

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**NATIONAL TECHNICAL UNIVERSITY  
«KHARKIV POLYTECHNIC INSTITUTE»**

**APPROVED**

Rector of NTU «KhPI»

\_\_\_\_\_ Yevgen SOKOL

«\_\_\_\_\_» \_\_\_\_\_ 2021.

**PROFESSIONALLY-ORIENTED EDUCATIONAL  
PROGRAMME**

**«Computer Science and Intelligent Systems»**

**The first (Bachelor's) level of higher education**

Specialty **122 – Computer Science**

Field of Knowledge **12 Information Technologies**

Qualification **Bachelor of Computer Science**

**APPROVED**

**BY THE ACADEMIC COUNCIL OF NTU «KhPI»**

Head of the Academic Council

\_\_\_\_\_ Leonid TOVAZHNYANSKY

Protocol № 4 of «30» April 2021.

NTU «KhPI»

Kharkiv 2021

**APPROVAL PAGE**  
**of the professionally-oriented educational programme**

Level of higher education	First (Bachelor's)
Field of knowledge	12 Information Technologies
Specialty	122 «Computer Science»
Educational programme	
Qualification	Bachelor of Computer Science

**APPROVED**

«Computer Science» specialty work group  
Guarantor of «Computer Science and Intelligent  
Systems» Educational Programme  
\_\_\_\_\_ Vasyl LYSYTSKYI

«\_\_\_»\_\_\_\_\_ 2021.

**RECOMMENDED**

Methodological Council of NTU "KhPI"  
Deputy Head of the Methodological  
Council  
\_\_\_\_\_ Ruslan MYGUSHCHENKO

«\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Head of the Department of Software Engineering  
and Management Information Technologies  
\_\_\_\_\_ Mykhailo GODLEVSKYI

«\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Dean of the Faculty of Computer Science  
and Software Engineering  
\_\_\_\_\_ Maxim MALKO

«\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Employer  
«TELESENS IT» LLP  
Director

\_\_\_\_\_ Olesia ULIANOVA

«\_\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Employer  
«ACADEMY SMART» LLP

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«\_\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Employer  
«NIX SOLUTIONS LTD» LLP  
Director

\_\_\_\_\_ Viktor SHALNIEV

«\_\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Reviewer  
Head of the Department of Computer  
Science and Information Technologies,  
National Aerospace University  
«Kharkov Aviation Institute»

\_\_\_\_\_ Oleg FEDOROVYCH

«\_\_\_\_»\_\_\_\_\_ 2021.

**AGREED**

Chairman of the student government  
Student of group \_\_\_\_\_

\_\_\_\_\_

«\_\_\_\_»\_\_\_\_\_ 2021.

## **PREFACE**

The educational program for training bachelors in specialty 122 – “Computer Science” meets the Standard of Higher Education of the first (Bachelor’s) level, which was approved by the order of the Ministry of Education and Science of Ukraine since 10.07.2019 № 962 and enacted since 2019/2020 academic year.

Developed by the specialty work group of the Department of Software Engineering and Management Information Technologies of the Faculty of Computer Science and Software Engineering of the National Technical University “Kharkiv Polytechnic Institute” consisting of:

### **Head of the specialty work group (EP Guarantor)**

Lysytskyi Vasyl Lavrentiiiovych, Candidate of Technical Sciences, Associate Professor

Associate Professor of the Department of Software Engineering and Management Information Technologies

### **Members of the specialty work group:**

Moskalenko Valentyna Volodymyrivna, Doctor of Technical Sciences, Associate Professor

Professor of the Department of Software Engineering and Management Information Technologies

Cherednichenko Olga Yuriivna, Candidate of Technical Sciences, Associate Professor

Associate Professor of the Department of Software Engineering and Management Information Technologies

### **Reviewers:**

Fedorovych Oleg Yevgenovych, Doctor of Technical Sciences, Professor, Head of the Department of Computer Science and Information Technologies, National Aerospace University «Kharkov Aviation Institute»

### **Reviews of external stakeholders:**

1. «ACADEMY SMART» LLP.
2. «TELESENS IT» LLP.
3. «NIX SOLUTIONS LTD» LLP.

