MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL UNIVERSITY "LVIV POLYTECHNIC

"APPROVED"
Acting rector
National University
Lviv Polytechnic
_____ Yu. BOBALO
"____"_____ 2025

EDUCATIONAL-PROFESSIONAL PROGRAMME

COMPUTER SCIENCE (Design and programming of intelligent systems and devices)

FIRST (BACHELOR'S) LEVEL OF HIGHER EDUCATION

AREA EXPERTISE 12 "Information technology"

SPECIALITY 122 "Computer Science"

Considered and approved by
Lviv Polytechnic National
University Scientific Council
"___" _____ 2025
Protocol No. ___

Lviv 2025

LETTER OF AGREEMENT
educational-professional program

Higher education level	The first (Bachelor's) level
Higher education degree	Bachelor
Branch of knowledge	12 Information Technology
Specialty	122 Computer Science

DEVELOPED AND APPROVED

The Scientific and Methodological Commission of 122 Computer Science
Protocol No. ___ of the meeting from
"__" _____ 2025

The Head of the Commission
_____ Uliana MARIKUTSA

APPROVED

The Vice-Rector on Scientific and Pedagogical of Lviv Polytechnic National University
_____ Oleg DAVIDCHAK
"_____ " _____ 2025

The Head of the Educational and Methodological Department

_____ Vasyl TOMIUK
" ___ " _____ 2025

RECOMMENDED

The Scientific and Methodological Council of the University
Protocol No. ____
"_____" _____ 2025

The Head of the Council

_____ Anatoliy ZAGORODNIY

The Director of the Educational and Scientific Institute of Computer Science and Information Technology

_____ Natalya SHAKHOVSKA

"___ " _____ 2025

PREFACE

Developed by the working group of the Scientific and Methodological Commission of the speciality 122 "Computer Science" of Lviv Polytechnic National University on the basis of the approved standard of higher education in the speciality 122 "Computer Science", Order No. 962 of 10.07.2019, consisting of:

Yaroslav SOKOLOVSKYY	- Doctor of Technical Sciences, Professor, Professor of the CAD Department - guarantor of the educational programme
Mykhaylo LOBUR	- Doctor of Technical Sciences, Professor, Head of the CAD Department
Serhiy SHCHERBOVSKYKH	- Doctor of Technical Sciences, Professor of the CAD Department
Uliana MARIKUTSA	- D. in Engineering, Associate Professor, Associate Professor of the CAD Department
Mykhaylo MELNYK	- D. in Engineering, Associate Professor, Associate Professor of the CAD Department
Oksana OBORSKA	- D. in Engineering, Associate Professor, Associate Professor of the CAD Department
Andriy KERNYTSKYY	- D. in Engineering, Associate Professor, Associate Professor of the CAD Department
Rostyslav KRYVYY	- D. in Engineering, Associate Professor of the CAD Department
Ivan ZAHORODNIY	- Director of the Software Engineering Center of Excellence, SoftServe
Oksana KOHUT	- Competence Expert, Software Engineering Center of Excellence, SoftServe
Yevhen BEHEN	- Competence Expert, Software Engineering Center of Excellence, SoftServe
Anton BAKALETS	- D. in Engineering, Application Architect, Big Data and Analytics Group SoftServe
Marta BASISHYN	- Higher Education Student, Group PP-35

Guarantor of the Program, Professor of the Department
of Computer-Aided Design System _____ Yaroslav SOKOLOVSKYY
(signature) (surname, initials)

The draft educational and professional program was discussed and approved at the Academic Council of the Scientific and Research Institute of Computer Science and Information Technologies.

Protocol No. ____ "_____ " _____ 2025.

Chair of the Academic Council of the
Educational and Scientific Institute of CSIT _____ Natalya SHAKHOVSKA
(signature) (surname, initials)

APPROVED AND ENTERED INTO FORCE
by order of the Rector of Lviv Polytechnic National University
"____" _____ 2025. No_____

Profile of the programme 122 Computer Science Bachelor's degree in speciality 122 "Computer Science" Design and programming of intelligent systems and devices

