

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**

«Software Engineering»

The first (Bachelor's) level of higher education

Specialty 121 – Software Engineering

Field of Knowledge 12 Information Technologies

Qualification Bachelor of Software Engineering

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	121 – Software Engineering
Educational programme	
Qualification	Bachelor of Software Engineering

APPROVED

«Software Engineering » specialty work group
Guarantor of « Software Engineering Educational
Programme

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« ____ » _____ 2021.

RECOMMENDED

Methodological Council of NTU "KhPI"
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Head of the Department of Software Engineering
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Dean of the Faculty of Computer Science
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Reviewer
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_____ Oleg FEDOROVYCH

« ____ » _____ 2021.

AGREED

Chairman of the student government
Student of group _____

« ____ » _____ 2021.

PREFACE

The educational programme for training bachelors in specialty 121 – “Software Engineering” 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 29.10.2018 p. № 1166.

Developed by the specialty design 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:

1. Head of the specialty design group(EP Guarantor)

Litvinova Yuliia Serhiivna, Candidate of Technical Sciences, Associate Professor of the Department of Software Engineering and Management Information Technologies.

2. Cherednichenko Olha Yuriivna, Candidate of Technical Sciences, Associate Professor

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3. Shmatko Alexander Vitalievich, Candidate of Technical Sciences, Associate Professor

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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 in specialty № 121 – Software Engineering

1 – General information	
Full name of the higher education institution and structural subdivision	National Technical University “Kharkiv Polytechnic Institute”, Faculty of Computer Science and Software Engineering, Department of Software Engineering and Management Information Technologies
Higher education degree and qualification full name in English	Bachelor Educational qualification: Bachelor of Software Engineering Diploma Qualification: Bachelor of Software Engineering
The official name of the educational programme	Software Engineering
Type of diploma and duration of the educational programme	Bachelor diploma, single, 240 ECTS credits, 4 years
Availability of accreditation	Certificate MOES order since 24.04.2019 № 356-П
Cycle/level	NFR of Ukraine – 6 рівень, FQ-EHEA– first cycle, EQF LLL – level 6
Prerequisites	Completed secondary education, junior bachelor degree in related (or other specialties) in accordance with the conditions and rules of admission
Language(s) of teaching	Ukrainian, English
The validity of the educational programme	According to the validity of the accreditation certificate
Internet address of educational programme description	https://web.kpi.kharkov.ua/asu/inzheneriya-programmnogo-obespecheniya/
2 – The purpose of the educational programme	
Training of specialists competent to set and solve tasks related to the development,	

maintenance and quality assurance of software in combination with a high level of professional training, the formation of a scientific worldview and providing a broad outlook in the social, humanitarian, fundamental and in Software engineering field.

Achieving this goal is based on the principles of continuity and individualization of teaching, fundamentality and integrity of knowledge, practical orientation and awareness of the place of acquired competencies, the symbiosis of scientific and systemic approaches and more.

3 – Characteristics of the educational programme

Subject area (field of knowledge, speciality, specialization)	Field of knowledge: 12 – Information Technologies Specialty: 121 – Software Engineering
Direction of the educational programme	Professional training of students seeking to become specialists in the area of engineering and research and in the field of information technology.
The main focus of the educational programme and specialization	The main advantage of the programme is the formation of the widest possible scientific and technical worldview of the would-be professional in the field of information technology of Software Engineering Specialty. Key words: software, information technologies, software engineering.
Features of the programme	Focus on partnerships with domestic and foreign educational and scientific institutions, the private sector, scientists and practitioners, participation in international programs to improve the quality of education. Training is carried out with the use of innovative pedagogical technologies, in particular - a project approach implemented within the program "Ucode Connect" in the training laboratory Innovation Campus of the SEMIT Department of NTU "KhPI", where students have the opportunity to master practical skills and develop softskills required by modern IT industry.

4 – Eligibility of graduates for employment and further education

Eligibility for employment	Professional activity as a software engineer; software engineer; system developer; database developer; web-developer; system administrator; information systems engineer; software development and testing specialist. Graduates can work in professions in accordance with the National Classification of Occupations DK 003: 2010
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	<p>approved by the order of the Ministry of Economic Development and Trade of Ukraine dated August 18, 2020 № 1574:</p> <p>2131.2 Developers of computing systems</p> <p>2132 Professionals in the field of Software Development</p> <p>2132.2 Software Developers</p> <p>2132.1 Researchers (programming)</p>
Further training	A student who was trained in this curriculum and received a Bachelor's degree can continue his studies in the Free Economic Zone of Ukraine and abroad to obtain a Master's degree in the field of knowledge "Information Technology" or related.
5 – Teaching and assessment	
Teaching and studying	The teaching process involves the use of such educational technologies as: lectures, laboratory work, practical classes, work in small groups, seminars, discussions, brainstorming, presentations that develop communication and leadership skills, independent work with literary sources; methods of project-based learning and challenge-based learning within the program "Ucode Connect" in the training laboratory Innovation Campus of the SEMIT Department of NTU "KhPI"; mixed forms of learning using distance platforms.
Assessment	Oral and written exams, tests, testing. Assessment is carried out on a national scale (excellent, good, satisfactory, unsatisfactory); 100 - scale and ECTS scale (A, B, C, D, E, FX, F).
6 – Programme competencies	
Integral competence	Ability to solve complex specialized problems or practical problems of software engineering, characterized by complexity and uncertainty of conditions, using theories and methods of information technology
General competencies (GC)	<p>GC 01. Ability to abstract thinking, analysis and synthesis.</p> <p>GC 02. Ability to apply knowledge in practical situations.</p> <p>GC 03. Ability to communicate in the state language both orally and in written form.</p> <p>GC 04. Ability to communicate in a foreign language both orally and in written form.</p> <p>GC 05. Ability to learn and master modern knowledge.</p> <p>GC 06. Ability to search, process and analyze information from various sources.</p> <p>GC 07. Ability to work in a team.</p>

	<p>GC08. Ability to act for ethical reasons.</p> <p>GC09. The desire to preserve the environment.</p> <p>GC10. The ability to act socially responsibly and consciously.</p> <p>GC11. 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.</p> <p>GC12. 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>Professional competencies of the speciality (PC)</p>	<p>PC13. Ability to identify, classify and formulate software requirements.</p> <p>PC14. Ability to participate in software design, including modelling (formal description) of its structure, behavior and functioning processes.</p> <p>PC15. Ability to develop architectures, modules and components of software systems.</p> <p>PC16. Ability to formulate and ensure software quality requirements in accordance with customer requirements, specifications and standards.</p> <p>PC17. Ability to adhere to specifications, standards, rules and recommendations in the professional field in the implementation of life cycle processes.</p> <p>PC18. Ability to analyze, select and apply methods and tools to ensure information security (including cybersecurity).</p> <p>PC19. Knowledge of information data models, the ability to create software for data storage, retrieval and processing.</p> <p>PC20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems.</p> <p>PC21. Ability to assess and take into account economic, social, technological and environmental factors affecting the sphere of professional activity.</p> <p>PC22. Ability to accumulate, process and systematize professional knowledge on the creation and maintenance of software and recognition of the importance of lifelong</p>

	<p>learning.</p> <p>PC23. Ability to implement phases and iterations of the life cycle of software systems and information technology based on appropriate models and approaches to software development.</p> <p>PC24. Ability to carry out the system integration process, apply change management standards and procedures to maintain the integrity, overall functionality and reliability of the software.</p> <p>PC25. Ability to reasonably select and master software development and maintenance tools.</p> <p>PC26. Ability to algorithmic and logical thinking.</p>
7 – Programme learning outcomes	
<p>Programme learning outcomes in general training</p>	<p>PLO 1. Analyze, purposefully search for and select the necessary information and reference resources and knowledge to solve professional problems, taking into account modern advances in science and technology.</p> <p>PLO 2. Know the code of professional ethics, understand the social significance and cultural aspects of software engineering and adhere to them in professional activities.</p> <p>PLO 3. Know the basic processes, phases and iterations of the software life cycle.</p> <p>PLO 4. Know and apply professional standards and other regulatory documents in the field of software engineering.</p> <p>PLO 5. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.</p> <p>PLO 6. Ability to select and use the appropriate task methodology of software development.</p> <p>PLO 7. Know and apply in practice the fundamental concepts, paradigms and basic principles of operation of language, tools and computing software engineering.</p> <p>PLO 8. Be able to develop a human-machine interface.</p> <p>PLO 9. Know and be able to use methods and tools for collecting, formulating and analyzing software requirements.</p> <p>PLO10. Conduct a pre-project survey of the subject area, systematic analysis of the design object.</p> <p>PLO11. Choose source data for design, guided by formal methods of describing requirements and modelling.</p> <p>PLO12. Put effective approaches to software design into practice.</p> <p>PLO13. Know and apply methods of algorithm development, software design and data and knowledge</p>

	<p>structures.</p> <p>PLO14. Put into practice the tools of domain analysis, design, testing, visualization, measurement and documentation of software.</p> <p>PLO15. Being motivated to choose programming languages and development technologies to solve problems of software design and maintenance.</p> <p>PLO16. Have the skills of team development, approval, design and release of all types of software documentation.</p> <p>PLO17. Be able to apply methods of component software development.</p> <p>PLO18. Know and be able to apply information technology processing, storage and transmission of data.</p> <p>PLO19. Know and be able to apply methods of software verification and validation.</p> <p>PLO20. Know the approaches to evaluating and ensuring the quality of software</p> <p>PLO21. Know, analyze, select, skillfully apply the means of information security (including cybersecurity) and data integrity in accordance with the applied tasks and software systems.</p> <p>PLO22. Know and be able to apply methods and tools of project management.</p> <p>PLO23. Be able to document and present the results of software development.</p> <p>PLO24. Be able to calculate the economic efficiency of software systems.</p> <p>PLO25. 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>
8 – Resource support for programme implementation	
Staffing plan	<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).</p> <p>Instructors-practitioners, specialists and employees of IT companies, as well as foreign specialists are involved in teaching.</p>

Logistics	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 conditions for educational activities of educational institutions” of December 30, 2015. № 1187, Annex 13).
Information and educational and methodological support	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). Application in the educational process of LMS (Learning management system) Ucode. The Scopus scientometric database is available for remote work on the territory of the university and there is access to unique information on the Web of Science.
9 – Academic mobility	
National credit mobility	Based on bilateral agreements on academic mobility.
International credit mobility	On the basis of bilateral agreements, as well as within the framework of ERASMUS + KA1 academic mobility programs, in particular with University Paris 13, France; University of Maribor, Slovenia; University of Klagenfurt, Austria.
Training of foreign higher education applicants	The license provides for the training of foreigners and stateless persons.

2. List of components of the professionally-oriented educational programme and their logical sequence

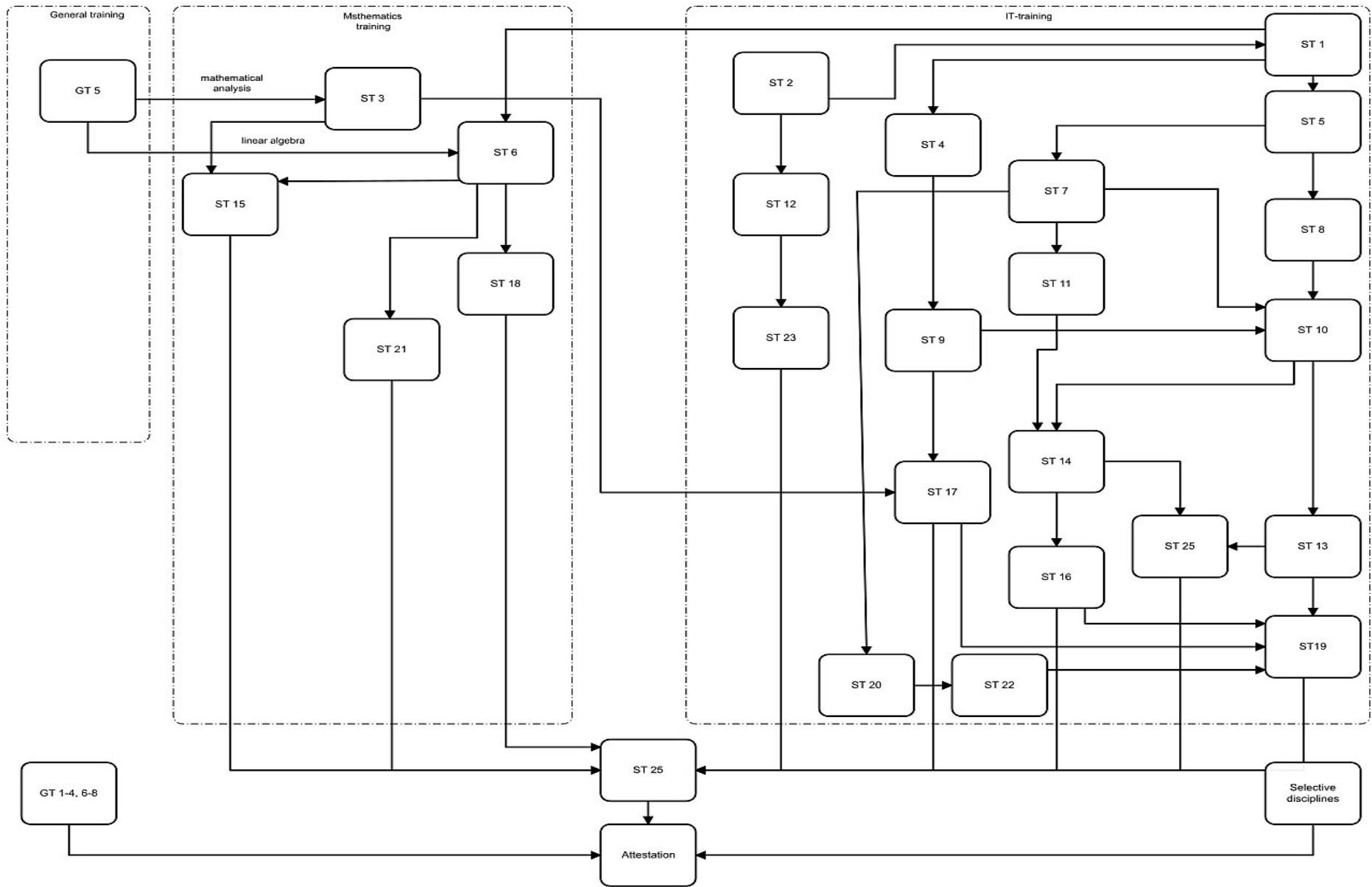
2.1. List of EP components

A/D code	Components of the educational programme	Credit number	Final control form
1	2	3	4
Mandatory components of EP			
<i>General training</i>			
GT 1	History and culture of Ukraine	3	Exam
GT 2	Ukrainian language (professional orientation)	3	Exam
GT 3	Foreign language for professional purposes	12	Test, Exam in the final semester
GT 4	Philosophy	3	Exam
GT 5	Higher mathematics	12	Exam
GT 6	Physics	4	Exam
GT 7	Green computing	3	Exam
GT8	Physical education	12	Test
<i>Special (professional) training</i>			
ST 1	Programming basics	10	Exam
ST2	Fundamentals of software engineering	4	Test
ST3	Probability theory and mathematical statistics	6	Exam
ST4	Computer architecture fundamentals and operating systems	4	Test
ST5	Fundamentals of the theory of algorithms	4	Test
ST 6	Computer mathematics	15	Test, Exam in the final semester
ST7	Data models and structures	3	Exam
ST8	Object-oriented programming. Introductory practice	4	Exam
ST9	Fundamentals of computer networks	3	Test
ST10	Fundamentals of web development	3	Exam
ST11	Design and development of databases	3	Exam
ST12	Software requirements engineering	3	Test
ST13	CI/CD Cloud Computing	3	Test
ST 14	Architecture and design of software	8	Exam
ST 15	Practical seminar on mathematical methods in software engineering	5	Test
ST16	Software quality, testing and support	3	Exam
ST17	Fundamentals of cybersecurity	3	Exam
ST18	Decision making theory	4	Exam
ST19	Scientific and practical seminar Software Engineering	7	Test
ST20	Software modeling and analysis	5	Exam
ST21	Mathematical models and system analysis	4	Test
ST22	Artificial intelligence systems	3	Test
ST 23	Fundamentals of software project management	3	Exam

1	2	3	4
ST 24	Project	6	Test
ST 25	Pre-graduation practice	6	Test
	Attestation	6	
	Total volume of mandatory components:	180	
Selective components of EP			
SP1	Profiled set of disciplines 01 "Research and Development"	25	
SP1.1	Probabilistic models	4,0	Test
SP1.2	Knowledge representation models	6,0	Test
SP1.3	Fuzzy logic and fuzzy systems	4,0	Test
SP1.4	Machine learning	3,0	Test
SP1.5	Experiment planning	4,0	Test
SP1.6	Intelligent systems modeling technologies	4,0	Test
SP2	Profiled set of disciplines 02 «Software Development and Startup»	25	Test
SP 2.1	Fundamentals of entrepreneurship	4,0	Test
SP 2.2	Startup business models	6,0	Test
SP 2.3	Internet marketing	4,0	Test
SP 2.4	Startup business analytics	3,0	Test
SP 2.5	Fundamentals of prototyping	4,0	Test
SP 2.6	Fundamentals of business planning	4,0	Test
SP3	Profiled set of disciplines 03 «Innovation Campus»	25	Test
SP 3.1	Development of corporate information systems (part 1)	4,0	Test
SP 3.2	Development of corporate information systems (part 2)	6,0	Test
SP 3.3	Databases for corporate information systems	4,0	Test
SP 3.4	Architecture of corporate information systems	3,0	Test
SP 3.5	Project workshop	4,0	Test
SP 3.6	Formation and Development of IT Project Teams	4,0	Test
SDP	Selective disciplines of professional training according to the List	24	
SD	Selective disciplines from the University Catalog of Disciplines	11	
Total volume of selective components		60	
TOTAL VOLUME OF THE EDUCATIONAL PROGRAMME		240	

2.2 Structural and logical scheme of EP

1 year		2 year		3 year		4 year	
1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
Foreign Language GT3							
Physical EducationGT8						Green Computing GT7	Philosophy GT4
History and culture of Ukraine GT 1	Ukrainian Language GT 2	Data models and structures ST7	Fundamentals of web-development ST10	Architecture and design of Software ST14			
Higher mathematics GT5		Object-oriented programming. Introductory practice ST8	Design and development of DBST11	CI/CD Cloud Computing ST13	Project ST24	Decision-making theory ST18	Artificial intelligence systems ST 22
Programming basics ST 1					Fundamentals of computer networks ST9	Software requirements Engineering ST12	Software quality, testing and support ST16
Fundamentals of SEST2	Fundamentals of the theory of algorithms ST5	Computer mathematics ST6			Fundamentals of Cyberecurity ST17	Selective component of EP (ST1.5 or ST2.5orST3.5)	Mathematical models and system analysis ST 21
Physics GT 6	Computer architecture fundamentals and operating systems ST4	Computer mathematics ST6			Practical seminar on mathematical methods in SEST15	Selective component of EP (ST1.6 or ST2.6 or ST3.6)	Pre-graduation practice ST25
	Probability theory and mathematical statistics ST3	Selective component of EP (ST1.1 or ST2.1 or ST3.1)	Selective component of EP (ST1.2orST2.2orST3.2)	Selective component of EP (ST1.3orST2.3orST3.3)	Selective component of EP (ST1.4 or ST2.4orST3.4)	Scientific and practical seminar Software Engineering ST19	
		Selective disciplines SDP			Selective disciplines SD		



Semester	Components of the educational programme
1	GT 1, GT 3, GT 5, GT6, GT 8, ST1, ST2
2	GT 2, GT 3, GT5, GT 8, ST 1, ST 3, ST4, ST5
3	GT 3, GT8, ST 6, ST 7, ST 8, ST 9, SP x.1, SDP
4	GT 3, GT 8, ST 6, ST 10, ST 11, ST 12, SP x.2, SDP
5	GT 3, GT 8, ST 6, ST13, ST 14, SP x.3, SDP , SD
6	GT 3, GT8, ST 14, ST 15, ST 16, ST 17, SP x.4, SD
7	GT3, GT7, ST 18, ST 19, ST 20. SP x.5, SP x.6, SD
8	GT3, GT4, ST 19, ST 21, ST 22, ST 23, ST 25

3. Higher education applicants' certification

Types of higher education applicant's certification	Certification is carried out in the form of the public defense of a qualifying bachelor's thesis
Requirements for qualifying work	<p>Qualification work involves solving a specialized problem or a practical problem of software engineering, characterized by complexity and uncertainty of conditions, using theories and methods of information technology.</p> <p>There can be no academic plagiarism, falsification or writing off in the qualification work.</p> <p>Qualification work must be published on the official website of the higher education institution or its subdivision, or in the repository of the higher education institution.</p> <p>Publication of qualification works containing information with limited access should be carried out in accordance with the requirements of current legislation.</p>

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

	PC01	PC02	PC03	PC04	PC05	PC06	PC07	PC08	PC09	PC10	PC11	PC12	PC13	PC14	PC15	PC16	PC17	PC18	PC19	PC20	PC21	PC22	PC23	PC24	PC25	PC26	
GT1			*		*	*		*		*	*	*															
GT2		*	*	*	*	*											*										
GT3		*		*	*	*						*					*										
GT4	*		*		*	*		*		*	*	*											*			*	
GT5	*				*																*						
GT6	*				*																*						
GT7	*	*			*	*			*	*	*										*	*					
GT8		*			*	*						*															
ST 1	*	*			*	*								*											*	*	
ST2	*			*	*	*	*	*	*			*	*	*		*	*						*			*	
ST3	*				*	*																				*	
ST4					*	*																					
ST5	*				*	*																				*	*
ST6	*				*	*																					*
ST7	*				*	*								*	*				*				*				*
ST8		*			*	*	*							*	*								*			*	
ST9					*	*																	*				
ST10					*	*							*	*									*			*	
ST 11		*			*	*							*	*	*				*							*	
ST12					*	*							*	*		*	*	*						*	*	*	*
ST13					*	*																		*	*	*	
ST14		*			*	*							*	*	*		*		*				*	*	*	*	
ST15	*	*	*		*	*	*																*				*
ST16					*	*								*		*	*							*			
ST17					*	*													*								
ST18	*				*	*																					*
ST19	*	*	*	*	*	*	*	*					*	*	*					*				*		*	*
ST20	*				*	*								*	*	*	*		*								*
ST21	*				*	*																					*
ST22	*				*	*																				*	*
ST23		*			*	*	*							*			*					*					*
ST24		*	*		*	*	*		*				*	*	*		*		*	*	*		*	*		*	*
ST25		*	*		*	*	*	*	*	*			*	*	*			*	*	*	*	*	*	*	*	*	*

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

	PLO01	PLO02	PLO03	PLO04	PLO05	PLO06	PLO07	PLO08	PLO09	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20	PLO21	PLO22	PLO23	PLO24	PLO25
GT 1	*	*																							
GT2	*	*																					*		
GT3	*																						*		
GT4	*	*																							
GT5	*																								
GT6	*																								
GT7	*																								
GT8																									*
ST 1						*	*				*	*			*	*									
ST2		*	*			*					*					*									
ST3							*																		
ST4										*						*									
ST5										*			*												
ST6							*																		
ST7					*		*									*									
ST8					*										*	*									
ST9						*								*	*	*									
ST10						*						*			*	*									
ST11						*						*			*	*		*							
ST12	*		*	*		*	*		*						*	*									
ST13													*		*	*									
ST14			*							*			*	*		*	*								
ST15	*			*		*			*		*					*									
ST16														*					*	*					
ST17																*						*			
ST18						*										*									
ST 19	*			*						*		*				*	*							*	
ST20						*					*														
ST21						*																			
ST22							*	*																	
ST23			*													*							*		
ST24				*			*									*	*						*	*	
ST 25							*					*				*							*	*	

Head of the graduating department _____ Mykhailo GODLEVSKYI

Head of the specialty design group

(EP Guarantor)

_____ Yuliia LITVINOVA