# 1. Profile of the specialty educational programme

## 122 – Computer Science

<b>1 – General information</b>	
<b>Full name of the higher education institution and structural subdivision</b>	National Technical University “Kharkiv Polytechnic Institute”, Faculty of Computer Science and Software Engineering, Department of Software Engineering and Management Information Technologies
<b>Higher education degree and qualification full name in English</b>	Higher education degree: Bachelor Educational qualification: Bachelor of Computer Science Diploma Qualification: Bachelor of Computer Science
<b>The official name of the educational programme</b>	Computer Science and Intelligent Systems
<b>Type of diploma and duration of the educational programme</b>	Bachelor diploma, single, 240 ECTS credits, 4 years
<b>Availability of accreditation</b>	Certificate RD-IV № 2158945 of 12.08.2013, valid until July 1, 2023
<b>Cycle/level</b>	FQ-EHEA – first cycle, EQF LLL – level 6, NFR of Ukraine – level 6
<b>Prerequisites</b>	Completed secondary education, junior bachelor degree in related (or other specialties) in accordance with the conditions and rules of admission
<b>Language(s) of teaching</b>	Ukrainian, English
<b>The validity of the educational programme</b>	Updated annually
<b>Internet address of educational programme description</b>	<a href="https://web.kpi.kharkov.ua/asu/specialnosti/">https://web.kpi.kharkov.ua/asu/specialnosti/</a>
<b>2 – The purpose of the educational programme</b>	
<p>Training of specialists competent to conduct theoretical and experimental research in the field of computer science and intelligent management systems; apply mathematical methods and algorithmic principles in modeling, design, development, and maintenance of information management technologies; develop, implement and maintain intelligent systems for analysis and data processing of organizational, technical, natural and socio-economic systems.</p> <p>Goal achievement is based on the principles of continuity and individualization of learning, fundamentality, and integrity of knowledge, practical orientation and awareness of the purpose of acquired competencies, the symbiosis of scientific and systemic approaches, and more.</p>	
<b>3 – Characteristics of the educational programme</b>	
<b>Subject area (field of knowledge, speciality, specialization)</b>	Field of knowledge: 12 – Information Technologies Specialty: 122 – Computer Science

<b>Direction of the educational programme</b>	Professional training of specialists in the field of computer science and intelligent systems.
<b>The main focus of the educational programme and specialization</b>	Special training in the field of information technology in the specialty “122 – Computer Science”. In-depth study of computer mathematics and intelligent systems, information technology and foreign language for IT professionals. Keywords: computer science, intelligent management system, information technology.
<b>Features of the programme</b>	Focus on partnership with domestic and foreign educational and scientific institutions, the private sector, scientists and practitioners, participation in international programs. Training is carried out with the use of innovative pedagogical technologies, in particular – a project approach in the training laboratory “Innovation Campus” of SE&MIT Department of NTU “KhPI”, where students have the opportunity to master practical skills of software development and testing, as well as develop soft skills needed by modern specialists in computer science and intelligent systems to work in IT companies and IT departments. Internships in IT companies and student participation in real projects. Opportunity to study in English.
<b>4 – Eligibility of graduates for employment and further education</b>	
<b>Eligibility for employment</b>	Graduates can work in professions according to the State Job Classification SJC 003:2010: 2131 Professionals in the field of computing systems 2131.2 Developers of computing systems 2132 Professionals in the field of programming 2132.2 Computer software developers 2433.2 Professionals in the field of information and information analysts 2139 Professionals in other computing areas (computerization) 2139.2 Professionals in other computing areas 2447 Professionals in project and software management field 2447.2 Project and software management professionals
<b>Further education</b>	Opportunity to continue studying at the second (Master’s) level of higher education. Acquisition of additional qualifications in the system of postgraduate education.
<b>5 – Teaching and assessment</b>	
<b>Teaching and studying</b>	Student-oriented training, self-study, learning through project practice. The learning process involves the use of such learning technologies as lectures, laboratory classes, practice classes,

