academic plagiarism in the scientific works of KNTEU employees, applicants for higher education (checking for plagiarism of all final qualifications, publications, publication of dissertation research on the official website of KNTEU), compliance with the Code of Ethics of Ukrainian scientists. |

| | 9 –Academic mobility | |
|---|---|---|
| **National credit mobility** | National credit mobility is carried out in accordance with the concluded agreements on academic mobility. | |
| **International Credit Mobility** | International credit mobility is realized within the framework of cooperation agreements between KNUTE and higher education institutions of France, Great Britain, Poland, Germany, within the framework of which partnership exchange and training is carried out. Training in the field of KA1 with obtaining loans at universities of Erasmus + countries. | |
| **Teaching foreign applicants for higher education** | Foreign applicants for higher education are guaranteed all rights and freedoms, in accordance with current legislation of Ukraine and the Charter of the University. Training of foreign applicants for higher education is carried out on general terms with additional language training. | |

## 3.1.1 The list of components of the educational program (EP)

| Code n / a | Components of the educational program (academic disciplines, course projects (works), practices, qualification exam) | Number of credits |
|---|---|---|
| 1 | 2 | 3 |
| **Compulsory components of the EP** | | |
| CC 1. | Introduction to computer science | 6 |
| CC 2. | Discrete Math | 6 |
| CC 3. | Physics | 6 |
| CC 4. | Mathematical analysis | 6 |
| CC 5. | Foreign language for professional orientation | 24 |
| OK 6. | Probability theory and mathematical statistics | 6 |
| CC 7. | Computer technologies of data processing and visualization | 6 |
| CC 8. | Algorithmization and programming | 6 |
| CC 9. | Theory of algorithms | 6 |
| CC 10. | Optimization methods and models | 6 |
| CC 11. | Numerical programming methods | 6 |
| CC 12. | Design of information systems | |
| CC 12.1 | Control work on information systems design | 6 |
| CC 13. | System programming | 6 |
| CC 14. | Application programming tools | 6 |
| CC 15. | Systems theory and systems analysis | 6 |
| CC 16. | Technologies of distributed systems and parallel computing | 6 |
| CC 17. | Simulation modeling | 6 |
| CC 17.1 | Control work for simulation modeling | |
| CC 18. | Artificial Intelligence | 6 |
| CC 19. | Raid arrays and distributed server systems | 6 |
| CC 20. | Java Script Programming | 6 |
| CC 21. | Machine learning | 6 |
| CC 22. | Corporate network administration systems | 9 |
| CC 23. | Fuzzy models and networks | 6 |

| | | |
|---|---|---|
| **Total volume of compulsory components:** | | **159** |
| **Selective components of the EP** | | |
| SC 1. | Administration of server systems | 6 |
| SC 2. | Architecture of computer systems | 6 |
| SC 3. | Life safety | 6 |
| SC 4. | Vector and tensor analysis | 6 |
| SC 5. | Differential equations | 6 |
| SC 6. | Economic theory | 6 |
| SC 7. | E-commerce | 6 |
| SC 8. | Electrical engineering | 6 |
| SC 9. | Engineering and computer graphics | 6 |
| SC 10. | Information systems and technologies in economics | 6 |
| SC 11. | History of Ukrainian Culture | 6 |
| SC 12. | Computer data visualization systems | 6 |
| SC 13. | Linear algebra and analytic geometry | 6 |
| SC 14. | Logic | 6 |
| SC 15. | Mathematical logic | 6 |
| SC 16. | Management | 6 |
| SC 17. | Organization of databases and knowledge | 6 |
| SC 18. | Science of law | 6 |
| SC 19. | Psychology | 6 |
| SC 20. | Automated design systems | 6 |
| SC 21. | Sociology | 6 |
| SC 22. | Mobile application development technology | 6 |
| SC 23. | Information theory and coding | 6 |
| SC 24. | Data analysis technologies | 6 |
| SC 25. | Technologies for creating software products | 6 |
| SC 26. | Java Technology | 6 |
| SC 27. | Philosophy | 6 |
| SC 28. | Digital systems and technologies | 6 |
| SC 29. | Web-технології Web technologies | 6 |
| **The total amount of selective components:** | | **60** |
| **Practical training** | | |
| Practical training 1 | | 6 |
| Practical training 2 | | 6 |
| **Total** | | 12 |
| **Attestation** | | |
| Preparation for attestation | | 3 |
| Preparation of final qualifying work and defense | | 6 |
| **Total** | | 9 |
| **АМИ TOTAL VOLUME OF EDUCATIONAL PROGRAM** | | **240** |