1 - General information	
Full name of the higher education institution and structural unit	**Lviv Polytechnic National University**
Level of higher education	First (bachelor's)
Official name of the study programme	Computer Science (Design and programming of intelligent systems and devices) Design and programming of intelligent systems and devices
Type of diploma and scope of the educational programme	The scope of the bachelor's degree programme in 122 "Computer Science" is: - based on a complete general secondary education of 240 ECTS credits; To obtain a bachelor's degree on the basis of a junior bachelor's degree (junior specialist), a higher education institution has the right to recognise and re-accredit no more than 120 ECTS credits obtained within the previous educational programme of training a junior bachelor (junior specialist) in specialities within the field, and no more than 60 ECTS credits obtained within the previous educational programme of training a junior bachelor (junior specialist) in other specialities. At least 50% of the volume of the educational programme should be aimed at ensuring general and special (professional) competencies in the specialty defined by the higher education standard.
Availability of accreditation	
Cycle/level	NQF of Ukraine - level 6 FQ-EHEA - first cycle, QF-LLL - level 6
Background.	Complete general secondary education
Language(s) of instruction	Ukrainian, English
Basic concepts and their definitions	The programme uses basic concepts and their definitions in accordance with the Law of Ukraine "On Higher Education"
2 - Objective of the study programme	
	Training of specialists capable of applying mathematical foundations, algorithmic principles in modelling, designing, developing and maintaining intelligent systems and technologies; mastering modern methods of creating and maintaining application software for various purposes: solving complex problems and practical problems of designing, developing, testing, implementing, operating and maintaining intelligent systems for data analysis and processing in organisational, technical, natural and socio-economic systems.
3 - Characteristics of the study programme	
Subject area (field of knowledge, speciality)	**Object(s) of study and/or activity**: mathematical, information, simulation models of real phenomena, objects, systems and processes; models of data and knowledge representation; models, methods and technologies

	obtaining, storing, processing, transmitting and using information; theory, analysis, development, evaluation of efficiency, implementation of algorithms; methods and algorithms for operational multidimensional and intellectual data analysis and decision-making; high-performance computing, including parallel computing and big data; system analysis of objects and processes of computerisation; models of subject areas and methods of building intelligent systems based on knowledge and decision-making technologies;; mathematical and software support of the automotive process **Learning objectives***:* training of specialists capable of conducting theoretical and experimental research in the field of computer science; applying mathematical methods and algorithmic principles in modelling, designing, developing and maintaining information technologies; developing, implementing and maintaining intelligent systems for analysing and processing data of organisational, technical, natural and socio-economic systems. **Theoretical content of the subject area***:* modern models, methods, algorithms, technologies, processes and methods of obtaining, representation, processing, analysis, transmission, storage of data in information systems. **Methods, techniques and technologies***:* mathematical models, methods and algorithms for solving theoretical and applied problems that arising in the development of IT; modern technologies and platforms programming; methods of data collection, analysis and consolidation distributed information; design technologies and methods, Development and quality assurance of IT components; methods intelligent analysis and data visualisation technologies; methods artificial intelligence, CASE modelling technology and designing IT technologies for business analysis and data analytics. **Tools and equipment***:* distributed computing systems; computer networks; mobile, cloud and fog technologies, database management systems, operating systems
Orientation of the educational programme	Educational and professional academic. The bachelor's degree programme is designed for students who aspire to become specialists in the field of engineering and research in the field of computer science and information technology; Emphasis on readiness to work and acquire knowledge skills in programming, design, development and operation of intelligent systems and devices. The programme is focused on the formation of a broad scientific and technical outlook of future professionals capable of solving urgent problems and acquiring practical skills. The research line is professionally oriented, the expert line is practically oriented.
Main focus of the study programme and specialisation	The programme allows graduates who have completed the bachelor's programme to carry out design and technological, production and technological, organisational and managerial; innovative professional activities in the field of computer science. It involves close interaction with representatives of the academic and technical business communities in the context of: sustainable development of society, internationalisation of education, transformation of the labour market through interaction with stakeholders. Keywords: Computer science; information intelligent systems; design, implementation, operation

Features of the programme	Integration of professional training in computer science with research and development activities. The programme is based on modern knowledge of mathematical and physical disciplines, which are the basis for computer science; modern ideas about trends and patterns of development of intellectual information technologies. The educational programme includes: teaching of certain disciplines by IT specialists of enterprises and institutions of the National Academy of Sciences of Ukraine, the possibility of internships in leading IT companies (SoftServe, EPAM, ELEKS, Sombra, JetSoftPro, N-iX), and the availability of a university-wide academic mobility programme. There are 3 lines in total: For the design line of intelligent systems and devices. Promising approaches to the application of methods and information technology tools for designing intelligent systems and devices. For the programming line of intelligent systems and devices. Promising approaches to the use of programming languages, specifications, frameworks and technology in the design and development of intelligent systems and devices are being developed. For the line system design Promising areas of a systematic approach to the development of computer-aided design systems and their components intended for the design of objects of various physical nature are being developed.
4 - Suitability of graduates of the study programme to employment and further education	
Suitability for employment	Jobs in the field of information technology, IT companies, specialists in the development of mathematical, information and software of information systems, in the field of information technology, as well as database and system administrators
Further training	They have the right to continue their studies at the second (master's) level of higher education. Acquisition of additional qualifications in the system of postgraduate education.
5 - Teaching and assessment	
Teaching and learning	Lectures, practical classes, term papers, research laboratory work, independent work based on textbooks, manuals and lecture notes, consultations with teachers, preparation of a bachelor's thesis. active involvement of students in practical activities at the company's IT base is based on Lviv's IT companies, including NiX, SoftServe Corporation, Elex LLC, etc.
Evaluation	The rating assessment of students' achievements is carried out during the semester by conducting current and semester controls. A 100-point scale is used to evaluate students' integrated knowledge and skills for each component of the educational programme with conversion to the national scale ("excellent", "good", "satisfactory" or "unsatisfactory") in accordance with the Regulations on Rating Assessment of Student Achievement of Lviv Polytechnic National University. The assessment system includes: written and oral exams, laboratory reports, oral presentations, and defence of a bachelor's thesis.
6 - Programme competences	
Integral competence (INT)	The ability to solve complex specialised tasks and practical problems in the field of computer science or in the process of studying, which involves the application of theories and methods of information technology and is characterised by complexity and uncertainty of conditions