	work in small groups, seminars, discussions, brainstorming, presentations that develop communication and leadership skills, independent work with literary sources; mixed forms of learning using distance platforms, project approach and “challenge-based learning” in the training laboratory “Innovation Campus” of SEMIT Department of NTU “KhPI”.
<b>Assessment</b>	<p>Monitoring of students’ knowledge and skills is carried out in the form of continuous and final control.</p> <p>Continuous control – oral and written questioning, assessment of work in small groups, testing, defense of group and individual research tasks and projects.</p> <p>Final control – oral and written exams, tests taking into account the accumulated points of current control, defense of reports on practices, defense of term papers.</p> <p>State certification – preparation and public defense (presentation) of the final qualifying work.</p> <p>Assessment is carried out according to the National Scale (“excellent”, “good”, “satisfactory”, “unsatisfactory”), 100-point scale, and ECTS scale (A, B, C, D, E, FX, F).</p>
<b>6 – Programme competencies</b>	
<b>Integral competence</b>	Ability to solve complex specialized problems and practical problems in the field of computer science and intelligent management systems or in the learning process, which involves the application of theories and methods of information technology and is characterized by complexity and uncertainty of conditions.
<b>General competencies (GC)</b>	<p>GC1. Ability to abstract thinking, analysis and synthesis.</p> <p>GC2. Ability to apply knowledge in practical situations.</p> <p>GC3. Knowledge and understanding of the subject area and understanding of professional activity.</p> <p>GC4. Ability to communicate in the official language both orally and in writing.</p> <p>GC5. Ability to communicate in foreign language.</p> <p>GC6. Ability to learn and master modern knowledge.</p> <p>GC7. Ability to search, process and analyze information from various sources.</p> <p>GC8. Ability to generate new ideas (creativity).</p> <p>GC9. Ability to work in team.</p> <p>GC10. The ability to be critical and self-critical.</p> <p>GC11. Ability to make justified decisions.</p> <p>GC12. Ability to evaluate and ensure the quality of performed work.</p> <p>GC13. Ability to act being based on ethical considerations.</p> <p>GC14. Ability to implement personal rights and responsibilities as a member of society, to realize the values of civil (free</p>

	<p>democratic) society and the need for its sustainable development, the rule of law, human and civil rights, and freedoms in Ukraine.</p> <p>GC15. 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, techniques and technologies, active recreation and leading a healthy lifestyle.</p>
<p><b>Professional competencies of the speciality (PC)</b></p>	<p>PC1. Ability to mathematically formulate and study continuous and discrete mathematical models, justify the choice of methods and approaches for solving theoretical and applied problems in the field of computer science, analysis and interpretation.</p> <p>PC2. Ability to detect statistical patterns of non-deterministic phenomena, the use of computational intelligence methods, including statistical, neural network and fuzzy data processing, machine learning and genetic programming methods, etc.</p> <p>PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic calculations, design, develop and analyze algorithms, evaluate their efficiency and complexity, solvability and unsolvability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems.</p> <p>PC4. Ability to use modern methods of mathematical modelling of objects, processes, and phenomena, to develop models and algorithms for the numerical solution of mathematical modelling problems, to take into account the errors of approximate numerical solution of professional problems.</p> <p>PC5. Ability to provide a formalized description of operations research tasks in organizational, technical, and socio-economic systems for different purposes, to determine their optimal solutions, to build optimal management models taking into account changes in the economic situation, to optimize management processes in different systems and hierarchies.</p> <p>PC6. Ability to think systematically, apply the systems analysis methodology to study complex problems of different nature, methods of formalization and solution of system problems with conflicting goals, uncertainties, and risks.</p> <p>PC7. Ability to apply the theoretical and practical basics of methodology and modelling technology to study the characteristics and behavior of complex objects and systems, to</p>



	<p>conduct computational experiments with processing and analysis of results.</p> <p>PC8. 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 management mechanisms.</p> <p>PC9. Ability to implement a multi-tier computing model based on the client-server architecture, including databases, knowledge bases, 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.</p> <p>PC10. Ability to apply methodologies, technologies, and tools to manage the life cycle processes of information and software systems, information technology products and services according to customer requirements.</p> <p>PC11. Ability to conduct intelligent data analysis based on methods of computational intelligence, including large and poorly structured data, their operational processing and visualization of analysis results in the process of solving applied problems.</p> <p>PC12. Ability to ensure the organization of computational processes in information systems of various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.</p> <p>PC13. Ability to develop network software that operates based on different topologies of structured cable systems, uses computer systems and data networks, and analyzes the quality of computer networks.</p> <p>PC14. Ability to apply methods and tools of information security, to develop and operate special software for security of information resources of critical information infrastructure.</p> <p>PC15. Ability to analyze and perform functional modelling of business processes, construction and practical application of functional models of organizational, economic, and production-technical systems, methods of risk assessment of their design.</p> <p>PC16. Ability to implement high-performance computing based on cloud services and technologies, parallel and distributed computing in the development and maintenance of distributed parallel information processing systems.</p> <p>PC17. Ability to apply the theoretical and practical basics of modern management theory for complex organizational, technical and socio-economic systems to build intelligent management systems, in the process of designing intelligent</p>
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	<p>systems to use modern information processing technologies and methods of computational intelligence.</p> <p>PC18. Ability to apply modern methods of decision-making theory, including methods of ranking, formation, and coordination of collective expert assessments, multi-criteria optimization etc., to build intelligent management systems.</p> <p>PC19. Ability to comprehensively use for the creation of intelligent management systems methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems.</p> <p>PC20. Ability to develop the architecture of software systems and their particular components during the design of intelligent management systems in various fields, to manage the life cycle of intelligent management systems software.</p>
<b>7 – Programme learning outcomes</b>	
<b>Programme learning outcomes</b>	<p>PLO1. Apply knowledge of the fundamental 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.</p> <p>PLO2. 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 informatization objects.</p> <p>PLO3. Use knowledge of the laws of random phenomena, their properties and operations with them, models of random processes, and modern software environments to solve problems of statistical data processing and construction of predictive models.</p> <p>PLO4. 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 management objects, etc.</p> <p>PLO5. 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.</p> <p>PLO6. Use methods of numerical differentiation and integration of functions, solution of ordinary differential and integral equations, features of numerical methods and possibilities of their adaptation to engineering problems, have skills of software implementation of numerical methods.</p>

	<p>PLO7. Understand the principles of modelling organizational and technical systems and operations; use methods of operations research, solve single- and multicriteria optimization problems of linear, integer, nonlinear, stochastic programming.</p> <p>PLO8. Use the methodology of system analysis of objects, processes, and systems for the tasks of analysis, prediction, management, and design of dynamic processes in macroeconomic, technical, technological, and financial objects.</p> <p>PLO9. Develop software models of subject areas, choose a programming paradigm from the standpoint of convenience and quality of its application to implement methods and algorithms that solve problems in the computer science field.</p> <p>PLO10. Use tools for developing client-server applications, design conceptual, logical, and physical models of databases, develop and optimize database queries, create distributed databases, repositories and showcases of databases, and knowledge bases, including those based on cloud services, using web programming languages.</p> <p>PLO11. Have the skills to manage the life cycle of software, products, and services of information technology under the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, technical task, business plan, agreement, contract).</p> <p>PLO12. Apply methods and algorithms of computational intelligence and intelligent data analysis in the tasks of classification, prediction, cluster analysis, search for associative rules using software tools to support multidimensional data analysis based on technologies DataMining, TextMining, WebMining.</p> <p>PLO13. Know the system programming languages and methods for the software development that interacts with the components of computer systems, know network technologies, computer network architectures, have practical skills in administration technology of computer networks and their software.</p> <p>PLO14. 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.</p> <p>PLO15. Understand the concept of information security, the principles of secure software design, ensure the security of</p>
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	<p>computer networks in conditions of incomplete and uncertain input data.</p> <p>PLO16. Perform parallel and distributed computations, apply numerical methods and algorithms for parallel structures, parallel programming languages in the development and operation of parallel and distributed software.</p> <p>PLO17. Apply for the construction of intelligent management systems theoretical and practical foundations of modern management theory, design intelligent systems using modern information processing technologies and methods of computational intelligence.</p> <p>PLO18. Apply modern methods of decision-making theory for the construction of intelligent management systems, including methods of ranking, formation, and coordination of collective expert assessments, multi-criteria optimization, and others.</p> <p>PLO19. Create intelligent management systems using methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems.</p> <p>PLO20. Develop the architecture of software systems and their particular components during the construction of intelligent management systems in various fields, as well as manage the life cycle of intelligent management systems software.</p> <p>PLO21. Apply the principles of moral, cultural, scientific values and increase the achievements of society, use different types and forms of physical activity to lead a healthy lifestyle and professional activities in the field of information technology.</p>
<b>8 – Resource support for programme implementation</b>	
<b>Staffing plan</b>	<p>Meets the staffing plan requirements for ensuring the implementation of educational activities in the field of higher education in accordance with current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine “On approval of licensing conditions for educational activities of educational institutions” of December 30, 2015. № 1187, Annex 12; with changes made in accordance with the Resolution of the Cabinet of Ministers №365 of 24.03.2021).</p> <p>Instructors-practitioners, specialists and employees of IT companies, as well as foreign specialists are involved in teaching.</p>
<b>Logistics</b>	<p>Meets the technological requirements for logistics of educational activities in the field of higher education in accordance with current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine “On approval of licensing</p>

	conditions for educational activities of educational institutions” of December 30, 2015. № 1187, Annex 13).
<b>Information and educational and methodological support</b>	Meets the technological requirements for teaching and information support of educational activities in the field of higher education in accordance with current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine “On approval of licensing conditions for educational activities of educational institutions” of December 30, 2015, № 1187 14 – 15). Using LMS (Learning Management System) in the educational process. Access to the electronic repository of NTU “KhPI” (eNTUKhPIIR) via the Internet (including the university Wi-Fi network).
<b>9 – Academic mobility</b>	
<b>National credit mobility</b>	Based on bilateral agreements on academic mobility.
<b>International credit mobility</b>	Based on an agreement with University Paris 13, France; University of Maribor, Slovenia; ERASMUS + KA1 academic mobility projects.
<b>Training of foreign higher education applicants</b>	The license provides for the training of foreigners and stateless persons.

## 2. List of components of the professionally-oriented educational programme

### 2.1. List of EP components

A/D code	Components of the educational programme	Credit hours	Final control form	
			Exams (semester)	Tests (semester)
1	2	3	4	5
<b>Mandatory components of EP</b>				
<b>General training</b>				
GT 1	History and culture of Ukraine	3.0	1	
GT 2	Ukrainian language (professional orientation)	3.0	1	
GT 3	English for specific purposes	12.0	8	1-2, 6-7
GT 4	Philosophy	3.0	8	
GT 5	Higher mathematics	12.0	1, 2	
GT 6	Physics	4.0	1	
GT 7	Green computing	3.0	7	
GT 8	Physical education	12.0		1-6
<b>Special (professional) training</b>				
PT 1	Algorithmization and programming	10.0	1, 2	
PT 2	Fundamentals of computer science and artificial intelligence methods	4.0		1
PT 3	Probability theory and mathematical statistics	6.0	2	
PT 4	Operating systems	4.0		2
PT 5	Algorithms and data structures	4.0		2
PT 6	Discrete mathematics	5.0		3
PT 7	Numerical methods	4.0	4	
PT 8	Operations research	11.0	5	6
PT 9	Databases	6.0	3, 4	
PT 10	Object-oriented programming. Introductory practice	4.0	3	
PT 11	Computer networks	3.0		3
PT 12	Fundamentals of web development	3.0	4	
PT 13	Fundamentals of business analysis	3.0		4
PT 14	Distributed computing and cloud services	3.0		5
PT 15	Architecture and design of software	8.0	5, 6	
PT 16	Software quality, testing and support	3.0	6	
PT 17	Fundamentals of cybersecurity	3.0	6	
PT 18	Decision making theory	4.0	7	
PT 19	Mathematical modelling and systems analysis	4.0		7
PT 20	Fundamentals of knowledge bases	3.0		8
PT 21	Methods of computational intelligence	5.0	7	
PT 22	Intelligent control systems	4.0		8
PT 23	Intelligent data analysis	3.0		8
PT 24	Fundamentals of project management	3.0	8	
PT 25	Project (practice)	6.0		6
PT 26	Pre-graduation practice	6.0		8
	Attestation	6.0		

A/D code	Components of the educational programme	Credit hours	Final control form	
			Exams (semester)	Tests (semester)
	<b>Total volume of mandatory components:</b>		<b>180.0</b>	
<b>Selective components of EP</b>				
<b>OP 1</b>	<b>Profiled set of disciplines 01 «Research and Development»</b>	<b>25.0</b>		<b>3-7</b>
OP 1.1	Probabilistic models	4.0		3
OP 1.2	Knowledge representation models	6.0		4
OP 1.3	Fuzzy logic and fuzzy systems	4.0		5
OP 1.4	Machine Learning	3.0		6
OP 1.5	Experiment planning	4.0		7
OP 1.6	Intelligent systems modeling technologies	4.0		7
<b>OP 2</b>	<b>Profiled set of disciplines 02 «Software Development and Startup»</b>	<b>25.0</b>		<b>3-7</b>
OP 2.1	Internet marketing	4.0		3
OP 2.2	Startup business models	6.0		4
OP 2.3	Startup business analytics	4.0		5
OP 2.4	Fundamentals of business planning	3.0		6
OP 2.5	Fundamentals of prototyping	4.0		7
OP 2.6	Fundamentals of entrepreneurship	4.0		7
<b>OP 3</b>	<b>Profiled set of disciplines 03 «Innovation Campus»</b>	<b>25.0</b>		<b>3-7</b>
OP 3.1	Development of corporate information systems (part 1)	4.0		3
OP 3.2	Development of corporate information systems (part 2)	6.0		4
OP 3.3	Databases for corporate information systems	4.0		5
OP 3.4	Architecture of corporate information systems	3.0		6
OP 3.5	Project workshop	4.0		7
OP 3.6	Formation and Development of IT Project Teams	4.0		7
<b>OPT</b>	<b>Selective disciplines of professional training according to the List</b>	<b>24.0</b>		<b>3-5</b>
<b>OD</b>	<b>Selective disciplines from the University Catalog of Disciplines</b>	<b>11.0</b>		<b>5-7</b>
	<b>Total volume of selective components</b>		<b>60.0</b>	
	<b>TOTAL VOLUME OF THE EDUCATIONAL PROGRAMME</b>		<b>240.0</b>	

