MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

APPROVED
Rector of the NTU "KhPI"
_____Yevgen SOKOL
«24» «____05___» 2024

EDUCATIONAL AND PROFESSIONAL PROGRAM

«MODERN PROGRAMMING, MOBILE DEVICES
AND COMPUTER GAMES»

Second higher education level
Specialty –123 Computer engineering
Branch of knowledge –12 information technologies
Qualification – Master of Computer Engineering

APPROVED
by the Academic Council of the NTU "KhPI"
_____ Leonid TOVAZHNYANSKYY

(protocol №_4_ from "26" 04 2024)

Kharkiv 2024

CERTIFICATE OF APPROVAL
Educational and professional program

Higher Education Level	Second (Master)
Branch of Knowledge	12 Information Technologies
Specialty	123 Computer Engineering
Qualifications	Master of Computer Engineering

APPROVED
Head of the Support Group
for the specialty Computer
Engineering
_____ Svitlana GAVRYLENKO
«___» _____ 2024

RECOMMENDED
Methodical Council of the NTU "KhPI"
Deputy Chairman of the Methodical
Council
_____Ryslan MYGOUSHCHENKO
«___» _____ 2024

AGREED
Head of Department
of Computer Engineering
and Programming

_____ Oleksandr ZAKOVOROTNYI
«___» _____ 2024

AGREED
Director of Educational and Scientific
Institute of Computer Sciences
and Information Technologies

_____Mykhailo HODLEVSKYI
«____» _____ 2024

AGREED
Student of the group KN-M923b

(member of the EP working group)

_____ Dmytro Yampolskyi
«___» _____ 2024

REVIEWERS:

Productive comments and feedback on the draft educational and professional program (EPP) were received from:

1. Andriy KOVALENKO, Kharkiv National University of Radio Electronics, Head of the Computer Electronics Department.

2. Serhii ROZHOK, General Director of EPAM SYSTEMS LLC.

3. Vyacheslav ALEKSYEV, professor of the Department of Cyber Security, Pedagogical University named the National Education Commission, Krakow, Poland.

4. Oksana SEVRYUKOVA, GlobalLogic Co-ordinator, L&D

FOREWORD

The educational and professional program meets the standard of higher education in the specialty 123 "Computer Engineering" for the second (master's) level of higher education, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated March 18, 2021 No. 330 (123 Computer engineering).

Developed by the working group of the educational and professional program "Modern programming, mobile devices and computer games" of the Educational and Scientific Institute of Computer Sciences and Information Technologies of the National Technical University "Kharkiv Polytechnic Institute" in the composition of:

Guarantor of the educational program

Svitlana GAVRYLENKO, doctor of technical sciences, professor, professor of the department of computer engineering and programming.

Members of the working group of the educational and professional program:

1. Anatoly POVOROZNYUK, doctor of technical sciences, professor, professor of the department of computer engineering and programming.
2. Hanna FILATOVA, doctor of technical sciences, professor, professor of the department of computer engineering and programming.
3. Dmytro YAMPOLSKY, student of group KN-M923b.

The educational and professional program was discussed after receiving wishes and proposals from students, graduates, scientific and pedagogical workers, stakeholders and was approved at a meeting of the "Computer Engineering and Programming" department (protocol No. 11 dated April 22, 2024).