General competences (GK)	GC1. Ability to think abstractly, analyse and synthesise. GC2. Ability to apply knowledge in practical situations. GC3. Knowledge and understanding of the subject area and understanding of professional activities. GC4. Ability to communicate in the state language both orally and in writing. GC5. Ability to communicate in a foreign language. GC6. Ability to learn and master modern knowledge. GC7. Ability to search, process and analyse information from various sources. GC8. Ability to generate new ideas (creativity). GC9. Ability to work in a team. GC10. Ability to be critical and self-critical. GC11. Ability to make informed decisions. GC12. Ability to assess and ensure the quality of work performed. GC13. Ability to act on the basis of ethical considerations. GC14. The ability to exercise their rights and responsibilities as a member of society, to understand 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. GC15. The ability to preserve and enhance 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 technology, to use various types and forms of physical activity for active recreation and healthy lifestyle. GC16. Ability to make decisions and act in accordance with the principle of inadmissibility of corruption and any other manifestations of dishonesty. GC17. Ability to use modern methods of software development, which is a component of information intelligent systems. GC18. Ability to use written and oral professional communication in the state and foreign languages, as well as proper command of professional terminology. GC19. Ability to apply the theoretical and practical foundations of designing intelligent information systems and devices in various subject areas.
Professional competences of the speciality (PC)	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. PC2. Ability to identify statistical patterns of non-deterministic phenomena, apply methods of computational intelligence, including statistical, neural network and fuzzy data processing, machine learning and genetic programming methods, etc. PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic computing, design, develop and analyse algorithms, evaluate their effectiveness and complexity, solvability and intractability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems. PC4. Ability to use modern methods of mathematical modelling of objects, processes and phenomena, develop models and algorithms for numerical solution of mathematical modelling problems, take into account errors in approximate numerical solution of professional problems.

	PC5. Ability to carry out a formal description of the tasks of researching operations in organisational, technical and socio-economic systems for various purposes, to determine their optimal solutions, to build models of optimal management taking into account changes in the economic situation, to optimise management processes in systems of various purposes and hierarchy levels. PC6. Ability to think in systems, apply the methodology of system analysis to study complex problems of different nature, methods of formalisation and solution of systemic problems with conflicting goals, uncertainties and risks. PC7. Ability to apply the theoretical and practical foundations of modelling methodology and technology to study the characteristics and behaviour of complex objects and systems, to conduct computational experiments with processing and analysis of results. PC8. Ability to design and develop software using various programming paradigms: generalised, object-oriented, functional, logical, with appropriate models, methods and algorithms of computation, data structures and control mechanisms. PC9. Ability to implement a multi-level computing model based on client-server architecture, including databases, knowledge and data warehouses, to perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services. PC10. 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. PC11. Ability to analyse data intelligently based on computational intelligence methods, including large and poorly structured data, process them quickly and visualise the results of analysis in the process of solving applied problems. PC12. Ability to ensure the organisation of computing processes in information systems for various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software. PC13. Ability to develop network software that operates on the basis of various topologies of structured cabling systems, uses computer systems and data networks and analyses the quality of computer networks. PC14. Ability to apply methods and tools to ensure information security, develop and operate special software to protect information resources of critical information infrastructure. PC15. Ability to analyse and functional modelling of business processes, build and apply functional models of organisational, economic, production and technical systems, methods of risk assessment of their design. PC16. Ability to implement high-performance computing based on cloud services and technologies, parallel and distributed computing in the development and operation of distributed systems of parallel information processing PC17. Ability to apply the theoretical and practical foundations of the creation of intelligent systems and devices of various nature. PC18. Ability to develop software, use programming languages, descriptions of information resources, specifications, tools, libraries, frameworks and technologies in the design and creation of intelligent systems and devices of various nature.

