Ministry of Education and Science of Ukraine
Khmelnytskyi National University

APPROVED
by the Academic Board of
Khmelnytskyi National University
Record № 9 of 28.03.2019

Head of the Academic Board
_____ M. YE. SKYBA
Signature Initials, surname

EDUCATIONAL AND PROFESSIONAL

Type of the educational program

COMPUTER ENGINEERING AND PROGRAMMING

Name of the educational program

HIGHER EDUCATION LEVEL	**first (Bachelor's)**
MAJOR	**123 «Computer Engineering»** Code and name
FIELD OF STUDY	**12 «Information Technology»** Name code and name
QUALIFICATION	**Bachelor of Computer Engineering** Name

The educational program is put into force
from 1. 09. 2019

Order № 107 of 27.06. 2019

Rector _____ M. YE. SKYBA
Signature Initials, surname

Khmelnytskyi 2019

SUBMITTED

By the department of Computer Engineering and System Programming

Record № 8 of 15.02. 20 19

Head of the Department
Signature T. O. Hovorushchenko
Initials, surname

Department of Cyber Security and Computer Systems and Networks

Record № 7 of 18.02 20 19

Head of the Department
Signature Yu. P. Klyots
Initials, surname

PROJECT GROUP

Guarantor (Head of the project group)
A.O.Nicheporuk, Candidate of Technical Sciences
Signature Initials, surname, academic degree and rank

Members of the project group:

O.S.Savenko, Candidate of Technical Sciences, Full Professor
Signature Initials, surname, academic degree and rank

D. M. Medzatyi, Candidate of Technical Sciences, Associate Professor .
Signature Initials, surname, academic degree and rank

Signature V. M. Stetsiuk .
Initials, surname, academic degree and rank

APPROVED:

Academic Board of the Faculty of Programming and Computer and Telecommunication Systems

Record № 1 of 21.02. 20 19

Head of the Academic Board Signature O.S.Savenko
Initials, surname

Academic Board of the Faculty of International Relations

Record № 7 of 26.02. 20 19

Head of the Academic Board Signature V.V.Tretko
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Educational and Methodological Department

Head Signature L.S.Liubokhynets
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Academic Department

Head Signature O.H.Samoliuk
Initials, surname

Department for Ensuring the Quality of Higher Education

Head Signature H.V.Krasylnykova
Initials, surname

APPROVAL FORM

Head of the Student Council of
the Faculty of Programming and Computer and Telecommunication Systems

Name

Signature — I. Pelekhata (Initials, surname)

Director «IT-Klaster Khmelnytskoho» NGO
Name of the organization, enterprise

Signature — S.O.Yatsyshen (Initials, surname)

Director «G M Host» LLC
Name of the organization, enterprise

Signature — A.V.Harmatiuk (Initials, surname)

Director «ITT» (IT-telecommunication company) LLC
Name of the organization, enterprise

Signature — V.S.Simohuk (Initials, surname)

Educational Program Profile for the Major
123 «Computer Engineering»
Code and name of the major

1. General Information	
Full name of the institution of higher education and structural unit	Khmelnytskyi National University Faculty of Programming and Computer and Telecommunication Systems Department of Computer Engineering and System Programming
Higher education level	Bachelor's
Name of the academic qualification	Bachelor of Computer Engineering
Official name of the educational program	«Computer Engineering and Programming» Educational and Professional Program
Degree type and volume of the educational program	Bachelor's Degree – single major, volume of the educational and professional program – 240 ECTS credits, length of the study – 4 years
Accreditation	First time accreditation is to be carried out in 2024
Cycle/ level	National Qualification Framework – level 7; FQ-EHEA – first cycle; EQF LLL – level 6
Prerequisites	Complete general secondary education
Language(s) of instruction	English
Validity term of the educational program	5 years
Permanent web page of the educational program	http://www.khnu.km.ua/root/page.aspx?l=0&r=50&p=5&f=Б

2. Aim of the Educational Program
Formation of general cultural and professional competencies of competitive computer engineering specialists in Ukraine and abroad who can independently use and implement computer engineering technologies, solve complex specialized tasks and practical problems in the field of computer engineering or in the study process which involves the application of certain theories and methods of relevant sciences and is characterized by complexity and uncertainty of conditions.