An exam is the form of final control for all components of the educational program.
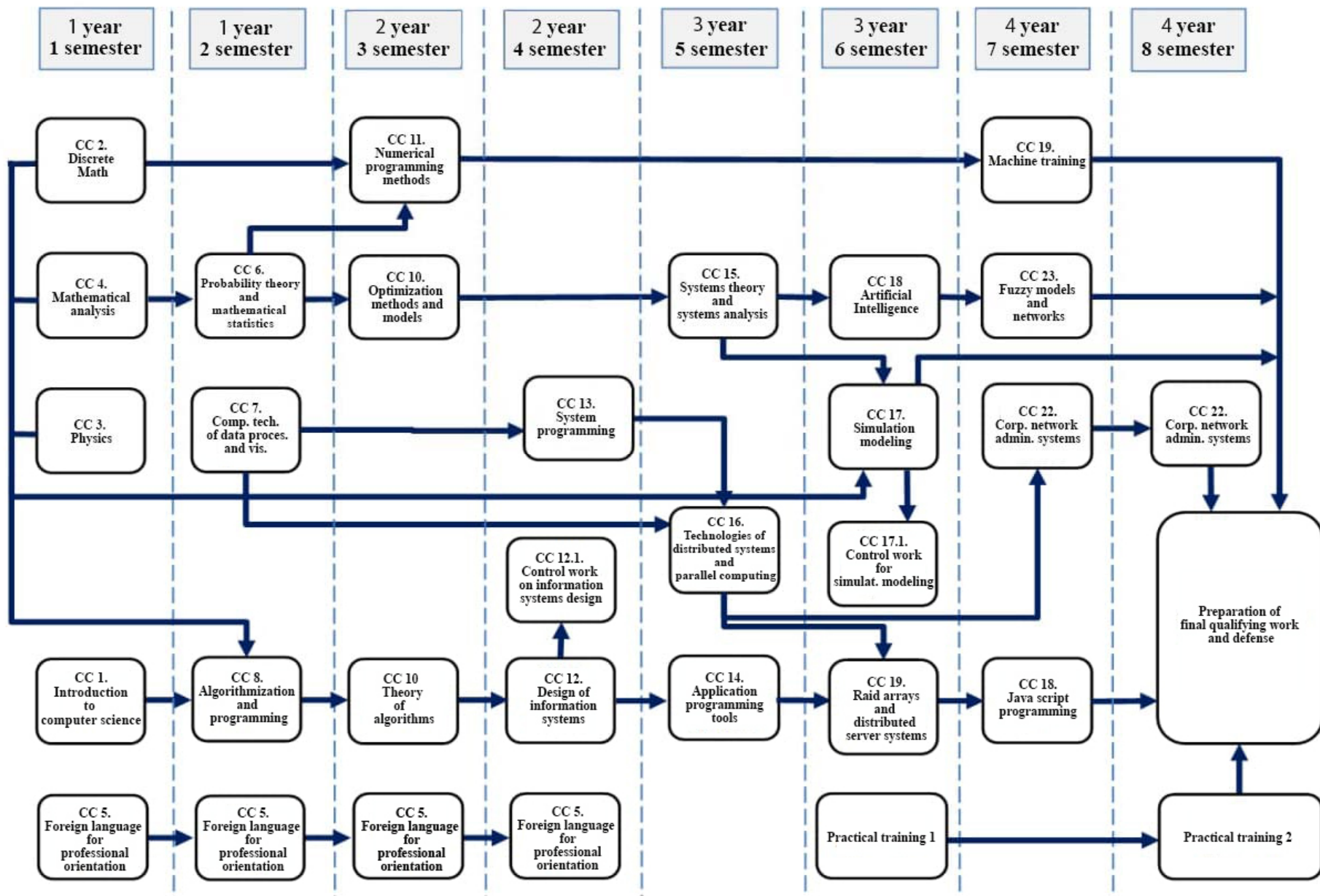
### 3.1.2. Form of attestation of applicants for higher education

Attestation is carried out in the form of defense of the final qualifying work.

The final qualification work should provide for a theoretical, systemic or experimental study of a complex specialized problem or practical problem in the field of computer science, which is characterized by the complexity and uncertainty of conditions and requires the use of theories and methods of information technology.

The final qualifying work should not contain academic plagiarism, falsification and fabrication.