1. PROFILE OF EDUCATIONAL PROGRAMS FOR SPECIALTIES

1 – GENERAL INFORMATION	
HIGHER EDUCATIONAL INSTITUTION AND STRUCTURAL DEVELOPMENT	National technical university "Kharkiv Polytechnic Institute", Educational and Scientific Institute of Computer Science and Information Technologies, Department of Computer Engineering and Programming
DEGREE OF HIGHER EDUCATION AND QUALIFICATION TITLE IN THE ORIGINAL LANGUAGE	Master. Master's degree in computer engineering.
OFFICIAL NAME OF THE EDUCATIONAL PROGRAM	Educational and professional program «Modern programming, mobile devices and computer games»
TYPE OF DIPLOMA AND VOLUME OF EDUCATIONAL PROGRAM	Master's Degree, 90 ECTS credits under the educational and professional program / duration of study is 1 year 4 months.
AVAILABILITY OF ACCREDITATION	Certificate of accreditation: НД 2192135 Ministry of Education and Science of Ukraine. Term of validity: until July 1, 2025.
CYCLE/LEVEL	second (master's) level of higher education, НРК - 7th level, EQF - 7th level, QF-EHEA - second cycle
PRECONDITION	The presence of the first (bachelor's) level of higher education
TEACHING LANGUAGE	Ukrainian, English is for foreigners
TERM FOR EDUCATIONAL PROGRAMS	According to the certificate validity term the Educational Program is reviewed annually.
LINK TO THE PERMANENT POSTING OF THE EDUCATIONAL PROGRAM DESCRIPTION	https :// blogs . kpi . kharkov . ua / v 2/ qual 1 ty / dokumenty / diyuchy - osvitni - programy / osvitnij - riven - magistr /
2 – PURPOSE OF THE EDUCATIONAL PROGRAM	
Formation and development of a set of knowledge, skills and abilities necessary for solving research and innovation problems in the field of computer engineering	

3 – CHARACTERISTICS OF THE EDUCATIONAL PROGRAM	
SUBJECT AREA (KNOWLEDGE, SPECIALTY, SPECIALIZATION)	**The objects** of professional activity of masters are: software and hardware of computers and computer systems, local, global computer networks and the Internet, cyber-physical systems, interfaces and protocols for the interaction of their components; methods of presenting, receiving, storing, transmitting, processing and protecting information in a computer; mathematical models of computing processes; technologies for performing computations, including parallel, distributed, mobile, web-based and cloud-based, intelligent and smart, etc. **The aims** of the study are to train specialists capable of solving complex research and innovation problems in the field of computer engineering. **The theoretical content of the subject area** is the concepts, principles of research, design, production, use and maintenance of computers and computer systems, computer networks. **Methods, techniques and technologies:** methods of researching processes in computer systems and networks, methods of computer-aided design and production of software and hardware for computer systems and networks and their components, methods of mathematical and computer modelling, information technology, programming technologies. **Tools and equipment:** software, tools and computer hardware, network, mobile, cloud technologies, etc.
ORIENTATION OF EDUCATIONAL PROGRAM	**The orientation of the educational program** is educational and professional. Integration of professional training in the field of computer engineering with innovative and scientific activities, focus on research work to analyse trends in the development of hardware and software of modern computer and information systems and tools for their modelling in order to implement innovative projects.
MAIN FOCUS OF THE EDUCATIONAL PROGRAM AND THE SPECIALIZATION	Training of specialists capable of developing software and hardware, system and application software for computer systems and networks of universal and special purpose. Keywords: computer systems and networks, software and hardware, system and application software, data processing.
PROGRAM FEATURES	The special features of the educational program are the training of specialists in the field of modern programming, mobile devices and computer games, taking into account the experience of the department's scientific schools: ‘Modelling and Management of Complex Technical Objects’, “Intelligent Decision Support Systems for Diagnostic and Treatment Activities”, “Methods of Information Processing and Protection in Computer Systems”, and their implementation in educational components. This is supported by ten full-time Doctors of Technical Sciences and twenty-three PhDs in Computer Engineering, under whose supervision more than ten PhD theses have been defended over the past 5 years, and by cooperation agreements with leading companies.