3. Educational Program Characteristics	
Subject area (field of study, major, specialization (if available))	Computer Engineering (12 Information Technology; 123 Computer Engineering)
The target of the Educational Program	The educational and professional program is targeted at training specialists capable of independent use and implementation of computer engineering technologies; forming and developing general and professional competencies in computer engineering which contribute to the social stability, competitiveness and mobility of the graduate in the labor market; obtaining higher education (taking into account international quality standards of higher education) for the development, implementation and research of computer engineering technologies; meeting the needs of employers and society in qualified bachelors in computer engineering; performing applied research in the field of computer engineering.
The main focus of the educational program and specialization	Specialized education in the field of information technology in the "Computer Engineering" major. The emphasis of the program is placed on the ability to solve complex specialized tasks and practical problems in the field of computer engineering, in particular the development of algorithmic support and software, design and development of system and application software of computer systems that involves the use of certain theories and methods of computer engineering and is characterized by complexity and uncertainty of conditions. Keywords: computers, computer systems, computer networks, cyberphysical systems, information technologies, system software, application software.

Peculiarities of the educational program	Integrated training of specialists for independent use and implementation of computer engineering technologies. In order to provide contact with real production CASE-learning is offered, i.e. the study of several courses with the programs of Khmelnytskyi IT companies in the course of which students will deal with real tasks (cases).
4. Professional Suitability of Graduates and Their Further Study	
Professional suitability	According to the National Occupational Classification ДК 003:2010: 213 – Professional in the field of computing (computerization) 2131 – Professional in the field of computer systems 2131.2 – System Administrator; Computer software engineer 2132 – Professional in the field of programming 2132.2 – Developer of computer programs; Software Engineer; Programmer (database); Application programmer; System programmer 2139 – Professional in other areas of computing (computerization) 2139.2 – Computer application engineer 247 – Safety and quality professional 312 – Technical specialist in the field of computer facilities 3121 – Programming Technician
Further Study	Possibility to study the program of the second (master's) level of higher education (National Qualification Framework – level 8). Acquiring additional qualifications in the system of postgraduate education.
5. Teaching and Assessment	
Teaching and learning	Lectures. Workshops and practical classes. Problem solving classes. Laboratory work. Group work. Research. Internship / practictical training. Online / e-learning. Individual work. Classical (explanation and illustration) and active (problem, interactive, project, self-developing, game, situational, positional and contextual learning, cooperation) learning technologies.
Assessment	Written examinations, pass-fail tests, graded pass-fail tests, presentations, defense of laboratory and practical work, defense of practice, course projects, qualification work, etc.
6. Program Competences	
Integral competence (IC)	Ability to solve complex specialized tasks and practical problems during professional activity in the field of computer science or training which involves the application of theories and methods of computer engineering and is characterized by complexity and uncertainty of conditions.
General competences (GC)	GC1. Ability of abstract thinking, analysis and synthesis GC2. Ability to learn and master modern knowledge GC3. Ability to apply knowledge in practical situations GC4. Ability to communicate in the state language both orally and in writing GC5. Ability to communicate in a foreign language GC6. Interpersonal skills GC7. Ability to identify, raise and solve problems GC8. Ability to work in a team GC9. Ability to exercise one's rights and duties as a member of society, to realize the values of civic (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine GC10. 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; use various forms of activities and exercise for active recreation and conducting a healthy lifestyle