The final qualifying work must be published on the official website of the institution of higher education or its structural unit or in the repository of the institution of higher education.

### 3.1.3. Matrix of compliance of program competencies to the 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 12.1 | CC 13 | CC 14 | CC 15 | CC 16 | CC 17 | CC 17.1 | CC 18 | CC 19 | CC 20 | CC 21 | CC 22 | CC 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GC 1 |  |  | • | • |  |  |  |  |  | • |  |  |  |  |  | • |  | • |  |  |  |  |  |  |  |
| GC 2 | • | • | • |  |  |  | • | • | • | • | • | • | • | • | • |  | • | • | • |  | • | • |  | • | • |
| GC 3 | • |  |  |  |  |  | • | • |  |  |  | • | • | • |  |  | • | • | • | • | • | • | • | • | • |
| GC 4 | • |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC 5 |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC 6 |  |  | • | • |  | • | • |  |  | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  | • |
| GC 7 |  |  |  |  |  | • | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  | • |  |
| GC 8 |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  | • |  |  |  |  | • |
| GC 9 |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |
| GC 10 |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |
| GC 11 |  |  | • |  |  | • |  |  |  | • |  |  |  |  |  | • |  | • |  |  |  |  |  |  |  |
| GC 12 |  |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  | • |  |
| GC 13 | • |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  |  |  | • |  |  |  |  |  |  |
| GC 14 | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC 15 | • |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SC 1 |  | • | • | • |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SC 2 |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  | • |  | • |
| SC 3 |  |  |  |  |  |  | • | • |  |  |  | • | • |  |  |  |  | • |  | • |  |  |  |  |  |
| SC 4 |  |  | • |  |  |  | • | • | • | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |
| SC 5 |  | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  | • |  | • |  |  |  |  |  |  |
| SC 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  | • |
| SC 7 |  |  | • |  |  |  |  |  |  | • | • |  |  |  |  |  |  | • | • |  |  |  |  |  |  |
| SC 8 | • |  |  |  |  |  | • | • |  |  |  |  |  | • | • |  |  |  |  | • |  | • |  |  | • |
| SC 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  | • |  |  | • |  |
| SC 10 |  |  |  |  |  |  |  |  |  |  |  | • | • | • | • |  |  |  |  |  |  | • |  |  |  |
| SC 11 |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  | • |  | • |
| SC 12 | • |  |  |  |  | • |  |  |  |  |  | • | • | • | • |  | • |  |  |  |  | • |  |  |  |
| SC 13 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  | • | • |  | • |  |
| SC 14 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  | • |  |  | • |  |
| SC 15 |  |  |  |  |  |  |  |  |  |  |  | • | • |  |  |  |  | • | • |  |  |  |  |  | • |
| SC 16 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  | • |  |  |  |  |

### 3.1.4. Matrix of correspondence of program competences to selective components of the educational program

| Components / Competences | SC 1 | SC 2 | SC 3 | SC 4 | SC 5 | SC 6 | SC 7 | SC 8 | SC 9 | SC 10 | SC 11 | SC 12 | SC 13 | SC 14 | SC 15 | SC 16 | SC 17 | SC 18 | SC 19 | SC 20 | SC 21 | SC 22 | SC 23 | SC 24 | SC 25 | SC 26 | SC 27 | SC 28 | SC 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GC 1 | | | | | | | | | | | | | | | | | | | | | | | | • | | | • | | |
| GC 2 | | | | • | | • | | | • | | • | | | | | | | | | | | | | | | | | | |
| GC 3 | | | | | | | • | | • | | • | | | | | | • | | | | | | | | | | | | |
| GC 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GC 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GC 6 | • | | | | • | | | | | | | | | | | | | | | | | | | | | | | | |
| GC 7 | | | | | | | • | | | | | | | | | | | | | | | | | • | | | | | |
| GC 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | • | | |
| GC 9 | | | | | | | | | | | | | | | | • | | • | | | | | | | | | | | |
| GC 10 | | | • | | | | | | | | | | | | | | | • | | | | | | | | | • | | |
| GC 11 | | | | | | | | | | | | | | • | | • | | | | | | | | | | | | | |
| GC 12 | | | | | • | | | | • | | | | | | | | | | | | | | | | | | | | |
| GC 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GC 14 | | | • | | | | | | | | • | | | | | | • | | | • | | | | | | | | | |
| GC 15 | | | • | | | | • | | | | • | | | | | | | | | | | | | | | | | | |
| SC 1 | | | | • | | | | | | | | • | | | | | | | | | | | | • | | | | | |
| SC 2 | | | • | | | | | | | | | | | | | | | | | | | | | • | | | | | |
| SC 3 | | | | | | | | | | | | | • | • | | | | | | | | | | | | • | | | |
| SC 4 | | | | • | | | | | | | | | | | | | | | | | | | | | | | | | |
| SC 5 | | | | | | | | | | | | | | | • | | | | | | | | | | | | | | |
| SC 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | • | |
| SC 7 | | | | | | | | | | | | | | | | | | | | | | | | • | | | | • | |
| SC 8 | | | | | | | | | | | | | | | | | | | | | | | | | • | • | | | |
| SC 9 | • | | | | | | | | | | | | | | | | • | | | | | • | • | | | | | | |
| SC 10 | • | | | | | | | | | • | | | | | | | | | | | | | | | | | | | |
| SC 11 | | | | | | | | | | | | • | | | | | | | | | | | | • | | | | | |
| SC 12 | • | | | | | | | • | | | | | | | | | | | | | • | | | | | • | | | |
| SC 13 | | | | | | | | • | • | | | | | | | | | | | | | • | • | | | • | | | • |
| SC 14 | • | • | | | | | | | | | | | | | | | | | | | | | | • | | | | | |
| SC 15 | | | | | | | | | | | | | | | | | | | | | • | | | | | | | | |