Professional competences of the professional direction (PCD)	**1. For the programming line of intelligent systems and devices:** 1.1) Ability to accumulate, process and systematise professional knowledge on the creation and maintenance of software and implement iterations of the programming life cycle of intelligent systems and 1.2) Ability to use programming languages, descriptions of information resources, specifications, tools, libraries, frameworks and technologies in the design and development of intelligent systems and devices; 1.3) the ability to administer computer-aided design systems for intelligent systems and devices and be able to develop technical documentation for the object being designed; 1.4) Ability to use standard protocols and software and hardware of local and global computer networks for the design and effective operation of information systems. **2. For the design of intelligent systems and devices:** 2.1) the ability to use methods and tools of modern information technologies for the design of intelligent systems and devices and the ability to use them in practice; 2.2) the ability to use knowledge of methods of building systems with self-organisation and self-learning and the ability to apply them the design of intelligent systems and devices; 2.3) the ability to use knowledge of mathematical modelling methods and the ability to use them for computer-aided design of intelligent systems and devices. 2.4) Ability to use basic Internet of Things technologies, in particular, industry 4.0, industrial Internet of Things, machine learning, as well as virtual and augmented reality, in the design process. **3. System design for the line** 2.5) the ability to use knowledge of the theoretical foundations of system design of complex objects and the ability to apply them in practice; 2.6) the ability to use knowledge of methods of building systems with self-organisation and self-learning and the ability to apply them in system design; 2.7) the ability to use knowledge of synthesis and optimisation methods and the ability to use them in the computer-aided design of complex objects and systems; 2.8) the ability to use knowledge of geometric modelling methods in the computer-aided design of complex objects and systems in various fields.
7 - Programme learning outcomes	
Knowledge (PR)	PR1. To apply knowledge of the basic forms and laws of abstract and logical thinking, the basics of the methodology of scientific knowledge, forms and methods of extracting, analysing, processing and synthesising information in the subject area of computer science. PR2. To use modern mathematical apparatus of continuous and discrete analysis, linear algebra, analytical geometry in professional activities to solve theoretical and applied problems in the process of designing and implementing information technology objects. PR3. 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 build predictive models.

	PR4 Use methods of computational intelligence, machine learning, neural network and fuzzy data processing, genetic and evolutionary programming to solve problems of recognition, forecasting, classification, identification of control objects, etc. PR5. Design, develop and analyse algorithms for solving computational and logical problems, evaluate the effectiveness and complexity of algorithms based on the use of formal models of algorithms and computable functions. PR6. To 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, to have skills in software implementation of numerical methods. PR7. Understand the principles of modelling organisational and technical systems and operations; use methods of researching operations, solving single and multi-criteria optimisation problems of linear, integer, nonlinear, stochastic programming. PR8. Apply 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. PR9. 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. PR10. Use tools for developing client-server applications, design conceptual, logical and physical models of databases, develop and optimise queries to them, create distributed databases, data warehouses and showcases, knowledge bases, including those on cloud services, using web programming languages. PR11. 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). PR12. Apply methods and algorithms of computational intelligence and data mining in the tasks of classification, forecasting, cluster analysis, search for associative rules using software tools to support multidimensional data analysis based on DataMining, TextMining, WebMining technologies. PR13. Master system programming languages and methods of developing programmes that interact with computer system components PR14. Know network technologies, computer network architectures, have practical skills in computer network administration technology and PR15. Apply knowledge of the 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 organisational, economic and production and technical systems. PR16. Understand the concept of information security, the principles of secure software design, ensure the security of computer networks in conditions of incomplete and uncertainty of the source data.

	PR17. Perform parallel and distributed computing, apply numerical methods and algorithms for parallel structures, parallel programming languages in the development and operation of parallel and distributed software. **For the programming line of intelligent systems and devices:** 1.1) Accumulate, process and systematise professional knowledge on the creation and maintenance of software and implement iterations of the programming life cycle of intelligent systems and devices 1.2) Carry out a systematic analysis of the architecture of the organisation and its IT infrastructure, plan the scaling of the information system. Justify the choice of tools (technical structure and software tools), their interaction within the created system, carry out its design, development, deployment and support 1.3) Use programming languages, descriptions of information resources, specifications, tools, libraries, frameworks and technologies in the design and development of intelligent systems and devices; 1.4) Use standard protocols and software and hardware local and global computer networks for the design and effective operation of information systems. **For the design line of intelligent systems and devices:** 3.1) Master the methods and means of modern information technologies for the design of intelligent systems and devices and the ability to use them in practice; 3.2) Select, apply and develop new methods and algorithms for pattern recognition and computer vision to solve scientific and applied problems 2.3) Design, develop, program and manage robots, embedded devices and computerised systems, test, debug and implement software for various mobile platforms. 3.3) Perform administration of the system of computer-aided design of intelligent systems and devices and be able to develop technical documentation for the object being designed **System design for the line** 3.4) Master the methods and tools of a systematic approach to the process of computer-aided design; 3.5) Apply knowledge of multicriteria optimisation methods to solve specific computer aided design problems; 3.6) Develop complex mathematical models for complex objects and systems; 3.7) Apply knowledge of modern methods and tools of systems with self-organisation and self-study in system design;
8 - Resource support for programme implementation	
Key characteristics of staffing	70% of the academic staff involved in teaching professionally oriented disciplines in the speciality 122 "Computer Science" have academic degrees and academic titles, with 40% of practical experience in the speciality.
Main characteristics of logistics support	**Laboratories:** Operating systems; Computer networks; CNC machines; Embedded systems. **Equipment:** Svan SV 111; Vibro analyser SWAN-958 + Set of Accessories; Plata NVIDIA TESLA (Compute Processor K20 PN: C2J97AA); Ploter (Epson SureColor z system CISS); Data Cards NI USB-6001 Model: 782604-01; 781050-01 National Instruments multifunction NI PCIe-6361; Opt. Microscope Bresser Biolux LCD 401600x

Main characteristics of information and methodological support	Use of the virtual learning environment of Lviv Polytechnic National University and the author's developments of research and teaching staff; textbooks and manuals with the stamp of the Academic Council of Lviv Polytechnic National University, materials from edx and Prometeus educational platforms.
9 - Academic mobility	
National credit mobility	On the basis of bilateral agreements between Lviv Polytechnic National University and technical universities of Ukraine.
International credit mobility	On the basis of bilateral agreements between Lviv Polytechnic National University and higher education institutions of foreign partner countries.
Training of foreign students for higher education	Ukrainian, English

1. Distribution of the content of the educational and professional programme by component groups and training cycles

№ n/a	Preparation cycle	The volume of the academic load of a higher education student (credits / %)		
		Required. components of the educational and professional programme	Selective components of the educational and professional programme	Total for the entire period of study
1	2	3	4	5
1.	General training cycle	**74/30,8**	**6/2,5**	**80/33,3**
2.	Professional training cycle	**106/44,2**	**54/22,5**	**160/66,7**
Total for the entire period of study		**180/75**	**60/25**	**240 / 100**

2. List of components of the educational and professional programme

Code	Name of the OP component	Volume component in ECTS credits	Form final control
1	2	3	5
Mandatory components of the educational and professional programme			
1. General training cycle			
SK1	Foreign language (for professional purposes)	9	examination
SK2	History of Ukrainian statehood and culture	3	examination
SK3	Ukrainian language (for professional purposes)	3	differential
SK4	Philosophy	3	examination
SK5	Algebra and geometry	6	examination
SK6	Discrete mathematics	6	examination
SK7	Mathematical analysis and differential equations	5	examination
SK8	Probability theory and mathematical statistics	5	examination
SK9	Numerical methods	5	differential
SK10	Mathematical methods of operations research	5	examination
SK11	Algorithmisation and programming	14	examination
SK12	Computer circuitry and computer system architecture	5	examination
SK13	Physics	5	examination
Total per cycle:		**74**	
2. Professional training cycle			
SK14	Organisation of databases and knowledge	6	examination
SK15	Object-oriented programming	7	differential
SK16	Computer networks, interfaces and data transfer protocols	5	examination
SK17	Distributed systems technologies and parallel computing	4	examination
SK18	IT project management	5	examination
SK19	Occupational health and safety basics	3	differential

SK20	Digital signal and image processing	3	differential credit
SK21	Information theory and security technology	4	differential credit
SK22	Operating systems	5	examination
SK23	Web development and design technologies	6	examination
SK24	Data mining and visualisation systems	5	examination
SK25	Developing cross-platform applications together with the CD	6	examination
SK26	Business analysis and development of technological products together with the CW	7	examination
SK27	Design and development of information systems in cooperation with the CW	7	examination
SK28	Computer graphics and geometric modelling	5	examination
SK29	Application of artificial intelligence systems in technological solutions together with CW	7	examination
SK30	Augmented reality technologies	4,5	examination
SK31	Design and technology practice	3	differential credit
SK32	Practice on the topic of bachelor's thesis	4,5	differential credit
SK33	Completing a bachelor's thesis	6	
SK34	Defence of a bachelor's thesis	3	
Total per cycle:		**106**	
Together, the components are mandatory:		**180**	
Selective components of the study programme			
Selectable component blocks			
Elective components of other study programmes			
	Total	**6**	
2. Professional training cycle			
Selected components of module 0100 **Programming of intelligent systems and devices*:***			
VB11	Design and development of mobile applications	5	examination
VB12	Microprocessor systems	5	examination
VB13	Programming intelligent embedded systems	5	differential credit
VB14	Artificial intelligence systems	5	examination
VB15	Software robotics	4	examination
VB16	Human-machine interaction	5	examination
VB17	Pattern recognition and computer vision	5	examination
VB18	IoT technologies and standards	5	examination
VB19	Cloud technologies and deployment of information systems	5	examination
VB20	Integration of information systems	4	differential credit
Total:		**48**	
Selected components of the module 0200 Design of intelligent systems and devices:			
VB21	IoT technologies and standards	5	differential credit
VB22	Programming and design of microprocessor systems	5	examination
VB23	Machine learning methods in design systems	5	examination
VB24	Intelligent embedded systems	4	examination