	General competences defined by the Educational Program: GC11. Ability to understand the subject area and professional activity GC12. Ability to use information and communication technologies GC13. Ability to solve tasks and make appropriate decisions GC14. Ability to develop and manage projects, evaluate and ensure the quality of work performed
Special (professional, subject matter) competences (PC)	PC1. Ability to apply legal and regulatory framework, as well as national and international requirements, practices and standards for the purpose of professional activity in the field of computer engineering. PC2. Ability to use modern methods and programming languages to develop algorithmic programs and software. PC3. Ability to create system and application software for computer systems and networks. PC4. Ability to protect information processed by the computer and in cyberphysical systems and networks in order to implement the established information security policy PC5. Ability to use design automation tools and systems to develop components of computer systems and networks, Internet applications, cyberphysical systems, etc. PC6. Ability to design, implement and maintain computer systems and networks of various types and purposes PC7. Ability to use and implement new technologies, including smart, mobile, green and secure computing technologies, to participate in the modernization and reconstruction of computer systems and networks, various embedded and distributed applications, in particular to increase their efficiency. PC8. Willingness to participate in the implementation of computer systems and networks, their installation at facilities for various purposes. PC9. Ability to systematically administer, use, adapt and operate existing information technologies and systems. PC10. Ability to organize workplaces, their technical equipment, placement of computer equipment, use of organizational, technical, algorithmic and other methods and means of information protection. PC11. Ability to draw up the obtained work results in the form of presentations, scientific and technical reports. PC12. Ability to identify, classify and describe the operation of software and hardware, computer systems and cyberphysical systems, networks and their components through the use of analytical and modeling methods. PC13. Ability to solve problems in the field of computer and information technologies, to determine the limitations of these technologies. PC14. Ability to design systems and their components taking into account all aspects of their life cycle and objectives, including design, configuration, operation, maintenance and disposal. PC15. Ability to justify the choice of methods for solving specialized tasks, critically evaluate the results and defend the decisions made. *Special competencies defined by the Educational Program*: PC16. Ability to analyze, synthesize and optimize computer and information technologies using mathematical models and methods. PC17. Ability to provide design and development of quality software and hardware for computer systems and networks. PC18. Ability to develop business solutions and evaluate new technological proposals. PC19. Ability to organize the collection and storage of data in databases and data warehouses, transmission and protection of information in software and hardware of computer systems and networks, including multimedia systems.

	PC20. Ability to use and manage modern information technology, computer engineering technology, cybersecurity methods and techniques while performing functional tasks and responsibilities.

7. Learning Outcomes (LO)

LO1. To know and understand the scientific principles that underlie the operation of computer tools, systems and networks.
LO2. To have skills in carrying out experiments, data collecting and modeling in computer systems.
LO3. To know the latest technologies in computer engineering.
LO4. To know and understand the impact of technical solutions in the social, economic, social and environmental context.
LO5. To have knowledge of the fundamentals of economics and project management.
LO6. To be able to apply knowledge to identify, formulate and solve technical tasks of the job using methods that are most suitable for achieving goals.
LO7. To be able to solve tasks of analysis and synthesis of tools specific to the field.
LO8. To be able to think on the system level and apply creativity when formulating new ideas.
LO9. To be able to apply knowledge of technical characteristics, design features, purpose and rules of operation of software and hardware of computer systems and networks to solve technical tasks in the field.
LO10. To be able to develop software for embedded and distributed applications, mobile and hybrid systems, calculate, operate equipment typical for the field.
LO11. To be able to search for information in various sources to solve tasks of computer engineering.
LO12. To be able to work effectively both individually and as a member of a team.
LO13. To be able to identify, classify and describe the operation of computer systems and their components.
LO14. To be able to combine theory and practice as well as make decisions and develop a strategy for solving tasks of the field taking into account universal values, social, state and industrial interests.
LO15. To be able to perform experimental research on professional topics.
LO16. To be able to evaluate the obtained results and give reasons for the decisions made.
LO17. To communicate orally and in writing on professional issues in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish).
LO18. To use information technology for effective communication at the professional and social levels.
LO19. To be able to adapt to new situations, justify, make and implement decisions within one's competence.
LO20. To realize the need for lifelong learning in order to deepen the acquired knowledge and acquire new professional knowledge, improve creative thinking.
LO21. To perform work at a high quality level and achieve the set goal in compliance with the requirements of professional ethics.
Learning outcomes determined by the Educational Program:
LO22. To apply knowledge of basic natural and general engineering (fundamental) courses as well as system modeling and discrete mathematics in solving typical tasks of design and use of software and hardware of computer systems and networks.
LO23. To use basic knowledge of informatics and modern information systems and technologies, programming skills, technologies of safe work in computer networks, methods of creating databases and Internet resources, technologies of development of algorithms and computer programs in high-level languages with application of object-oriented programming to solve tasks of design and use of software and hardware of computer systems and networks.
LO24. To justify the choice of methods for collecting, storing, transmitting and protecting information in software and hardware of computer systems and networks, including multimedia systems.
LO25. To administer, use, adapt and operate existing information and computer engineering technologies to ensure the protection of information in computer systems and networks in order to implement the established information security policy.

8. Resources for the Educational Program Implementation

Staff	All scientific and pedagogical workers who teach this educational and professional program have the qualification relevant to the profile and focus area of the courses taught, have the necessary experience of pedagogical work. All professors have the level of scientific and professional activity fulfilling at least four points of licensing

	requirements. Professors are constantly working on the implementation of international grant projects. Professionals with experience in research, management, innovation, creative work and work in the field are involved in the organization of the educational process.
Logistic support	Five specialized computer laboratories equipped with modern computer and specialized equipment, three equipped classrooms for practical and lecture classes with multimedia tools.
Information and educational and methodical support	Availability of: - Ukrainian and foreign professional periodicals in the relevant field in the library (including electronic form); - access to publications in scientometric databases such as Scopus, Web of Science; - the official website of KhNU which provides basic information on the organization of the educational process; - MOODLE modular learning environment; - electronic library of the university; - educational program, curriculum, academic course working programs, syllabuses in all courses of the curriculum; - practical training programs; - instructional guidelines for laboratory and practical work.
9. Academic Mobility	
National credit mobility	National credit mobility is planned for some training modules that provide the acquisition of general competences.
International credit mobility	Agreement on International Academic Mobility (Erasmus + KA1) with the University of Ostrava (Czech Republic) for 2015-2021.
Training foreign students	English-language educational program "Computer Engineering and Programming" of the first (bachelor's) level of higher education

II. Components of the Educational Program and Their Logical Order

2.1. Components of the Educational Program

CEP code number	Components of the Educational Program (CEP) (courses, course projects (works), practical trainings, qualification work)	ECTS credits	Final control	Semester
Compulsory Components of the Educational Program				
Genral Preparation Components(GPC)				
GPC.01	Higher Mathematics	16	examination	1, 2
GPC.02	Discrete Mathematics	6	examination	1
GPC.03	Physics	8	examination	2
GPC.04	Ukrainian (as a foreign language)	6	pass/ fail test	1,2
GPC.05	Theory of Electric and Magnetic Circuits	5	examination	3
GPC.06	Probability Theory and Mathematical Statistics	5	examination	4
GPC.07	Life Safety, Occupational Safety, Civil Defense and Ecological Safety	5	examination	8
GPC.08	Computer Logic	8	examination, course project	3
GPC.09	Information Technology	5	pass/ fail test	1
GPC.10	Philosophy	4	pass/ fail test	7
GPC.11	Culture Studies, Culture of Speech, Ethics and Aesthetics	4	pass/ fail test	6
GPC.12	Civic Society, Economics and Management	4	pass/ fail test	5
GPC.13	Data Processing and Multimedia Systems	5	examination	5
	Total	*81*		

Professional Training Components (PTC)				
PTC.01	Programming	14	examination, pass/ fail test, course project	1,2
PTC.02	Web Technologies	5	examination	2
PTC.03	Databases	7	examination	4
PTC.04	System Software	9	examination, course project	5,6
PTC.05	Computer Circuit Design and Computer-Aided Design Systems	7	examination, course project	5
PTC.06	Computer Architecture	6	examination	6
PTC.07	System Programming and Internet of Things	4	examination	7
PTC.08	System Modeling	8	examination, course paper	4
PTC.09	Computer and Cyberphysical Systems	5	examination	7
PTC.10	Object-Oriented Programming	7	examination	3
PTC.11	Computer Networks, System Administration and Cyber Security	7	examination, course project	7
PTC.12	Design and Technological Practical Training	5	graded pass/ fail test	6
PTC.13	Pre-graduation Practical Training	5	graded pass-fail test	8
PTC.14	Bachelor Thesis	10	qualifying paper	8
PTC.15	Attestation examination (Ukrainian Language)		attestation examination	7
	Total	*99*		
	Total for compulsory components	180		

ELECTIVE COMPONENTS OF THE EDUCATIONAL PROGRAM				
	Elective courses 3 semester	10	pass/ fail test*	3
	Elective courses 4 semester	10	pass/ fail test*	4
	Elective courses 5 semester	10	pass/ fail test*	5
	Elective courses 6 semester	10	pass/ fail test*	6
	Elective courses 7 semester	10	pass/ fail test*	7
	Elective courses 8 semester	10	pass/ fail test*	8
	Total for the elective components	60		
	Total for the educational program	240		

* - the number of tests depends on the students' choice of elective courses

The description of all compulsory components can be found in Appendix A.

2.2. Structural and logical outline of the educational program

The structural and logical outline determines the scientific and methodological structuring of the process of implementing the educational program, ie a brief description of the logical sequence of studying the compulsory components of the educational program. The structural and logical outline is presented in the form of a graph (Appendix B).

2.3. Elective components of the educational program

Elective components of the educational program are selected by students from the university catalog of elective courses which is formed from academic courses provided by different departments at different levels of higher education. The creditworthiness of elective courses is divisible by 4. Every year the list of elective educational components

from each department is updated. In this program the students are to choose 2-3 courses with a total number of 10 credits in each semester from the 3rd to the 8th. The selection procedure is carried out within the time limits established by the Regulations on the Procedure for Free Choice of Academic Courses by students of Khmelnytskyi National University. The catalog of elective courses is posted on the university website.

III. Forms of student attestation

Attestation of students under the educational program "Computer Engineering and Programming", specialty 123 "Computer Engineering" of the first (bachelor's) level of higher education is carried out in the form of a certification exam in Ukrainian in the 7th semester and in the form of public defense of qualifying work in the 8th semester.

The qualifying work (Bachelor Thesis) contains the results of analytical and theoretical, systems or experimental research of one of the current tasks of the specialty 123 "Computer Engineering" within the framework of professional activity of bachelors, as well as the results of design, modeling, implementation and testing of computer tools specified in the task, students must show the achievement of learning outcomes defined by this educational and professional program, their ability to logically present their views on the topic based on modern scientific methods, justify the choice of hardware and software, draw sound conclusions and formulate specific proposals and recommendations regarding the obtained results.

There can be no academic plagiarism, falsification or copying the qualifying work.

Qualifying papers must be published on the official website of the higher education institution or its subdivision (department), or in the repository of the higher education institution (Khmelnytskyi National University).

IV. Requirements to the internal system for ensuring the quality of higher education

The internal system for ensuring the quality of the educational process and higher education (hereinafter - ISEQ) at the University meets the requirements of European standards and recommendations for quality in higher education, Article 16 of the Law of Ukraine "On Higher Education" (2014) and Article 41 "On Education"(2017). The established ISEQ operates at five organizational levels in accordance with the developed regulations which are posted on the University's website: http://www.khnu.km.ua/root/page.aspx?r=700&p=100.

The ISEQ includes:

1) strategy (policy) and procedures for ensuring the quality of education;

2) the system and mechanisms for ensuring academic integrity;

3) monitoring and regular review of educational programs;

4) ensuring publicity of information about educational programs, degrees of higher education and qualification;

5) published criteria, rules and procedures for evaluating students;

6) published criteria, rules and procedures for evaluating the pedagogical (scientific-pedagogical) activities of pedagogical and scientific-pedagogical workers;

7) ensuring the availability of the necessary resources for the organization of the educational process including the materials for independent work of students;

8) providing advanced training of pedagogical, scientific and scientific-pedagogical workers;

9) ensuring the availability of information systems for effective management of educational institutions;

10) creating inclusive educational environment, universal design and intelligent adaptation in the educational institution;

11) other procedures and measures determined by special laws or documents.

V. Matrix of compliance of program competences with the components of the educational program

The matrix of compliance of program competences with the compulsory components of the educational program is given in Appendix C.

VI. Matrix of providing learning outcomes (LO) with the relevant components of the educational program

The matrix of providing program learning outcomes (LO) with compulsory components of the educational program is given in Appendix D.

Sources

1. Law of Ukraine "On Education" [Electronic resource]. - Access mode: http://zakon3.rada.¬gov.ua/laws/show/2145-19.

2. Law "On Higher Education" [Electronic resource]. - Access mode: http://zakon4.rada.gov.¬ua/laws/show/1556-18.

3. Levels of the National Qualifications Framework [Electronic resource]. - Access mode: https://mon.gov.ua/ua/osvita/nacionalna-ramka-kvalifikacij/rivni-nacionalnoyi-ramki-kvalifikacij.

4. The Standard of Higher Education of Ukraine for the Specialty 123 – Computer Engineering approved by the Decree of the Ministry of Education and Science of November 19, 2018 № 1262.

5. Licensing Requirements for Educational Activities. Resolution of the Cabinet of Ministers of December 30, 2015 № 1187 (with amendments by the resolution of the Cabinet of Ministers of May 10, 2018 № 347).

6. Instructional Guidelines for the Development of Standards of Higher Education. Decree of the Ministry of Education and Science of 01.06.2017 № 600 (with amendments by the Decree of the Ministry of Education and Science of 21.12.2017 № 1648).

7. Instructional Guidelines for Educational Programs for Training Specialists of Different Levels of Higher Education at Khmelnytskyi National University (approved by the Scientific and Methodological Council of the University, Record of 26.12.2018 № 4).

8. Letter of the Ministry of Education and Science dated 05.06.2018 № 1 / 9-377 "Regarding the Clarification of Educational Programs Design".

9. Letter of the Ministry of Education and Science dated 28.04.2017 № 1 / 9-239 "Sample of Educational and Professional Program for the First and Ssecond Levels of Higher Education".

Course Descriptions

HIGHER MATHEMATICS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	1-2
Number of ECTS credits	16
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully apply knowledge of the main sections of higher mathematics in solving typical tasks of design and use of software and hardware of computer systems and networks; analyze, synthesize and optimize computer and information technologies using mathematical models and methods.

Course content. Linear algebra, vector algebra, analytic geometry, introduction to mathematical analysis, differential calculus of one-variable functions, differential calculus of functions of several variables, indefinite integral, definite integral, differential equations and their systems, numerical and functional series, multiples, curvilinear and surface integrals, field theory.

Planned academic activity: lectures – 70 hrs, practical classes – 140 hrs, independent work – 270 hrs, total – 480 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); workshops (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, written papers (independent and control works), defense of calculation works, colloquiums.

Type of semester control: examination – 1, 2 semesters.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Pedagogical Sciences, Associate Professor N. M. Samaruk.

DISCRETE MATHEMATICS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	1
Number of ECTS credits	6
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully use the knowledge of the main sections of discrete mathematics in solving typical tasks of design and use of software and hardware of computer systems and networks; analyze, synthesize and optimize computer and information technologies using discrete mathematics; solve tasks in set theories, relations and graphs, combinatorial problems; formalize applied problems using sets, graphs and relations; use elements of general algebra to represent software and hardware through their formalization and generalization.

Course content. Theory of sets. Matching and mapping. Newton binomial and polynomial formula. Theory of combinations. Theory of graphs. Algebras, codes, fields, rings, ideals.

Planned academic activity: lectures – 34 hrs, practical classes – 34 hrs, independent work – 112 hrs, total – 180 hrs.

Teaching forms (methods): verbal (talk, conversation, explanation, lecture); practical (practical work); visual (illustration of educational material, demonstration of practical methods of work).

Assessment forms: oral quiz, written papers and control works.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Full Professor O. S. Savenko.

