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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
PETRO MOHYLA BLACK SEA NATIONAL UNIVERSITY

EDUCATIONAL AND PROFESSIONAL PROGRAMME

"Software Engineering"
of the second level of higher education
in the specialty 121 "Software Engineering"
of the field of knowledge 12 "Information Technology".
Qualification: Master of Software Engineering

APPROVED BY THE ACADEMIC COUNCIL

Chairman of the Academic Council
_____ L. P. Klymenko
(Minutes No. 6 of "01" July 2024)

The educational programme is implemented from
"01" September 2024

Rector
_____ L. P. Klymenko
(Order No. 6-ВР of "01" July 2024)

Mykolaiv – 2024

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LETTER OF APPROVAL
of the educational and professional programme

Level of higher education	Second (master's) degree
Degree of higher education	Master's degree
Field of knowledge	12 Information Technology
Specialty	121 Software Engineering
Educational qualification	Master's degree in software engineering
Scope	90 ECTS credits
Duration of study	1 year 4 months

Head of the developing institution
Rector of
Petro Mohyla Black Sea National University

_____ L. P. Klymenko
"01" 07 2024

Guarantor of the educational programme
Doctor of Technical Sciences, Professor,
Professor of the Department of Software Engineering of
Petro Mohyla Black Sea National University

_____ A. V. Shved
"01" 07 2024

APPROVE
First Vice-Rector of
Petro Mohyla Black Sea National University

_____ Yu. V. Kotliar
"01" 07 2024

APPROVE
Dean of the Faculty of Computer Science of
Petro Mohyla Black Sea National University

_____ A. P. Boiko
"01" 07 2024

APPROVE
Head of the educational and methodical department of
Petro Mohyla Black Sea National University

_____ S. I. Shkirchak
"01" 07 2024

APPROVE
Head of the Department of
of Software Engineering of
Petro Mohyla Black Sea National University

_____ Ye. O. Davydenko
"01" 07 2024

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PREFACE

The Educational and professional programme (EPP) “Software Engineering” for the preparation of applicants for higher education of the second (master's) level in the specialty 121 “Software Engineering” of the field of knowledge 12 “Information Technology” in the scope of 90 ECTS credits with a study period of 1 year 4 months is necessary for obtaining the appropriate higher education degree “Master” with a qualification “Master of Software Engineering”.

The OPP contains the purpose and characteristics of the educational programme, professional job titles (according to the Classifier of Professions of Ukraine DK 003:2010) for graduate employment and opportunities for further education; approaches, methods and technologies of teaching and assessment; list of graduate competencies; programme learning outcomes; resource support for the implementation of the programme and data on academic mobility of the programme.

The mandatory and elective components of the EPP, the structural and logical scheme of the EPP are provided; the forms of certification of higher education applicants are described; the matrix of compliance of graduate programme competencies with the components of the EPP and the matrix of ensuring programmatic learning outcomes with the relevant components of the EPP are described.

The EPP was developed by a working group consisting of:

1. Shved Alona Volodymyrivna, Doctor of Technical Sciences (specialty 05.13.06 – Information Technology), Professor, Professor of the Department of Software Engineering, Head of the working group (guarantor of the educational programme);

2. Fisun Mykola Tykhonovych, Doctor of Technical Sciences (specialty 05.13.06 – Information Technology), Professor, Professor of the Department of Software Engineering;

3. Davydenko Yevhen Oleksandrovych, PhD in Technical Sciences (specialty 05.13.06 – Information Technologies), Associate Professor, Head of the Department of Software Engineering;

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4. Horban Hlib Valentynovych, PhD in Technical Sciences (specialty 05.13.06 – Information Technologies), Associate Professor, Associate Professor of the Department of Software Engineering.

The educational and professional programme “Software Engineering” for the training of specialists of the second (master's) level of higher education in the specialty 121 “Software Engineering” is developed in accordance with current international and national regulatory documents and methodological recommendations.

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1 PROFILE OF THE EDUCATIONAL PROGRAMME OF THE SPECIALTY 121 "SOFTWARE ENGINEERING"

1 – General information	
Full name of the higher educational institution and structural unit	Petro Mohyla Black Sea National University, Faculty of Computer Science.
Degree of higher education and title of qualification in the original language	Master's degree. Master of Software Engineering.
Official name of the educational programme	Software Engineering.
Type of diploma and scope of the educational programme	Master's degree, single. Scope: 90 ECTS credits. Duration of study: 1 year 4 months.
Availability of accreditation	Accredited by the National Agency for Higher Education Quality Assurance. Certificate of accreditation of the specialty № 3887 issued on 29.12.2022, valid until 01.07.2028.
Cycle/level	Second (master's) level. NQF of Ukraine – level 7, FQ-ENEA – second cycle, EQF-LLL – level 7.
Prerequisites	Admission conditions are determined by the "Rules for Admission to the Petro Mohyla Black Sea National University", confirmed by the Rector and approved by the Academic Council of the Petro Mohyla Black Sea National University. Bachelor's and Master's Degree (Specialist's Degree).
Languages of teaching	Ukrainian, English.
Duration of the educational programme	Until the end of the study period or the next update of the educational programme, but not more than 5 years.
Internet address of the permanent placement of the educational programme description	https://chmnu.edu.ua/training-information-base-computers/
2 – The purpose of the educational programme	
To meet the needs of society, the state and the region in modern high-quality training of qualified, competitive specialists who are able to set production tasks for the development, quality assurance of implementation and maintenance of software tools; to find rational methods and means of solving them; to ensure the sustainable development of IT companies in terms of the quality of software development processes and results.	
3 – Characteristics of the educational programme	
Subject area (field of knowledge, specialty, specialization)	Field of knowledge 12 "Information Technology" Specialty 121 "Software Engineering"

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Orientation of the educational programme	Educational and professional
Main focus of the educational programme	Organization and management of solving complex specialized tasks or practical problems of software engineering, characterized by complexity and uncertainty of conditions, using the theory and methods of information technology. *Keywords: modeling, design, system programming, software, software engineering, software verification, software validation, software life cycle.*
Programme specific features	The programme is designed to meet the needs of regional companies and to train specialists to meet the needs of regional companies. In particular, it focuses on the development of applications using artificial intelligence and Data Science methods, as there are a number of companies in the region that require specialists with relevant knowledge.
4 – Suitability of graduates for employment and further education	
Employability of graduates	Graduates with the educational qualification "Master of Software Engineering" can be employed at enterprises, institutions and establishments of any form of ownership as specialists in IT departments or at enterprises working in the field of IT technologies. According to the current version of the National Classifier of Ukraine DK 003:2010 – Classifier of professions – graduates can hold positions in the section "Professionals" by codes: 2131.2 Computer system developers: System administrator; Computer software engineer. 2132.2 Computer program developers: Software engineer; Programmer (database); System programmer. 2139.2 Professionals in other fields of computing: Computer application engineer. According to the classifier of economic activities NACE DK 009:2010, specialists who have completed the educational programme "Software Engineering" may be engaged in the following activities: 162.01 Computer programming. 162.02 Consulting on informatization issues. 162.09 Other activities in the field of information technology and computer systems.
Further education	Graduates with the educational qualification "Master of Software Engineering" can continue their education through: – training at the 8th qualification level of the National Qualifications Framework in the field of 12 – Information Technology – at the third (educational and scientific) level of higher education;

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	– training at the 7th qualification level of the National Qualifications Framework in related specialties at the second (educational and professional) level of higher education; – educational programmes, research grants and scholarships containing additional scientific and educational components.
	5 – Teaching and assessment
Teaching and learning	Teaching is conducted in the form of lectures (in-person, multimedia, distance), laboratory and practical classes, coursework, internships, consultations with teachers, and independent work of students. The Moodle system is also used for distance learning.
Assessment	The types of control – regular and final (exam, differentiated credit, credit, certification, defense of coursework) – are defined in the "Regulations on the Procedure and Methodology for Conducting Tests and Exams at the Petro Mohyla Black Sea National University". The final semester grades are assigned according to the ECTS scale (from A to F) and the national scale: for exams – excellent / good / satisfactory / unsatisfactory; for credits – passed / failed. The curriculum provides for exams, credits, internships, coursework and final certification – defense of a master's thesis.
	6 – Programme competencies
Integral competence	The ability of a person to solve complex tasks and problems in a particular field of professional activity or in the learning process, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.
General competencies (GC)	GC01. Ability to think abstractly, analyze and synthesize. GC02. Ability to communicate in a foreign language both orally and in writing. GC03. Ability to conduct research at the appropriate level. GC04. Ability to communicate with representatives of other professional groups of different levels (with experts in other fields of knowledge / types of economic activity). GC05. Ability to generate new ideas (creativity).
Professional competencies of the specialty (PC)	PC01. Ability to analyze subject areas, formulate, classify software requirements. PC02. Ability to develop and implement scientific and / or applied projects in the field of software engineering. PC03. Ability to design software architecture, model the processes of functioning of individual subsystems and modules. PC04. Ability to develop and implement new competitive ideas in software engineering. PC05. Ability to develop, analyze and apply specifications, standards, rules and guidelines in the field of software engineering. PC06. Ability to effectively manage financial, human, technical and other project resources in the field of software engineering.

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	PC07. Ability to critically think about problems in the field of information technology and at the boundaries of knowledge areas, integrate relevant knowledge and solve complex problems in broad or multidisciplinary contexts. PC08. Ability to develop and coordinate the processes, stages and iterations of the software life cycle based on the application of modern software development models, methods and technologies. PC09. Ability to ensure software quality. *PC10. Ability to apply artificial intelligence methods.*
	7 – Programme learning outcomes
	PLO01. To know and apply modern professional standards and other regulatory documents on software engineering. PLO02. Evaluate and select effective methods and models for the development, implementation, maintenance of software and management of relevant processes at all stages of the life cycle. PLO03. Build and research models of information processes in the applied field. PLO04. Identify information needs and classify data for software design. PLO05. Develop, analyze, justify and systematize software requirements. PLO06. Develop and evaluate software design strategies; justify, analyze and evaluate design options in terms of the quality of the final software product, resource constraints and other factors. PLO07. Analyze, evaluate and apply modern software and hardware platforms at the system level to solve complex software engineering problems. PLO08. Develop and modify software architecture to meet customer requirements. PLO09. Reasonably choose paradigms and programming languages for software development; apply in practice modern software development tools. PLO10. Modify existing and develop new algorithmic solutions for detailed software design. PLO11. Ensure quality at all stages of the software life cycle, including the use of relevant assessment models and methods, as well as automated software testing and verification tools. PLO12. Make effective organizational and management decisions in the face of uncertainty and changing requirements, compare alternatives, and assess risks. PLO13. Configure software, manage its changes and develop software documentation at all stages of the life cycle. PLO14. Predict the development of software systems and information technology. PLO15. To reengineer software in accordance with customer requirements.

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	PLO16. To plan, organize and carry out testing, verification and validation of software. PLO17. Collect, analyze, evaluate information necessary for solving scientific and applied problems using scientific and technical literature, databases and other sources. *PLO18. Develop applications using artificial intelligence methods.*
	8 – Resource support for programme implementation
HR support	The implementation of the educational programme is ensured by highly qualified personnel with academic degrees and academic titles, who have extensive experience in teaching, methodological, research work and meet the qualifications in accordance with the specialty in accordance with the licensing regulations. The programme involves more than 80% of academic staff with a degree and/or academic rank, at least 20% of whom have a doctorate or professorship. A system of professional development of teachers has been implemented, in particular through cooperation with leading IT companies. IT employers and practitioners are involved in the educational process.
Material and technical support	The material and technical support allows us to fully ensure the educational process throughout the entire cycle of training under the educational programme. The condition of the premises is certified by sanitary and technical passports and complies with existing regulations. Classrooms and laboratories are equipped with modern teaching aids and computer equipment. Each of the computer classes has from 12 to 25 computers with the necessary software installed, which allows the educational process to be conducted in accordance with modern requirements. There is a local computer network and access to the Internet. Applicants also have the opportunity to use their own PCs with free access to the Internet via wireless communication (Wi-Fi). Within the department there are laboratories of system software and software engineering.
Information, teaching and methodological support	The official website https://chmnu.edu.ua/ contains information about educational programmes, admission rules, regulations on structural units, academic and other activities, employment prospects, student organizations, international projects and academic mobility programmes, etc. All university staff, teachers, and students have access to the Internet at an unlimited corporate rate for legal entities. The library of the Petro Mohyla Black Sea National University provides access to the necessary specialized educational and scientific literature (174 thousand copies) through a subscription and in a reading room with 238 seats. There is also an institutional repository that provides online access to textbooks, manuals, guidelines and qualification works of the graduates of the Petro

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	Mohyla Black Sea National University published by the faculty. Users of the university's local computer network have access to the resources of scientometric databases Web of Science and Scopus. The distance learning system Moodle 3.0 is actively used in the course of training. E-courses for all academic disciplines have been created to support the educational programme.
	9 – Academic mobility
National credit mobility	On the basis of bilateral agreements between Petro Mohyla Black Sea National University and higher education institutions of Ukraine.
International credit mobility	On the basis of bilateral agreements between the Petro Mohyla Black Sea National University and higher education institutions of partner countries.
Training of foreign students	Training of foreign students is carried out on general terms with additional language training.

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2 LIST OF COMPONENTS OF THE EDUCATIONAL AND PROFESSIONAL PROGRAMME "SOFTWARE ENGINEERING" AND THEIR LOGICAL SEQUENCE

2.1 List of components of the EPP

Code n/a	Components of the educational programme (academic disciplines, course work, internships, qualification work)	Number of ECTS credits	Form of final control
1 NORMATIVE ACADEMIC DISCIPLINES			
	1.1 General training cycle		
GT.01	Professional foreign language	3	Credit
GT.02	Professional pedagogy	3	Credit
GT.03	Fundamentals of scientific research	3	Examination
	Total for the cycle	**9**	
	1.2 Professional training cycle		
PT.01	Methods of decision making	5	Credit
PT.02	Artificial intelligence systems	5	Examination
PT.03	Requirements for software	5	Credit
PT.04	Design of information systems	5	Examination, CW*
PT.05	Data Science methods in software engineering	4,5	Credit
PT.06	Deep machine learning	6	Examination, CW*
PT.07	Assistant internship	3	Diff. credit
PT.08	Pre-certification internship	7,5	Diff. credit
PT.09	Qualification work	15	
	Total for the cycle	**56**	
	Total for the normative part	**65**	
2. ELECTIVE ACADEMIC DISCIPLINES			
	2.1 General training cycle		
EGT.01	***Discipline 1 (from the university catalog of courses)*** **	5	Credit
	2.2 Professional training cycle		
	Discipline 1	4	Credit
	Discipline 2	4	Credit
	Discipline 3	4	Credit
	Discipline 4	4	Credit
	Discipline 5	4	Credit
EPT.01	Applied system analysis		
EPT.02	Methods of software systems development		
EPT.03	Digital transformation of business		
EPT.04	Logistics analysis technologies		
EPT.05	Decision making in conditions of fuzziness and multicriteria		

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Code n/a	Components of the educational programme (academic disciplines, course work, internships, qualification work)	Number of ECTS credits	Form of final control
EPT.06	Wireless computer networks		
EPT.07	Software for processing large amounts of data		
EPT.08	Applied computer vision		
EPT.09	Fuzzy sets and fuzzy logic in data processing		
EPT.10	Methods and systems of machine learning		
EPT.11	Knowledge-based technologies of computational intelligence		
EPT.12	Risk modelling in socio-economic systems		
EPT.13	Intelligent decision support systems		
EPT.14	Digitalization in the financial sector		
EPT.15	Software engineering methods in Big Data		
EPT.16	Models and methods of scenario analysis		
EPT.17	Fuzzy models and methods in decision-making systems		
EPT.18	Scenario modelling		
	Total for the elective part	**25**	
	Total for the educational programme	**90**	

Notes:

* – course work;

** – the list of elective disciplines is selected from the university-wide course catalog (may be changed upon proposals and recommendations of employers, higher education applicants or the scientific and pedagogical staff of the Petro Mohyla Black Sea National University with the approval of the Department of Software Engineering, the Scientific and Methodological Council of the Faculty of Computer Science, the Academic Council of the Petro Mohyla Black Sea National University).

2.2 Distribution by discipline cycles

№	Components of the educational and professional programme	Scope of the academic workload of a higher education student (credits / %)		
		Normative academic disciplines	**Elective academic disciplines**	**Total for the entire period of study**
1.	General training cycle	9/10%	5/5,5%	14/15,5%
2.	Professional training cycle	30,5/34,5%	20/22%	50,5/56,5%
3.	Practical training cycle	10,5/11,5%	–	10,5/11,5%
4.	Qualification work	15/16,5%	–	15/16,5%
	Total	65/72,5%	25/27,5%	90/100%

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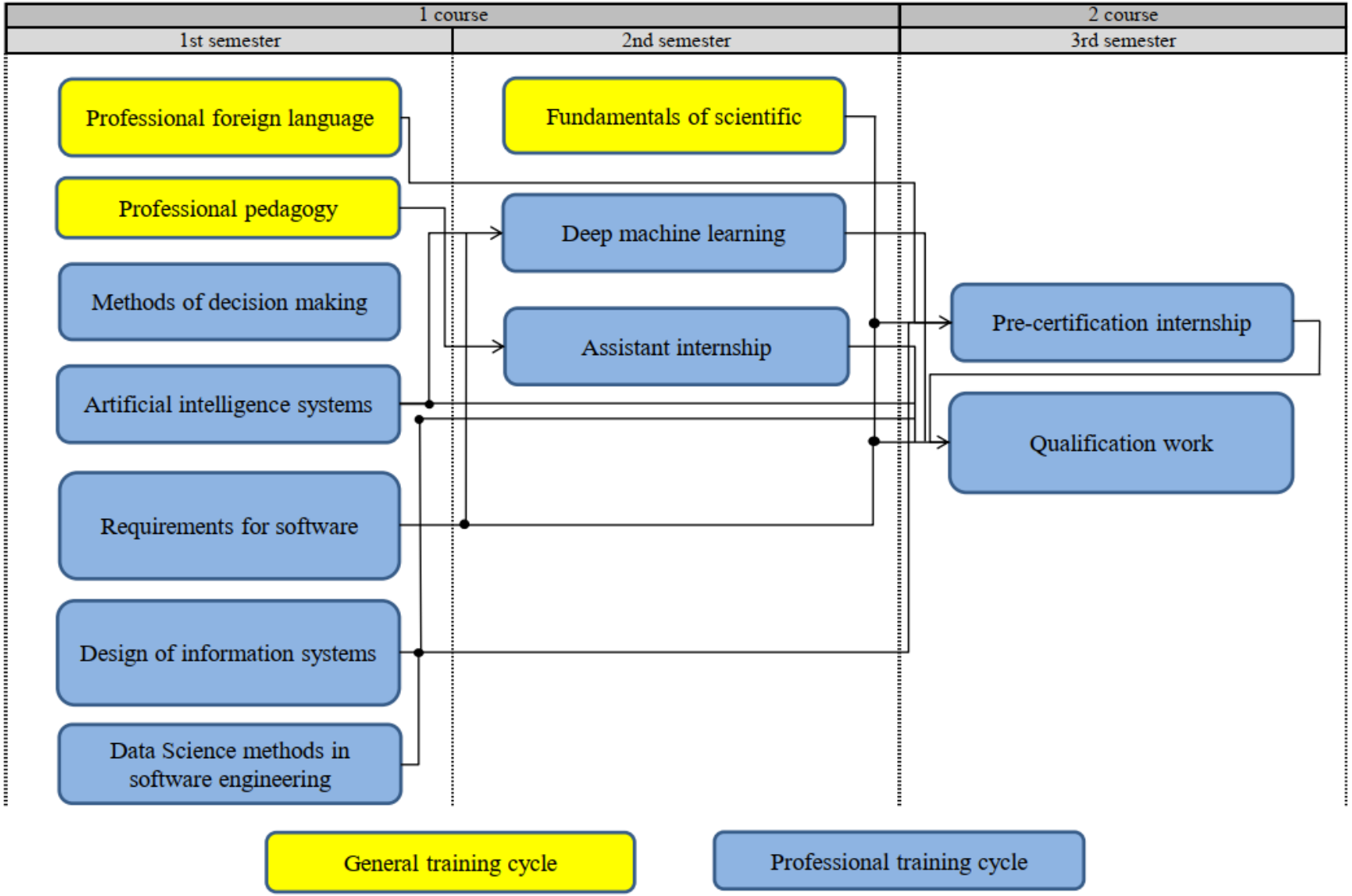
2.3 Structural and logical scheme of Master's training in specialty 121 “Software Engineering”



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3 FORMS OF CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Certification of graduates of the educational programme “Software Engineering” of the specialty 121 “Software Engineering” is carried out in the form of a public defense of qualification work.

The successful defense of the qualification work ends with the issuance of a standardized document on the award of a master's degree with the assignment of qualifications to the applicant: Master of Software Engineering.

Certification is carried out openly and publicly.

Forms of certification of higher education applicants	*Certification is carried out in the form of a public defense of qualification work.*
Requirements for qualification work	The qualification work must solve a complex task or problem of software engineering and involve research and/or innovation. *The qualification work must not contain academic plagiarism, fabrication, or falsification. The verification takes place using an online service. The 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.* *Qualification papers containing information with restricted access shall be published in accordance with the requirements of applicable law.*

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4 MATRIX OF CORRESPONDENCE OF PROGRAMME COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAMME

Code n/a	GC01	GC02	GC03	GC04	GC05	PC01	PC02	PC03	PC04	PC05	PC06	PC07	PC08	PC09	PC10
NORMATIVE ACADEMIC DISCIPLINES															
General training cycle															
GT.01		+		+											
GT.02	+			+	+		+			+	+				
GT.03	+		+		+	+				+		+			
Professional training cycle															
PT.01	+		+		+		+		+			+			
PT.02	+	+	+									+			+
PT.03			+	+		+		+		+			+	+	
PT.04	+		+			+	+	+			+		+		
PT.05	+		+		+		+		+			+			
PT.06	+		+				+					+		+	+
PT.07	+		+	+	+	+				+	+	+			
PT.08	+			+	+	+		+		+			+	+	
PT.09	+		+		+	+	+	+	+	+	+	+	+	+	

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5 MATRIX OF PROVIDING PROGRAMME LEARNING OUTCOMES WITH RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAMME

Code n/a	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05	PLO 06	PLO 07	PLO 08	PLO 09	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15	PLO 16	PLO 17	PLO 18
NORMATIVE ACADEMIC DISCIPLINES																		
General training cycle																		
GT.01																	+	
GT.02	+											+					+	
GT.03	+			+													+	
Professional training cycle																		
PT.01		+		+		+						+		+			+	
PT.02							+		+	+							+	+
PT.03	+		+		+			+			+		+		+	+		
PT.04	+	+		+		+				+					+		+	
PT.05		+		+		+						+		+			+	
PT.06			+	+			+										+	+
PT.07	+		+				+					+		+			+	
PT.08	+				+			+	+		+		+			+		
PT.09	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	

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