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| SC 16 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|---|--|--|--|--|--|

# 3.1.5. Matrix for providing program training outcomes with relevant compulsory components of the educational program

| Components / Program learning outcomes | 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 12.1 | CC 13 | CC 14 | CC 15 | CC 16 | CC 17 | CC 17.1 | CC 18 | CC 19 | CC 20 | CC 21 | CC 22 | CC 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO 1 | • |  | • | • |  |  | • |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |
| PO 2 |  | • | • | • |  |  |  |  |  | • |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 3 |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  | • | • | • |  |  |  |  |  |
| PO 4 |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  | • |  | • |  |  | • |
| PO 5 |  |  |  |  |  |  |  | • | • |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |
| PO 6 |  | • |  | • |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 7 |  | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  | • | • |  |  |  |  |  |  |
| PO 8 |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  | • | • | • |  |  |  |  |  |  |
| PO 9 |  |  |  |  |  |  |  | • | • |  |  |  |  | • | • |  |  |  |  |  |  | • |  |  |  |
| PO 10 |  |  |  |  |  |  |  |  |  |  |  | • | • |  | • |  | • |  |  |  | • |  |  | • |  |
| PO 11 |  |  |  |  | • |  |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 12 |  |  |  |  | • |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  | • |  |  | • | • |
| PO 13 |  |  |  |  | • |  |  | • | • |  |  |  |  |  | • |  |  |  |  |  | • | • |  | • |  |
| PO 14 |  |  |  |  | • |  |  | • | • |  |  |  |  |  | • |  |  |  |  |  | • | • |  | • |  |
| PO 15 |  |  |  |  |  |  |  |  |  |  |  | • | • |  | • |  |  | • | • |  |  |  |  |  |  |
| PO 16 | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  | • |  |
| PO 17 |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  | • |  |  |  | • |  |  |  |  |

# 3.1.6. Matrix for providing program training outcomes with relevant selective components of the educational program

| Components / Program training outcomes | SC 1 | SC 2 | SC 3 | SC 4 | SC 5 | SC 6 | SC 7 | SC 8 | SC 9 | SC 10 | SC 11 | SC 12 | SC 13 | SC 14 | SC 15 | SC 16 | SC 17 | SC 18 | SC 19 | SC 20 | SC 21 | SC 22 | SC 23 | SC 24 | SC 25 | SC 26 | SC 27 | SC 28 | SC 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  |  |  | • |  |  |
| PO 2 |  |  |  | • | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |
| PO 4 |  |  |  | • | • |  |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |
| PO 5 |  |  |  |  |  |  |  |  | • |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 6 |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 8 |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 9 |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  | • | • |  |  |  |
| PO 10 | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  | • | • |  | • | • |  |  |  |  |  | • |
| PO 11 |  |  | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | • |  |
| PO 12 |  |  |  | • | • |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |
| PO 13 | • |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  | • | • |  |  |  |
| PO 14 | • |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  | • | • |  | • | • |  |  |  |
| PO 15 |  |  |  |  |  |  |  |  | • | • |  |  |  |  |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |
| PO 16 | • | • |  |  |  |  |  | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PO 17 | • |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |