MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

TERNOPIL IVAN PULUJ NATIONAL TECHNICAL UNIVERSITY

EDUCATIONAL-PROFESSIONAL PROGRAM

«Computer engineering»

of the first level of higher education

on specialty 123 Computer engineering

Branch of knowledge 12 «Information technologies»

Qualification: Bachelor in Computer engineering

Approved by the Academic Council of Ternopil Ivan Puluj national technical university

Head of Academic Council

_____ / Yasniy P.V. /

(Minutes № 4 of "16" 04 2019)

Educational program is launched since 01.09 2019

Rector _____ / Yasniy P.V. /

(order № 47-2 of "22" 04 2019)

Ternopil 2019

PREFACE

Developed by the project group of the (specialty 123 «Computer engineering») based on the standard of higher education (order №1262 of 19.11.2018 «On Approval of the standard of higher education on specialty 123 «Computer engineering» for the first (Bachelor's) level of higher education») consisting of:

1. Lupenko Serhii, Doctor of Science (Engineering), Professor, Prof. of the Computer Systems and Networks Department of the Ternopil I.Puluj National Technical University
2. Osukhivska Halyna, Ph.D. in Engineering Science, Associate Prof., Head of the Computer Systems and Networks Department of the Ternopil I.Puluj National Technical University
3. 3. Lutskiv Andrii, Ph.D. in Engineering Science, Associate Prof. of the Computer Systems and Networks Department of the Ternopil I.Puluj National Technical University

Reviews of external stakeholders:

1. Dmytryshyn Serhii — owner and founder of LLC "CROWDIN" (Ternopil)

2. Deren Andrii — co-owner and manager of LLC "Dreams Innovative Technologies" (Ternopil)

1. Bachelor's Training Program in Specialty 123 "Computer engineering "

1 – General information	
Full name of the higher educational establishment and a structural subdivision	Ternopil I.Puluj national technical university, Faculty of Computer Information Systems and Software Engineering, Computer Systems and Networks Department
Educational qualification	Degree of higher education – Bachelor of Science Specialty - 123 Computer engineering Qualification – Bachelor in Computer engineering
Program official name	Educational-professional program «Computer engineering» of the first (Bachelor) level of higher education on specialty 123 «Computer engineering» branch of knowledge 12 «Information technologies»
Diploma type and number of credits according to the program	Bachelor's Diploma (Single Honours) , 240 credits ECTS/4 years of study
Accreditation	MES of Ukraine, Certificate of accreditation НД № 2087396, Order dated 19.12.2016 №1565
Cycle/level	FQ-EHEA – first cycle, EQF LLL – 6th level, HPK – 6th level
Admission Requirements	Complete general secondary education
Language(s) of instruction	Ukrainian, English
Educational program validity	Validity: 3 years 10 months
Permanent Internet address of educational program description	http://tntu.edu.ua
2 – Program purpose	
Formation of personal competencies of the professional able to solve complex specialized tasks and practical problems in computer engineering involving students' acquiring the required knowledge, skills and abilities in design, development, maintenance and servicing of computer systems, networks and their components; development of system and applied programs within functional, procedure and object-oriented approach for desktop, mobile, portable, embedded and cloud systems; schematic-based devices design.	
3 – Educational program characteristics	
Subject area (branch of knowledge, specialty)	Branch of knowledge: 12 Information technologies Specialty**:** 123 Computer engineering
Educational program orientation	Educational-professional program based on general scientific results of computer engineering within which the further professional career and post-graduate study is possible in the field of IT. The focus is made on technologies of development and maintenance of computer systems and networks and their software.
The main focus of the educational program and specialization	Training professionals able to use and implement computer engineering technologies, namely operating principles and architecture of microprocessor equipment, computer system components, construction and operation of computer systems and networks, methods and technologies of system and applied programs development within functional, procedure and object-

	oriented approach for desktop, mobile, portable, embedded and cloud systems
Program features	The program peculiarity is training specialists able to implement all stages of development and maintenance of computer systems and networks and their software; development of the project and general architecture of the system according to the computer engineering standards; development of computer system and networks components: software and hardware introduction and maintenance. The program enables students to participate in the programs of academic mobility (Erasmus+) and study by Ukrainian-German training program in Schmalkalden university of applied sciences (Germany)
4 – Graduates suitability for employment and further education	
Об'єкти професійної діяльності випускників	- software and hardware (apparatuses, system and applied software) of computer and computer system (multi-purpose and of special purpose) including stationary, mobile, embedded, distributed etc., local, global computer networks and systems Internet, cyber-physical systems, Internet of things, IT-infrastructure, interfaces and protocols of their components interaction. - information processes, technologies, methods, ways and systems of automated and automatic design; setup, production and operation, project documents, standards, procedures and facilities of maintenance of lifecycle control of above-mentioned software and hardware. - methods and techniques of information processing, mathematical models of computation processes, technologies of computation, including highly efficient ones, parallel, distributed, mobile, web-based and cloud, green (energy saving), safe, adaptive, intelligent, smart etc., architecture and functioning arrangement of the proper software and hardware.
Suitability for employment	Graduates can be employed by ДК 003:2010 according to the following qualification groups: 3114 Technical experts in the field of electronics and telecommunications, 3121 Technicians-programmers, namely: specialist in IT, specialist in software development and testing, specialist in software program development, technician in system administration, technician in configurated computer system, technician in structured cable system, technician of computation (information-computation) center.
Post-graduate study	Possibility to continue education by the program of the second cycle of higher education. Additional qualifications awarding in the post-graduation system of education.
5 – Teaching and Assessment	
Teaching and study	**Theoretical contents of the subject area:** concepts, conceptions, principles, methods, software and hardware and technologies of development, use and servicing of computer networks and systems, embedded and distributed computations. **Methods, techniques and technologies (obtained by the**

	graduates to use in practice): methods of automated design of software and hardware of computer systems and their components, methods of mathematical and computer modeling, information technologies, technologies of development of specialized software, technologies of network, mobile and cloud computations. **Tools and equipment (objects/things, gadgets/devices which are to be used by the students):** computer equipment, control and measuring instruments, software and hardware of automation and systems of computer-aided design.
Assessment	Oral and written examinations, current tests using e-learning system, practical assignments, defense of laboratory paper reports, essays, presentations, defense of course papers (projects) and reports on practice, qualification paper public defense as the final attestation.
6 – Program competencies	
Integral competence	Be able to solve practical problems and complex specialized tasks in the field of computer science, professional activity or in the study process involving the use of theories and methods of computer engineering and are characterized by complex and uncertain conditions.
General competencies (GC)	Z1. Ability of abstract thinking, analysis and synthesis. Z2. Be able to study and acquire advanced knowledge. Z3. Ability in applying theoretical knowledge in practice. Z4. Be able to communicate, speak and write, in the state language. Z5. Be able to communicate in a foreign language. Z6. Skills of interpersonal cooperation. Z7. Be able to see, set and solve problems. Z8. Ability of work in a team. Z9. Be able to implement rights and duties as a member of society; comprehension of value of civil (free democratic) society and the necessity of its sustainable development, supremacy of law, human rights and freedoms in Ukraine. Z10. Be able to store and add moral, cultural, scientific values and achievements of society due to the understanding of history and laws of development of the subject area, its place in the general system of knowledge about nature and society and in the development of the society, engineering and technologies, apply different kinds and forms of physical activity for active rest and healthy lifestyle.
Special (professional, subject area) competencies	P1. Be able to use legal and regulatory basis, as well as national and international requirements, experience and standards to conduct professional activity in the field of computer engineering. P2. Be able to apply modern programming methods and languages to develop algorithms and software. P3. Be able to create system and applied software of computer systems and networks. P4. Be able to guarantee the information safety which is processed in computer and cyber-physical systems and networks aims at the information safety policy implementation. P5. Be able to use facilities and systems of design automation to

	the development of computer systems and networks components, Internet applications, cyber-physical systems etc. P6. Be able to design, implement and service the computer systems and networks of different kinds and functions. P7. Be able to use and implement new technologies including the technologies of smart, mobile, green and safe calculations, take part in computer systems and networks, various built-in and distributed applications updating and reconstruction, namely to increase their efficiency. P8. Be ready to take part in the activity of computer systems and networks implementation on the objects of different functions. P9. Have skills of system administration, use, adaptation of current information technologies and systems. P10. Have skills of job management, its equipment, computer equipment location, use of organizational, technical and other methods and ways of information protection. P11. Be able to present the obtained work results as presentations, scientific-technical reports. P12. Be able to identify, classify and describe the software and technical facilities, computer and cyber-physical systems, networks and their components performance using analytical and modelling methods. P13. Be able to solve problems in the field of computer and information technologies, define the restrictions of these technologies. P14. Be able to design the systems and their components taking into account all aspects of their life cycle and the problem set, including the development, adjustment, maintenance, service and utilization. P15. Be able to give reasons of the choice of specialized problems solving methods, be critical in the obtained results assessment, substantiate and protect the decisions made. P16. Be able to use the apparatus of artificial neuron networks and machine learning to solve applied problems in computer engineering. P17. Be able to develop, maintain and support the cloud decisions and decisions within Internet-of-things technologies. P18. Be able to develop and improve circuit and electronic components and facilities of computer systems and networks of different functions. P19. Be able to use band implement the information processing technologies in data storage and transfer systems. P20. Be able to develop and use algorithms, software and hardware of data banks: relational and non-relational, centralized and distributed.
7 – Program learning outcomes	
Knowledge	N1. Know and understand scientific statements which form the basis of computer facilities, systems and networks functioning. N2. Have skills in conducting experiments, data collecting and modeling in computer systems. N3. Know the latest technologies in the field of computer engineering.

	N4. Know and understand the impact of engineering decisions on public, economic, social and ecological aspects. N5. Know the fundamentals of economics and project management. N6. Know main principles of software-hardware components operation of computer systems and networks on data transfer: electronic, circuit, algorithm, software.
Skills	N7. Be able to apply knowledge to identify, state and solve technical problems of the specialty using the most suitable methods to achieve the goals set. N8. Be able to solve problems of analysis and synthesis of the facilities typical for the specialty. N9. Have skills in system thinking, applying creativity to new ideas formation. N10. Be able to apply knowledge of technical characteristics, design features, use and maintenance procedure of hardware and software of computer systems and networks to solve technical problems within the specialty. N11. Be able to develop software for embedded and distributed applications, mobile and hybrid systems, calculate, and use typical for the specialty equipment. N12. Be able to search for the required information in different sources to solve problems computer engineering. N13. Be able to work efficiently both in the team and on one's own. N14. Be able to identify, classify and describe the computer systems and their components. N15. Be able to combine theory and practice, make decisions and develop a strategy of the activity to solve problems on the specialty taking into account human values, social, national and production interests. N16. Be able to conduct experimental research according to the profession topics. N17. Be able to assess the obtained results and substantiate the decisions made. N18. Be able to use modern analytical methods, modeling methods, machine learning tools and systems of artificial intelligence. N19. Be able to analyze the conventional components, design and create new circuit components of computer systems of various use. N20. Be able to design, develop and implement specialized computer systems: embedded, mobile, highly efficient. N21. Be able to design and use modern systems of transfer, storage and organization of data bases on the hardware and software levels. N22. Be able to create software components of computer systems of various use taking into account procedure, object-oriented and functional paradigms of programming. N23. Have skills in diagnostics, testing and support of hardware-software to provide their reliability, and security.
Communication	N24. Be able to communicate, speak and write, on professional