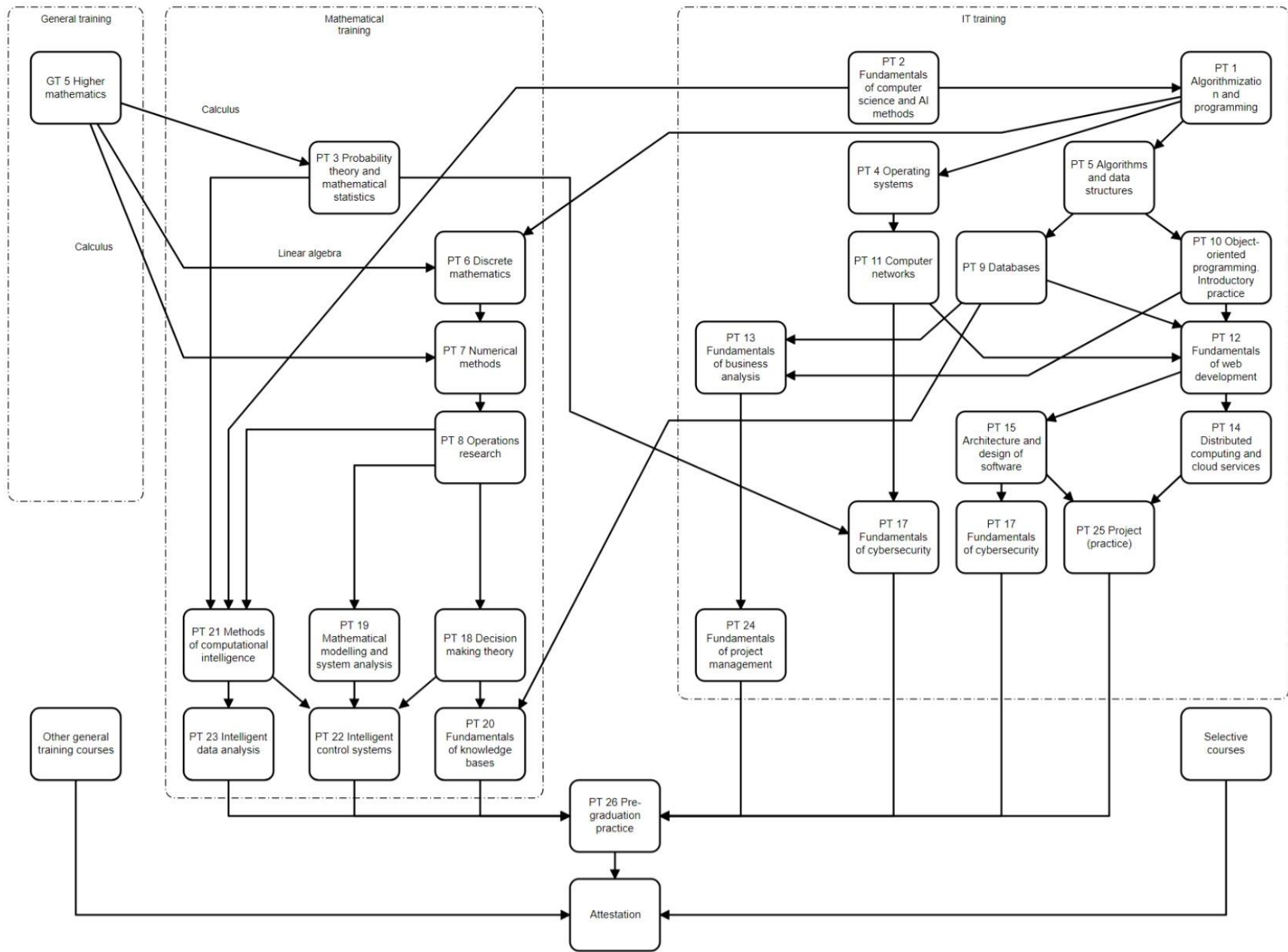
## 2.2. Structural and logical diagram of the EP