VB25	Cloud computing technologies	5	examination
VB26	DevOps technologies time. 1	5	examination
VB27	Computer-aided design (3D) technologies	5	examination
VB28	DevOps technologies time.2	4	examination
VB29	Cloud technologies for building information systems	5	examination
VB30	Application of artificial intelligence methods for system design	5	examination
Total:		**48**	
Selected components of the module 0300 System design:			
VB31	Information technology in design	5	differential credit
VB32	Self-organising and self-learning systems	5	examination
VB33	Designing microsystems	5	examination
VB34	Theoretical foundations of system design	4	examination
VB35	Engineering design of complex objects and systems	5	examination
VB36	Administration of computer-aided design systems	5	examination
VB37	Intelligent computer-aided design systems	5	examination
VB38	Methods of synthesis and optimisation	5	examination
VB39	Discrete models in system design	5	examination
VB40	Mathematical modelling in system design	4	examination
Total:		**48**	

Elective components of other study programmes	
Total:	**6**
Total for the training cycle	**54**
Total selected components	**60**
Together for the educational and professional programme:	**240**

4. Form of certification of higher education students

Attestation is carried out in the form of a qualification work defence. The qualification work should include a theoretical, systematic or experimental study of a complex specialised task or practical problem in the field of computer science, which is characterised by complexity and uncertainty of conditions and requires the application of theories and methods of information technology. The qualification work should not contain academic plagiarism, falsification and fabrication. The qualification work must be published on the official website of the higher education institution or its structural subdivision, or in the repository of the higher education institution.

5. Relationship between programme competences and components of the bachelor's degree programme in Computer Science (Design and programming of intelligent systems and devices)

COP	General competences																			Professional competences																	
	INT	GK1	GK2	GK3	GK4	GK5	GK6	GK7	GK8	GK9	GK10	GK11	GK12	GK13	GK14	GK15	GK16	GK17	GK18	PC1	PC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9	FC10	FC11	FC12	FC13	FC14	FC15	FC16	FC17	FC18
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
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SC2	+	+	+		+			+							+	+		+																			
SC3	+				+			+							+	+																					
SC4	+	+	+						+		+	+		+	+	+	+																				
SC5	+	+	+	+			+				+		+	+						+		+	+														
SC6	+	+	+	+			+	+					+							+		+															
SC7	+	+	+	+			+	+			+		+	+						+	+			+													
SC8	+	+	+				+	+	+		+	+							+	+	+				+												
SC9	+	+	+				+	+	+		+	+							+	+			+			+											
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SC18	+	+	+			+	+	+	+	+		+	+						+														+				
SC19	+	+	+	+						+	+	+	+	+	+	+			+																		
SC20	+	+	+	+			+	+	+			+	+						+	+			+			+	+										
SC21	+	+	+	+			+	+	+			+	+						+	+			+			+	+						+				
SC22	+	+	+	+			+	+	+			+	+						+								+	+			+	+					
SC23	+	+	+	+			+	+	+			+	+						+	+												+		+			
SC24	+	+	+	+			+	+	+			+	+						+		+				+					+					+		
SC25	+	+	+	+			+	+	+			+	+						+																		
SC26	+	+	+	+			+	+	+	+	+	+	+						+	+								+		+	+						
SC27	+	+	+	+			+	+	+	+	+	+	+						+	+		+													+	+	
SC28	+	+	+								+		+	+	+				+	+		+				+											
SC29	+	+	+								+		+	+	+				+		+			+													
SC30	+	+	+								+		+	+	+				+	+					+												+
SC31	+	+	+	+	+	+		+				+	+						+																+	+
SC32	+	+	+	+	+	+		+				+	+						+	+	+					+		+		+					+	+
SC33	+	+	+	+	+	+					+		+																				+		+	+

6. Matrix of ensuring the programme learning outcomes by the relevant components of the Bachelor's degree programme "Computer Science" in the speciality 122 "Computer Science" (Design and programming of intelligent systems and devices)"

Knowledge, Cill	Required components of the speciality																																
	SK1	SK2	SK3	SK4	SK5	SK6	SK7	SK8	SK9	SK10	SK11	SK12	SK13	SK14	SK15	SK16	SK17	SK18	SK19	SK20	SK21	SK22	SK23	SK24	SK25	SK26	SK27	SK28	SK29	SK 30	SC 31	SK 32	SK 33
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
PR1										+																							
PR2					+	+																											
PR3								+																			+						
PR4																	+																
PR5																												+					
PR6					+						+																						
PR7							+					+																	+	+			
PR8										+																							
PR9									+					+	+																		
PR10														+					+	+											+	+	
PR11																					+					+							
PR12																					+												+
PR13													+			+		+															
PR14													+			+		+															
PR15										+												+				+							
PR16																							+										
PR17																									+								

Components of elective unit 0100 Programming of intelligent systems and devices

COP	General competences																					
	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9	FC10	FC11	FC12	FC13	FC14	FC15	FC16	FC17	FC18	FKS1	FKS2	FKS3	FKS4
1																						
VB11													+				+					+
VB12												+								+		+
VB13																		+			+	
VB14											+										+	
VB15																		+	+			
VB16																			+			+
VB17											+						+			+		
VB18																	+		+			
VB19									+							+					+	
VB20																				+		+

COP	General competences																					
	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11	PR12	PR13	PR14	PR15	PR16	PR17	PR18	PRS1	PRS2	PRS3	PRS4
1																						
VB11																			+			
VB12													+								+	
VB13											+									+	+	
VB14				+															+			
VB15													+								+	
VB16													+									+
VB17												+									+	
VB18														+						+		+
VB19																	+					+
VB20															+				+	+		

Components of the elective unit 0200 Design of intelligent systems and devices

COP	General competences																					
	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9	FC10	FC11	FC12	FC13	FC14	FC15	FC16	FC17	FC18	FKS1	FKS2	FKS3	FKS4
1																						
VB21											+											+
VB22																		+	+			+
VB23											+									+	+	
VB24											+	+							+	+		
VB25									+							+					+	
VB26									+			+							+			+
VB27															+				+		+	
VB28									+			+							+			+
VB29									+							+						+
VB30											+									+		

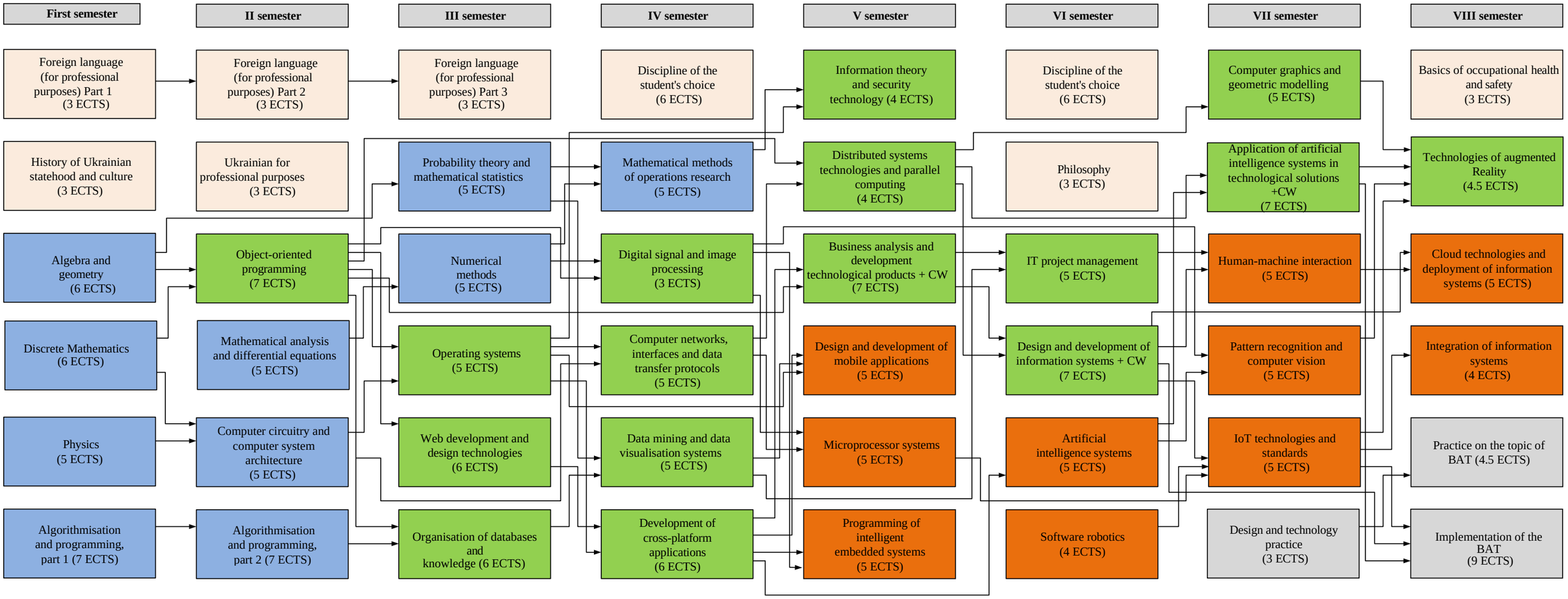
COP	General competences																					
	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11	PR12	PR13	PR14	PR15	PR16	PR17	PR18	PRS1	PRS2	PRS3	PRS4
1																						
VB21														+							+	
VB22											+										+	
VB23				+																+		
VB24											+										+	
VB25																	+		+			
VB26															+					+		+
VB27															+				+	+		
VB28															+					+		+
VB29																	+		+			+
VB30				+																+		+