4 – SUITABILITY OF GRADUATES FOR EMPLOYMENT AND FURTHER EDUCATION	
EMPLOYMENT SUITABILITY	Graduates can work in the following professions (according to the National Classifier of Professions DK 003:2010 https://zakon.rada.gov.ua/rada/show/va327609-10#Text): 2 Professionals 21 Professionals in the field of physical, mathematical and technical sciences 213 Professionals in the field calculation (computerization) 2131 Professionals in the field of computing systems 2131.2 Developers of computing systems 2132 Professionals in the programming field 2132.2 Developers of computer software 2139 Professionals in other areas of computing (computerisation) 2139.2 Professionals in other areas of computing According to information (https://minfin.com.ua/ua/2023/12/20/118205352/) based on the study of labour development trends in 2024, it is worth paying attention to the profession of software developer, project manager, web designer, SEO - specialist, information security analyst.
FURTHER EDUCATION	The master's degree program provides an opportunity to study at the eighth qualification level (PhD) in accordance with the National Qualifications Framework for Information Technology or related areas of study.
5 – TEACHING AND ASSESSMENT	
TEACHING AND TRAINING	Student-centered training, which is carried out in the form of lectures, seminars, practical and laboratory classes, consultations, trainings, independent learning, course projects, calculation tasks, pre-graduate practice, and qualification preparation work based on studying textbooks, study guides, and scientific periodicals, using the Internet; participation in scientific conferences, symposia, competitions, and contests; using non-formal education; publishing conference reports and scientific articles. The program provides for independent work with the possibility of consulting with a teacher on individual educational components, individual classes, and group project work.
ASSESSMENT	The educational program provides for the monitoring of students' knowledge and skills in the form of current and final control. Current control includes oral and written questioning, assessment of work in small groups, control and individual tasks, testing, defence of reports on laboratory and calculation tasks, course projects, practice, etc., presentations at conferences and symposia, defence of group and individual research tasks. The final control includes oral and written exams, tests based on the accumulated points of the current control. State certification is the preparation and public defence (presentation) of the final qualifying master's thesis. The qualification thesis must include elements of research and practical work. The higher education institution carries out a mandatory plagiarism check of all master's qualification works

	A rating system has been introduced, according to which students' academic achievements are assessed on the national scale (excellent, good, satisfactory, unsatisfactory); 100-point scale and ECTS scale (A, B, C, D, E, FX, F). In accordance with the procedure for recognising learning outcomes obtained in non-formal and/or informal education at NTU 'KhPI', the acquired knowledge can be partially or fully credited in the form of points for practical and/or laboratory classes.
6 – PROGRAMME COMPETENCIES	
INTEGRAL COMPETENCE	The ability to solve complex problems and problems in the field of computer engineering or in the process of training, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.
GENERAL COMPETENCES (SPECIALTIES DEFINED BY THE STANDARD OF HIGHER EDUCATION)	GC 1. Ability for adaptation and action in a new situation. GC 2. Ability to think abstractly, to perform analysis and synthesis. GC 3. Ability to carry out investigations on a responsible level. GC4. Ability to search, process, and analyze information from various sources. GC 5. Ability to generate new ideas (creativity). GC 6. Ability to identify, pose and solve problems. GC 7. Ability to make grounded decisions. GC 8. Ability to communicate in a foreign language.
SPECIAL COMPETENCIES (SPECIALTIES DEFINED BY THE STANDARD OF HIGHER EDUCATION)	SC 1. Ability to determine technical characteristics, design features, applications and operation of software, hardware-software tools, and computer systems and networks for various purposes. SC 2. Ability to develop algorithmic and software components of computer systems and networks, internet applications, and cyber-physical systems using modern methods, programming languages, and automated design tools and systems. SC 3. Ability to design computer systems and networks, taking into consideration goals, constraints, and technical, economic, and legal aspects. SC 4. Ability to build and study models of computer systems and networks. SC 5. Ability to design architecture and create system and application software for computer systems and networks. SC 6. Ability to promote new technologies, including smart, mobile, green and secure computing technologies, and participating in the modernization and reconstruction of computer systems and various applications and built-in (embedded) and distributed applications, in particular, with the purpose of increasing effectiveness thereof. SC 7. Ability to research, develop, and select technologies for creating large-scale and ultra-large systems. SC 8. Ability to ensure the quality of IT products and services throughout their lifecycle. SC 9. Ability to present the results of one's own research and/or developments in the form of presentations, scientific and technical reports, articles, and papers at scientific and technical conferences. SC 10. Ability to identify, classify and describe the operation of software and hardware, computer systems, and their components.