<b>Semester</b>	<b>Components of the educational programme</b>
1	GT 1, GT 3, GT 5, GT 6, GT 8, PT 1, PT 2
2	GT 2, GT 3, GT 5, GT 8, PT 1, PT 3, PT 4, PT 5
3	GT 8, PT 6, PT 9, PT 10, PT 11, OP X.1, OPT
4	GT 8, PT 7, PT 9, PT 12, PT 13, OP X.2, OPT
5	GT 8, PT 8, PT 14, PT 15, OP X.3, OPT, OD
6	GT 3, GT 8, PT 8, PT 15, PT 16, PT 17, PT 25, OP X.4, OD
7	GT 3, GT 7, PT 18, PT 19, PT 21, OP X.5, OP X.6, OD
8	GT 3, GT 4, PT 20, PT 22, PT 23, PT 24, PT 26



1 year		2 year		3 year		4 year	
1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
GT 8 Physical education							
GT 3 English for specific purposes					GT 3 English for specific purposes		
GT 1 History and culture of Ukraine	GT 2 Ukrainian language (professional orientation)						GT 4 Philosophy
GT 5 Higher mathematics		PT 9 Databases		PT 15 Architecture and design of software			
PT 1 Algorithmization and programming		PT 10 Object-oriented programming. Introductory practice	PT 13 Fundamentals of business analysis		PT 16 Software quality, testing and support	PT 19 Mathematical modelling and system analysis	PT 22 Intelligent control systems
					PT 17 Fundamentals of cybersecurity		
GT 6 Physics	PT 4 Operating systems	PT 11 Computer networks	PT 12 Fundamentals of web development		PT 25 Project (practice)		PT 24 Fundamentals of project management
				PT 14 Distributed computing and cloud services		GT 7 Green computing	
PT 2 Fundamentals of computer science and artificial intelligence methods	PT 5 Algorithms and data structures	PT 6 Discrete mathematics	PT 7 Numerical methods	PT 8 Operations research		PT 18 Decision making theory	PT 20 Fundamentals of knowledge bases
	PT 3 Probability theory and mathematical statistics	SC OP X.1	SC OP X.2	SC OP X.3	SC OP X.4	SC OP X.5	
		SC OPT				SC OP X.6	
SC OD							
*remark							
GT – General training component		PT – Professional training components				SC – Selective components	

PT 26 Pre-graduation practice



### 3. Higher education applicants' certification

<b>Types of higher education applicant's certification</b>	Certification is carried out in the form of defense of qualifying work.
<b>Requirements for qualifying work</b>	<p>Qualifying work should include theoretical, system engineering, or experimental research of a complex specialized task or practical problem in the field of computer science, which is characterized by complexity and uncertainty of conditions and requires the use of theories and methods of information technology.</p> <p>There should be no academic plagiarism, falsification, or fabrication in the qualifying work.</p> <p>Qualifying work must be published on the official website of the Higher Education Institution or its structural unit, or in the repository of the higher education institution.</p>

#### 4. Matrix of programme competence conformity to components of the educational programme

	GC1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	GC9	GC10	GC11	GC12	GC13	GC14	GC15	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15	PC16	PC17	PC18	PC19	PC20		
GT 1														+	+																						
GT 2			+	+											+																						
GT 3			+		+																																
GT 4										+			+		+																						
GT 5	+	+														+																					
GT 6	+																																				
GT 7	+	+	+			+		+				+	+								+				+												
GT 8															+																						
PT 1	+	+	+			+	+		+										+					+													
PT 2	+	+	+			+	+										+	+								+											
PT 3	+	+	+														+																				
PT 4	+	+	+			+																						+		+							
PT 5	+	+	+			+	+												+					+													
PT 6	+	+	+			+	+									+		+																			
PT 7	+	+	+			+										+		+	+																		
PT 8	+	+	+			+										+		+	+	+	+																
PT 9	+	+	+			+																		+	+												
PT 10	+	+	+			+			+															+													
PT 11	+	+	+			+																							+	+							
PT 12	+	+	+			+			+															+	+												
PT 13	+	+	+			+	+			+												+										+			+		
PT 14	+	+	+			+			+															+		+							+				
PT 15	+	+	+			+			+															+	+	+		+							+	+	
PT 16	+	+	+			+	+		+	+		+														+			+								
PT 17	+	+	+			+																								+							
PT 18	+	+	+			+	+		+		+	+	+			+			+	+	+	+													+		
PT 19	+	+	+			+	+									+		+	+	+	+	+													+	+	
PT 20	+	+	+			+	+																	+		+											
PT 21	+	+	+			+	+																			+									+		
PT 22	+	+	+			+	+										+	+		+	+	+					+					+	+		+	+	
PT 23	+	+	+			+	+										+						+				+						+	+			
PT 24	+	+	+			+	+		+	+	+	+		+													+										+
PT 25	+	+	+			+		+	+	+	+	+	+	+	+	+							+	+	+	+	+	+		+	+						
PT 26	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Continuation of matrix of programme competence conformity to components of the educational programme