Components of elective unit 0300 System design

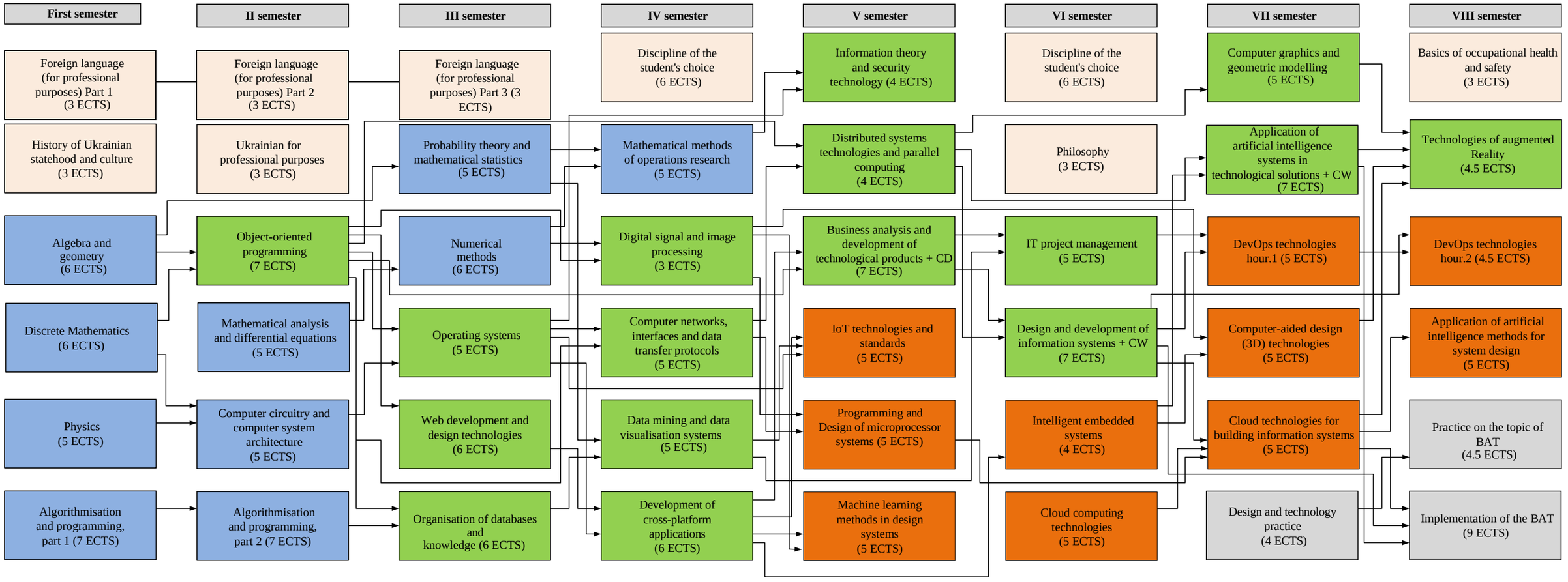
COP	General competences																				
	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9	FC10	FC11	FC12	FC13	FC14	FC15	FC16	FC17	FC18	FKS1	FKS2	FKS3	FKS4
1																						
VB31															+				+		+	
VB32											+									+		
VB33												+							+			
VB34																	+		+		+	
VB35																	+	+	+		+	
VB36										+								+		+		
VB37											+										+	
VB38						+															+	
VB39						+													+			+
VB40							+													+		+

COP	General competences																					
	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11	PR12	PR13	PR14	PR15	PR16	PR17	PR18	PRS1	PRS2	PRS3	PRS4
1																						
VB31															+				+			
VB32				+																		+
VB33											+								+			
VB34															+						+	+
VB35															+						+	
VB36											+								+			
VB37												+									+	+
VB38							+													+		
VB39								+													+	
VB40															+				+	+		

Structural and logical scheme of bachelor's training in the educational and professional programme "Design and programming of intelligent systems and devices" in the speciality 122 - Computer Science (0100 - Programming of intelligent systems and devices)



Structural and logical scheme of bachelor's training in the educational and professional programme "Design and programming of intelligent systems and devices" in the speciality 122 - Computer Science (0200 - Design of intelligent systems and devices)



Structural and logical scheme of bachelor's training in the educational and professional programme "Design and programming of intelligent systems and devices in the speciality 122 - Computer Science (0300 - System Design)