	SC 11. Ability to develop effective methods for solving complex computer engineering problems, critically evaluating the results and justifying the decisions made. *Additional competence* SC 12. Ability to develop, collect and study methods, models and information technologies for intelligent data analysis – data mining (including Big Data), to ensure the efficiency of making project decisions.
7 – LEARNING OUTCOMES OF EDUCATION	
LEARNING OUTCOMES OF EDUCATION FOR THE SPECIALTY - (SPECIALTIES DEFINED BY THE STANDARD OF HIGHER EDUCATION)	LO 1. Apply general approaches to cognition, methods of mathematics, natural and engineering sciences to solve complex computer engineering problems. LO 2. Find the necessary data, analyze and evaluate them. LO 3. Build and investigate models of computer systems and networks, assess their adequacy, and determine their applicability limits. LO 4. Apply specialized conceptual knowledge, including modern scientific achievements in computer engineering, required for professional activities, original thinking, research, and critical understanding of information technology problems and interdisciplinary issues. LO 5. Develop and implement projects in computer engineering and related interdisciplinary fields, taking into consideration engineering, social, economic, legal, and other aspects. LO 6. Analyze issues, identify and formulate specific problems requiring solutions, and select effective methods to address them. LO 7. Solve tasks involving the analysis and synthesis of computer systems and networks. LO 8. Apply knowledge of technical characteristics, design features, purposes, and operating rules of hardware-software tools for computer systems and networks to solve complex computer engineering problems and related issues. LO 9. Develop software for embedded and distributed applications, mobile, and hybrid systems. LO 10. Search for information from various sources to solve computer engineering problems, analyze and evaluate this information. LO 11. Make effective decisions regarding the development, implementation, and operation of computer systems and networks, analyze alternatives, and evaluate risks and potential consequences. LO 12. Communicate fluently in spoken and written Ukrainian and one foreign language (English, German, Italian, French, Spanish) when discussing professional issues, research, and innovations in the field of information technology. LO 13. Clearly and unambiguously convey one's knowledge, conclusions, and reasoning on information technology issues and related interdisciplinary topics to specialists and non-specialists, including learners *Additional learning outcome* LO 14. Develop and study mathematical models and methods for intelligent data analysis, as well as algorithmic and software solutions, for implementing IT projects, mobile devices, and computer games.

8 – RESOURCE PROVISION FOR PROGRAM IMPLEMENTATION	
STAFFING	Educational program staffing complies with the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015. No. 1187 "On the approval of licensing conditions for the Conduct of Educational Activities of Educational Institutions" (with changes introduced under the Cabinet of Ministers Resolution No. 365 dated March 24, 2021. Addendum 15-16). There are 10 doctors of technical sciences at the departments with the specialty "Computer Engineering". Scientists and specialists from leading IT companies are also involved in teaching.
MATERIAL AND TECHNICAL SUPPLY	The material and technical support of the educational program complies with the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015. No. 1187 "On Approval of the Licensing Conditions for the Conduct of Educational Activities of Educational Institutions" (with changes introduced under the Cabinet of Ministers Resolution No. 365 dated March 24, 2021 Addendum 17). NTU 'KhPI' has classrooms that meet the requirements for conducting classes. The educational process uses computer equipment of the departments, which meets the requirements for the quantity and quality of equipment. Laboratory classes, course and diploma projects are conducted in computer laboratories of leading IT companies such as NIX Solution, EPAM, GlobalLogic, which are equipped with modern hardware and software.
INFORMATION AND EDUCATIONAL AND METHODOLOGICAL SUPPORT	Information and educational and methodical support of educational program complies with the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015. No. 1187 "On Approval of the Licensing Conditions for the Conduct of Educational Activities of Educational Institutions" (with changes introduced under the Cabinet of Ministers Resolution No. 365 dated March 24, 2021. Addendum 18). The Scientific and Technical Library of NTU 'KhPI' has a collection of more than 1.5 million volumes and provides information and bibliographic support for the scientific and educational process of the university. The library has an electronic repository of free access to full-text documents.
9 – ACADEMIC MOBILITY	
NATIONAL CREDIT MOBILITY	National academic mobility is implemented by higher education students under the educational programme on the basis of bilateral agreements between the National Technical University 'Kharkiv Polytechnic Institute' and higher education institutions of Ukraine.
INTERNATIONAL CREDIT MOBILITY	The possibility of concluding agreements on academic mobility and double degree is regulated by the Regulation on Academic Mobility of Students, Postgraduates, Doctoral Candidates, Academic and Research Staff. Individual agreements on academic mobility for study and research at universities and scientific institutions of partner countries are