	issues in Ukrainian and one of the foreign languages (English, German, French, Italian, Spanish). N25. Use IT for the efficient communication on professional and social levels.
Autonomy and responsibility	N26. Be able to adapt to the new environment, substantiate, make and implement decisions within the competence. N27. Be aware of the necessity to study throughout all life to advance the acquired knowledge and master new professional one, creative thinking improvement. N28. Do work well and achieve the goal set keeping to the requirements of professional ethics.
8 – Program implementation resources	
Staff assistance	All academic staff members providing the educational-professional program meet the requirements of the courses' specialization, has the required teaching and practical experience. Some professionals experienced in research, management, innovative, creative and occupational activities are involved into the teaching process.
Materials and equipment	Learning process according to the educational program takes place on classrooms and laboratory rooms equipped with multimedia apparatuses and proper hardware. The appropriate hardware is used in teaching-scientific work according to the educational program: computers, laptops, scanners, multimedia projectors.
Information support and teaching – learning materials	Official web-site www.tntu.edu.ua contains information of the educational programs, educational, scientific and teaching activities, structural subdivisions, admission requirements, contacts. All resources of scientific-technical library are available on the university site: http://library.tntu.edu.ua/. The TNTU e-learning system Atutor provides with the access to materials both in English and Ukrainian on educational program disciplines, presentations, tests, video material and other e-learning components.
9 – Academic mobility	
National credit mobility	Some agreements are signed of academic mobility and double diplomas.
International credit mobility	The agreements are signed of international academic mobility (Erasmus+) and study by Ukrainian-German training program in Schmalkalden university of applied sciences (Germany).
Foreign students training	There are favorable conditions for foreign students learning both in English and Ukrainian.

2. List of components of the educational-professional program and their logical sequence

2.1 List of components

No. In sequence	Discipline title	Number of credits ECTS	Form of final control
COMPULSORY COURSES			
Cycle of general training			
OK 1.	Computing Techniques and Algorithms	4,0	Credit tests
OK 2.	Higher Mathematics	12,0	Exam, 2 Ind. assign
OK 3.	Discrete Mathematics	4,5	Exam, 2 Ind. assign
OK 4.	Foreign Language for Specific Purposes	6,0	Exam
OK 5.	History and Culture of Ukraine	5,0	Exam
OK 6.	Theory of Electric and Magnetic Circuits	4,0	Credit tests
OK 7.	Probability Theory and Mathematical Statistics	4,0	Credit tests
OK 8.	Technoecology and Civil Safety	4,0	Credit tests
OK 9.	Ukrainian for Specific Purposes	5,0	Exam
OK 10.	Physics	9,5	Exam, 2 Ind. assign
Cycle of professional training			
OK 11.	Computer Architecture	6,0	Exam
OK 12.	Embedded Systems+Course projects	5,5	Exam
OK 13.	Software Engineering	5,0	Exam
OK 14.	Computer Graphics	4,0	Credit tests
OK 15.	Computer Electronics and Circuitry	7,5	Exam
OK 16.	Computer Logic	8,0	Exam
OK 17.	Computer Networks+Course projects	10,0	Exam
OK 18.	Computer Systems	4,0	Exam
OK 19.	Fundamentals of the Internet of Things	4,5	Залік
OK 20.	Fundamentals of Computer Engineering	4,5	Exam
OK 21.	Parallel and Distributed Computing	5,5	Exam
OK 22.	Programming	9,5	Exam
OK 23.	System Software	5,0	Exam

OK 24.	System Programming+Course works	6,5	Exam
OK 25.	Technologies of Computer System Design	6,5	Exam
OK 26.	Digital Signal Processing	5,5	Credit tests
Practical training			
OK 27.	Practical Training	3,0	Grading tests
OK 28.	Industrial Internship	3,0	Grading tests
OK 29.	Technological Practice	3,0	Grading tests
OK 30.	Bachelor's Graduation Thesis Writing	7,5	
OK 31.	Bachelor's Graduation Thesis Defense	1,5	
Total according to compulsory part:		**173,5**	
Optional courses			
Cycle of general training			
OC 1.1.	Optional courses1	3,0	Credit tests
OC 1.2.	Optional courses2	7,5	Exam
OC 1.3.	Optional courses3	4,0	Exam
Cycle of professional training			
OC 2.1.	Optional courses4	4,5	Credit tests
OC 2.2.	Optional courses5	4,0	Exam
OC 2.3.	Optional courses6	4,5	Credit tests
OC 2.4.	Optional courses7	4,5	Credit tests
OC 2.5.	Optional courses8	5,5	Credit tests
OC 2.6.	Optional courses9	4,5	Credit tests
OC 2.7.	Optional courses10	4,5	Credit tests
OC 2.8.	Optional courses11	6,0	Credit tests
OC 2.9.	Optional courses12	4,5	Credit tests
OC 2.10.	Optional courses13	5,0	Credit tests
OC 2.11.	Optional courses14	4,5	Credit tests
Total optional courses:		**66,5**	
TOTAL FOR BACHELOR TRAINING		**240,0**	

3. Attestation of undergraduates

Form of attestation	Public defense of the Qualification paper.
Requirements to the Qualification paper	The Qualification paper must contain the results of conducted analytical and theoretical, system-technical and experimental study of an urgent problem on specialty 123 «Computer engineering» within professional activity of Bachelor, and also the results of design, modeling, implementation and testing of the computer facilities specified in the assignment and show the achievements of the study results defined by this standard and the education program, the author's ability of logic, based on modern scientific methods stating his/her point of view on the paper subject-matter, substantiate the choice of hardware and software, make reasonable conclusions and give specific recommendations and make an important offer on the obtained results. The qualification paper must not contain any academic plagiarism, fabrication, cheating. The qualification papers should be made public on the official site of the higher educational establishment or its subdivision (faculty, department) or in the repository of the higher educational establishment.

Table 1.

Matrix of compliance of the competencies defined by the Standard with descriptors

Classification competencies	Knowledge	Skills	Communication	Autonomy and responsibility
General competencies				
Z1	**N1, N3**	**N8, N17, N18, N19, N20, N22**	**N24, N25**	**N26**
Z2	**N1, N4, N5**	**N9, N10, N12, N13, N15, N18, N20, N22**	**N24, N25**	**N26,N27**
Z3	**N4**	**N10-N16, N20, N22**	**N24, N25**	**N26,N28**
Z4	**-**	**-**	**N24**	**N27**
Z5	**-**	**N18, N22**	**N24, N25**	**N26, N27, N28**
Z6	**N4**	**N12**	**N25**	**N27**
Z7	**N2, N5**	**N8, N9, N17, N18, N19**	**N24, N25**	**N26, N27, N28**
Z8	**N5**	**N8, N10-N13, N17**	**N24, N25**	**N27, N28**
Z9		**N13, N17**	**N24, N25**	**N26, N27, N28**
Z10	**N1, N2, N3**	**N7-N9, N12,N14, N16, N17**	**N24, N25**	**N26, N27**
Special (professional) competencies				
P1	**N2, N4, N5**	**N8 N10, N11**	**-**	**N27**
P2	**N1, N2, N4, N5**	**N7-N9, N14, N17, N20, N22**	**N24, N25**	**N27**
P3	**N1, N2**	**N7, N9, N10, N14, N22**	**N25**	**N27**
P4	**N1, N2, N5**	**N7, N9-N14, N17**	**N25**	**N27**
P5	**N1, N2, N5**	**N7, N9-N14, N17, N19, N20**	**N25**	**N27**
P6	**N2, N4**	**N9, N10, N12, N13, N17**	**N24, N25**	**N26, N27, N28**
P7	**N4**	**N10, N12, N13, N17, N23**	**N24, N25**	**N26, N27, N28**
P8	**N2, N4**	**N10, N12, N13, N17, N23**	**N24**	**N26, N27, N28**
P9	**N2**	**N10, N12, N13, N17, N20, N21, N23**	**N24**	**N26, N27, N28**
P10	**N2, N4**	**N10 - N13**	**-**	**N26, N27, N28**
P11	**N5**	**N9, N12, N13, N17**	**N24, N25**	**N28**
P12	**N1, N2**	**N7-N9, N14, N17, N18**	**-**	**N27**

P13	**N1, N2, N4, N5**	**N7-N9, N14, N17, N23**	**N24, N25**	**N27**
P14	**N1, N2, N5**	**N7-N9, N14, N17, N19, N20**	**N25**	**N27**
P15	**N1-N3, N4**	**N7-N9, N12, N15-N17**	**N24, N25**	**N26, N27**
P16	**N1-N3, N6**	**N7-N9, N16-N18, N22**	**N24, N25**	**N26, N27, N28**
P17	**N3, N6**	**N8, N10-N14, N20-N23**	**N24, N25**	**N26, N27, N28**
P18	**N2, N3, N6**	**N7-N12, N14, N19, N23**	**N24, N25**	**N26, N27, N28**
P19	**N1-N3, N6**	**N7, N8, N10, N20-N22**	**N24, N25**	**N26, N27, N28**
P20	**N1-N3, N6**	**N7, N8, N10, N20-N22**	**N24, N25**	**N26, N27, N28**

Table 2.

Matrix of compliance of learning outcomes and competencies defined by the Standard

Program results	Competence																													
	General competencies										Special (professional) competencies																			
	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
N1	+	+								+		+	+	+	+							+	+	+	+					
N2							+			+	+	+	+	+	+	+		+	+	+		+	+	+	+					
N3	+		+							+															+					
N4		+				+					+	+				+	+	+	+	+			+		+					
N5		+					+	+			+	+		+	+						+		+	+						
N6								+		+		+	+	+	+							+	+	+	+	+		+	+	+
N7										+		+	+	+	+							+	+	+	+					
N8	+						+	+		+	+	+										+	+		+					
N9		+					+			+		+	+	+	+	+					+	+	+	+	+					
N10		+	+					+			+		+	+	+	+		+	+	+				+						
N11			+					+			+			+	+		+			+				+						
N12		+	+			+		+		+				+	+	+	+	+	+	+	+			+	+					
N13		+	+					+	+					+	+	+	+	+	+	+	+			+						
N14			+							+		+	+	+	+							+	+	+						
N15		+	+																						+					
N16			+							+															+					
N17	+						+	+	+	+		+		+	+	+	+	+	+		+	+	+	+	+					
N18	+	+			+		+					+										+				+				
N19	+						+								+									+				+		
N20	+	+	+									+			+									+			+			+
N21																			+								+		+	+

N22	+	+	+		+							+	+												+	+		+	+	
N23																	+	+	+				+				+	+		
N24	+	+	+	+	+		+	+		+		+				+	+	+	+		+		+		+					
N25	+	+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+		+		+	+	+					
N26	+	+	+				+		+	+						+	+	+	+	+					+					
N27		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+					
N28			+				+	+	+							+	+	+	+	+	+									

Table 3.

Matrix of correspondence of program competencies to the components of the educational program

Competencies	COMPULSORY COURSES																															Optional courses											
	Cycle of general training											Cycle of professional training														Practical training					Cycle of general training		Cycle of professional training										
	OK 1	OK 2	OK 3	OK4	OK 5	OK 6	OK 7	OK 8	OK 9	OK 10	OK 11	OK 12	OK 13	OK 14	OK 15	OK 16	OK 17	OK 18	OK 19	OK 20	OK 21	OK 22	OK 23	OK 24	OK 25	OK 26	OK 27	OK 28	OK 29	OK 30	OK 31	OC 1.1	OC 1.2	OC 2.1	OC 2.2	OC 2.3	OC 2.4	OC 2.5	OC 2.6	OC 2.7	OC 2.8	OC 2.9	OC 2.10	OC 2.11	OC 2.12
Z1	+	+			+	+	+			+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+								+	+	+	+	+	+	+	+	+	+	+
Z2												+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					+			+	+	+	+	+	+	+	+	+	+
Z3									+		+		+		+	+	+	+				+		+			+	+	+	+	+		+									+	+	
Z4			+										+		+	+	+	+				+		+						+	+	+												
Z5			+										+		+	+	+	+				+		+						+	+	+												
Z6																											+	+	+			+	+												
Z7													+		+	+	+	+			+	+	+	+	+																		+	
Z8																											+	+	+				+												
Z9				+				+	+		+																					+		+										
Z10				+					+		+																					+		+										
P1								+					+		+	+	+	+												+	+			+									+	
P2	+													+							+	+	+	+						+	+			+			+			+		+	+	
P3	+													+							+	+	+	+						+	+			+			+			+		+	+	

P4	+	+														+																									+		+	
P5	+											+	+		+	+	+			+	+	+	+	+					+	+				+			+			+		+	+	
P6											+	+				+	+			+		+	+	+				+	+	+						+						+	+	
P7												+	+			+	+	+		+	+	+		+					+	+		+		+	+	+	+	+			+	+	+	+
P8																										+	+	+	+			+											+	
P9												+	+		+	+	+			+	+	+	+	+		+	+	+	+					+	+	+	+	+	+	+	+	+	+	+
P10							+					+				+	+							+		+	+	+	+				+								+	+	+	+
P11			+					+				+		+	+	+	+				+		+			+	+	+	+	+	+	+												
P12											+	+		+	+	+								+	+											+			+			+		+
P13											+	+	+		+	+	+			+	+	+	+	+	+											+	+	+	+	+	+	+	+	+
P14							+					+	+			+	+	+	+					+									+			+							+	
P15	+	+			+	+					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					+				+	+	+	+	+	+	+	+	+	+	+
P16	+	+			+	+								+						+	+				+				+	+						+				+				+
P17	+											+	+	+		+	+	+	+	+	+	+		+										+			+					+	+	+
P18						+				+		+	+		+	+	+	+	+						+													+					+	+
P19						+										+	+			+					+	+	+	+	+								+	+			+			+
P20	+										+	+	+			+	+	+	+	+	+	+	+	+		+	+	+	+					+			+			+	+	+	+	+

Table 4.

The matrix of providing program learning outcomes with the relevant components of the educational program

	COMPULSORY COURSES																															Optional courses													
	Cycle of general training											Cycle of professional training														Practical training					Cycle of general training		Cycle of professional training											
Program results	ОК 1	ОК 2	ОК 3	ОК4	ОК 5	ОК 6	ОК 7	ОК 8	ОК 9	ОК 10	ОК 11	ОК 12	ОК 13	ОК 14	ОК 15	ОК 16	ОК 17	ОК 18	ОК 19	ОК 20	ОК 21	ОК 22	ОК 23	ОК 24	ОК 25	ОК 26	ОК 27	ОК 28	ОК 29	ОК 30	ОК 31	ОС 1.1	ОС 1.2	ОС 2.1	ОС 2.2	ОС 2.3	ОС 2.4	ОС 2.5	ОС 2.6	ОС 2.7	ОС 2.8	ОС 2.9	ОС 2.10	ОС 2.11	ОС 2.12
N1	+	+			+	+	+			+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+											+	+		+		+	+		+
N2	+															+																				+		+							
N3												+	+	+					+	+																								
N4				+				+	+		+																					+	+											
N5																																+												
N6	+											+	+	+	+	+	+	+	+	+	+	+	+	+	+	+											+	+	+	+	+	+	+	+
N7	+												+		+		+	+				+		+	+												+	+		+	+	+	+
N8	+																																			+		+	+		+	+		
N9																																				+							+		
N10													+				+	+				+	+	+			+	+	+	+	+											+		
N11	+													+								+	+	+												+			+					
N12	+											+	+	+	+	+	+	+	+	+	+	+	+	+	+	+																		
N13												+		+																														

N14												+	+		+	+	+	+	+		+	+	+	+	+	+							+											+	+
N15	+																										+	+	+	+	+			+												
N16						+				+																+													+					+	+
N17													+		+		+	+				+		+	+																			+	+
N18	+	+			+	+	+			+					+											+											+		+	+					
N19												+	+			+																													
N20													+		+		+	+				+		+	+												+				+				
N21																	+									+												+				+		+	+
N22	+													+								+	+	+											+						+	+	+		
N23												+	+	+		+	+	+	+	+	+	+	+	+	+	+												+	+		+	+		+	+
N24			+	+					+				+		+		+	+				+		+	+							+													
N25			+	+																												+			+										
N26										+																	+	+	+	+	+		+												
N27										+																	+	+	+	+	+		+												
N28			+	+									+		+		+	+				+		+	+		+	+	+	+	+		+												