	GC1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	GC9	GC10	GC11	GC12	GC13	GC14	GC15	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15	PC16	PC17	PC18	PC19	PC20		
OP 1.1	+	+	+				+														+													+			
OP 1.2	+	+	+			+	+																												+		
OP 1.3	+	+	+			+	+		+								+			+	+																
OP 1.4	+	+	+			+	+										+				+					+							+				
OP 1.5	+	+	+			+	+									+					+	+											+	+			
OP 1.6	+	+	+			+	+										+	+		+	+	+											+	+	+		
OP 2.1	+	+	+			+	+			+											+																
OP 2.2	+	+	+			+	+	+	+														+														
OP 2.3	+	+	+			+	+	+	+									+									+										
OP 2.4	+	+	+			+	+		+	+	+			+												+											
OP 2.5	+	+	+			+			+														+	+	+		+								+	+	
OP 2.6	+	+	+			+	+			+											+																
OP 3.1	+	+	+			+			+														+	+													
OP 3.2	+	+	+			+			+														+	+													
OP 3.3	+	+	+			+																	+	+													
OP 3.4	+	+	+			+			+														+	+	+		+								+	+	
OP 3.5	+	+	+			+		+	+	+	+	+	+	+	+	+							+	+	+	+	+			+	+						
OP 3.6	+	+	+			+	+		+	+	+	+		+												+											+

## 5. Matrix for providing programme learning outcomes with the corresponding components of the educational programme

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20	PLO21		
GT 1																						+	
GT 2																							+
GT 3																							+
GT 4	+																						+
GT 5		+																					
GT 6		+																					
GT 7								+			+												
GT 8																							+
PT 1	+				+				+														
PT 2	+		+	+								+											
PT 3			+	+																			
PT 4													+		+								
PT 5	+				+				+														
PT 6	+	+																					
PT 7		+			+	+																	
PT 8		+			+	+	+	+															
PT 9									+	+													
PT 10					+				+					+									
PT 11													+		+								
PT 12									+	+													
PT 13								+						+						+			
PT 14										+		+				+							
PT 15									+	+	+									+	+		
PT 16									+		+												
PT 17															+								
PT 18		+					+	+											+				
PT 19	+	+				+	+	+											+	+			
PT 20										+		+											
PT 21			+	+		+		+				+					+						
PT 22	+		+	+			+	+				+		+			+		+		+	+	
PT 23			+	+				+				+				+	+						
PT 24											+											+	
PT 25									+	+	+		+		+	+							
PT 26	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Continuation of matrix for providing programme learning outcomes with the corresponding components of the educational programme

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20	PLO21
OP 1.1			+					+													
OP 1.2																	+				
OP 1.3	+			+	+												+		+		
OP 1.4			+	+				+				+					+				
OP 1.5	+	+				+	+	+										+	+		
OP 1.6	+		+	+			+	+				+		+			+		+	+	
OP 2.1								+													
OP 2.2								+						+							
OP 2.3				+								+									
OP 2.4											+										
OP 2.5									+	+	+									+	+
OP 2.6								+													
OP 3.1									+	+											
OP 3.2									+	+											
OP 3.3									+	+											
OP 3.4									+	+	+								+	+	
OP 3.5									+	+	+		+		+	+					
OP 3.6											+									+	

Head of the graduating department \_\_\_\_\_ Mykhailo GODLEVSKYI

Head of the specialty work group

(EP Guarantor) \_\_\_\_\_ Vasyl LYSYTSKYI