	allowed.. Opportunity to participate in credit mobility programs (exchange, summer school) Fulbright, DAAD, TEMPUS, ERASMUS. Participation in the Wildau-Kharkiv IT Bridge project programs DAAD «Digital Ukraine: Ensuring Academic Success in Crisis ».
EDUCATION OF FOREIGN STUDENTS	International students are taught on general terms and conditions in English (or Ukrainian, if the student has completed the relevant training).

OVERVIEW OF EDUCATIONAL COMPONENTS OF EDUCATION AND PROFESSIONAL PROGRAM AND THEIR LOGICAL SEQUENCE

Code n/a	Components of the educational program (disciplines, projects/works, practice, qualified work)	Number of credits	Final control form
1	2	3	4
1. Mandatory educational components (applicants – Ukrainian citizens and foreigners)			
1.1 General preparation			
GT 1	Foreign Language in Professional Field	3	test
GT 2	Innovative Entrepreneurship and Startup Project Management	3	test
GT 3	Intellectual property	3	test
1.2 Special (professional) training			
ST1	Modern technologies of secure programming	5	exam
ST2	Tools and algorithms of decision-making	5	exam
ST3	Optimization of processes in multi-service systems and networks	5	exam
ST4	Programming for global networks	6	exam
ST5	Fundamentals of neurocomputing	5	exam
ST6	Fundamentals of scientific research	5	exam
2. Practical training			
PT1	Pre- graduation practice	11	test
3. Certification			
	Certification	11	defense
	Total amount of required components	**62**	
4. Elective educational components (applicants – Ukrainian citizens and foreigners)			
4.1 Specialized training			
4.1.1 Profiled package of educational components 01 “Computer Systems and Networks”			
OP1.1	Hardware of local and global networks	4	exam
OP1.2	Projecting of microcontroller devices	4	exam
OP1.3	Projecting of corporate networks	4	exam
4.1.2 Profiled package of educational components 02 “System Programming”			
OP2.1	Programming for corporate meetings	4	exam
OP2.2	Theory of compilers	4	exam
OP2.3	Machine learning	4	exam
4.1.3 Profiled package of educational components 03 “Specialized Computer Systems”			
OP3.1	Corporate security software	4	exam
OP3.2	Modeling and optimization of content computer games	4	exam
OP3.3	Methods for designing folding models dynamic objects	4	exam
	In total	12	

1	2	3	4
4.2 Educational components of free choice of general and professional training according to the list			
Educational components of free choice of professional training (OPT)			
OPT1	**Component1**	4	Test
OPT2	**Component2**	4	Test
Educational components of free choice of general training according to the list (OGT)			
OGT1	**Component1**	4	Test
OGT2	**Component2**	4	Test
	Total volume of elective components	**28**	
	Total number for the training period	**90**	

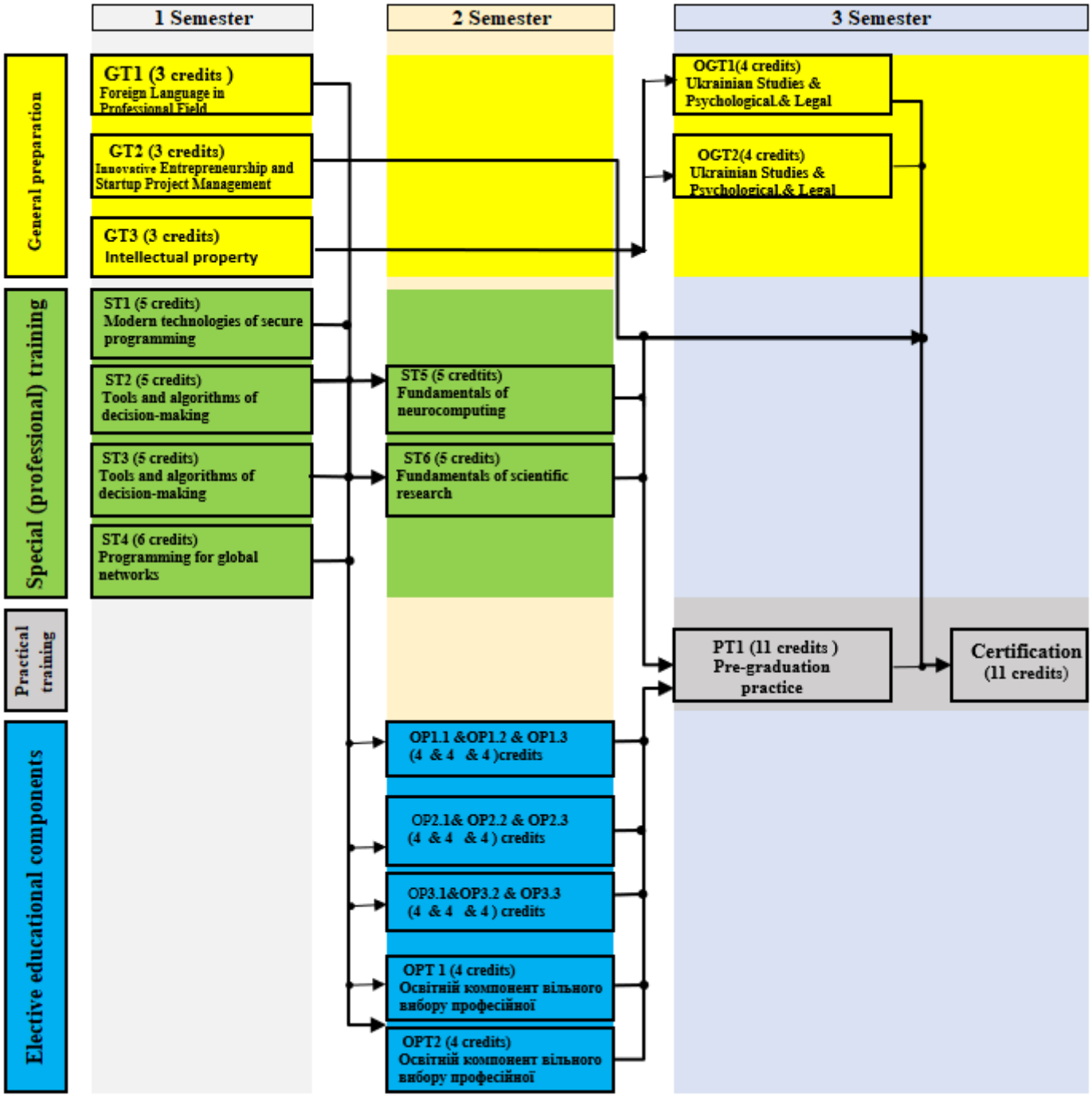
DISTRIBUTION OF CONTENT EDUCATION PROGRAMS FOR GROUPS OF COMPONENTS AND PREPARATION CYCLES

Item No.	Cycle preparations	Volume of academic workload of the student of higher education (ECTS credits / %)		
		Mandatory components of the educational and professional program	Elective components of the educational and professional program	In total for the whole term training
1.1	General preparation	9 / 10	–	9 / 10
1.2	Special (professional) training	31 / 35	–	31 / 35
2	Practical training	11/12	–	11/12
3	Certification	11/12	–	11/12
4	Elective educational components	–	28 / 31	28 / 31
In total for the whole term training		**62**/69	**28** / 31	**90** / 100

FORM OF CERTIFICATION OF HIGHER EDUCATION APPLICANTS

CERTIFICATION FORMS FOR HIGHER EDUCATION APPLICANTS	Public defence (demonstration) of qualification thesis.
REQUIREMENTS FOR QUALIFICATION WORK	A qualification work is an independently performed project and research work of a student, which provides the author's vision of the problem, the possibilities of its research and solution. The work demonstrates the author's ability to conduct empirical research, develop appropriate systems (tools), justify design decisions, process and analyse the results obtained, and formulate reasoned conclusions. The completion of final qualification works should contribute to - systematisation, consolidation and expansion of theoretical and practical knowledge in the speciality and application of this knowledge to solve specific problems; - development of skills of independent work and mastering the methodology of solving issues and problems posed in the final work; - assessing the level of mastery of a certain set of professional competences required for future professional activities. Qualification theses must be checked by technical means for plagiarism in accordance with the Regulations on the system of prevention and detection of academic plagiarism in the final qualification theses of higher education applicants of the National Technical University 'Kharkiv Polytechnic Institute' and placed in the repository of NTU 'KhPI'.
REQUIREMENTS FOR PUBLIC DEFENCE	The report consists of three semantic parts that correspond to the content of the qualification work: introduction, main part, and conclusions. The introduction highlights the relevance of the problem under study, formulates the object, subject, hypotheses and objectives of research and development. The main part primarily reveals the essence, methodology and peculiarities of organising and conducting the research and development of the project. The conclusions present the main results of the research and development, determine the theoretical and practical significance of the results and possible prospects for further research and development. The qualification work is assessed by the members of the examination committee at its closed meeting. The Commission takes into account the content of the work, the validity of the conclusions, the content of the report, the level of presentation of the project and answers to questions, feedback on the work, the level of theoretical and practical training of the student. The grades of the qualification work are announced on the same day after the defence of the entire group and the protocol of the commission meeting is completed. Based on the results of the final certification of students, the examination committee decides on the award of a qualification in the speciality and the issuance of a master's degree.

STRUCTURAL AND LOGICAL SCHEME
OF THE EDUCATIONAL AND PROFESSIONAL PROGRAMME



Correspondence matrix of learning outcomes and competences

	Learning outcomes	Competences																				
		Integral competence																				
		General competences (GC)								Special (professional) competences (SC)												*SC additional*
		GC 1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	SC1	SC2	SC3	SCK4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	*SC12*
LO from the standard	LO1	ST4 ST6	SC 2		SC 2	SC 2 ST 6					ST 5										
	LO2		ST 3		SC 3						ST 1	ST 1	ST 3					ST6	ST 1		
	LO3			ST5																	
	LO4						ST 1												ST 1		
	LO5							ST 4 PT1		ST 4	ST 4			ST 4							
	LO6				SC 3 ST 2						ST 2										
	LO7									ST4	ST4										
	LO8		ST 3			ST 6							ST 3		PT1					ST 3 ST 6 PT1	
	LO9									ST 4				ST 4	ST 4						
	LO10												ST3						ST1		
	LO11				ST 2										ST 2	ST 4	ST 2	PT1			
	LO12								SC 1												
	LO13			ST 6																	
LO additional	*LO14*																				ST 2 ST 5 ST 6