PHYSICS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	2
Number of ECTS credits	8
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully use the knowledge of physics in solving typical tasks of design and use of software and hardware of computer systems and networks; have skills in conducting experiments, data collection and modeling in computer systems; be able to solve tasks of analysis and synthesis of tools specific to the professional field; be able to apply knowledge of technical characteristics, design features, purpose and rules of operating technical devices; to preserve and multiply the scientific values and achievements of society on the basis of 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, machinery and technology.

Course content. Kinematics and dynamics of classical mechanics. Work and energy. Foundations of the relativity theory. The electric field and electric current. The magnetic field and electromagnetic induction. Oscillation and waves. Wave optics. Quantum phenomena. Wave-corpuscle range of properties of matter. Semiconductor phenomena in contacts.

Planned academic activity: lectures – 36 hrs, laboratory works – 36 hrs, independent work – 18 hrs, total – 240 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works and practical classes (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: defense of laboratory works, individual tasks presentations, written papers (test and control works), oral quiz.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor O. I. Yeriomenko.

THEORY OF ELECTRIC AND MAGNETIC CIRCUITS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	3
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully solve tasks of analysis and synthesis of technical devices; use knowledge of the theory of electric and magnetic circuits in solving typical tasks of design and use of software and hardware of computer systems and networks; have the necessary skills to conduct experiments, data collection; be able to perform experimental research on professional topics.

Course content. Methods of circuit analysis using Ohm's law, Kirchhoff's law, using contour currents and node potentials, including complex forms. Resonance phenomena. Circuits of mutual induction. Circuits with periodic non-sinusoidal voltage. Transient processes in linear circuits. Circuits with distributed parameters.

Planned academic activity: lectures – 34 hrs, laboratory works – 17 hrs, practical work – 17 hrs, independent work – 82 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works and workshops (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: written papers, tests, defense of laboratory and graphical and calculation works, final written paper.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Full Professor V. D. Kosenkov.

PROBABILITY THEORY AND MATHEMATICAL STATISTICS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	4
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully use the knowledge of probability theory and mathematical statistics in solving typical tasks of design and use of software and hardware of computer systems and networks; analyze, synthesize and optimize computer and information technologies using mathematical models and methods.

Course content. Basic concepts and theorems of the probability theory. Combinatorics. Bernoulli scheme. Random variables and functions. The main numerical characteristics of random variables. The laws of large numbers. Systems of several random variables. Basic concepts of mathematical statistics. Statistical evaluations of distribution parameters. Statistical hypothesis. Accuracy of evaluation, interval of confidence. Functional and correlation dependence.

Planned academic activity: lectures – 18 hrs, practical classes – 36 hrs, independent work – 96 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); workshops (using computer modeling, trainings, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, written papers (tests), self-control, control works.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Physical and Mathematic Sciences, Associate Professor A. O. Ramskyi.

LIFE SAFETY, OCCUPATIONAL SAFETY, CIVIL DEFENSE AND ECOLOGICAL SAFETY

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	8
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should know and understand the impact of technical solutions on the social and environmental context; be able to combine theory and practice as well as make decisions and develop a strategy for solving tasks of the professional field taking into account universal values, social, state and industrial interests; to organize workplaces, their technical equipment, placement of computer equipment; to understand and take into account environmental aspects, requirements of labor protection, industrial sanitation, fire safety and existing national and foreign standards in the formation of technical tasks and solutions.

Course content. Study of negative environmental factors, legal and regulatory framework for the protection of human health and life in conditions of negative environmental factors of residence and work and in emergency situations; practical skills of analysis and evaluation of working conditions, state labor protection at the enterprise; the use of individual and collective means of protection of human health and life.

Planned academic activity: lectures – 18 hrs, laboratory works – 18 hrs, practical classes – 18 hrs, independent work – 96 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory and practical works (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, written control papers.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2.University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor Yu. S. Sokolan.

COMPUTER LOGIC

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	3
Number of ECTS credits	8
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully solve tasks of synthesis and analysis of devices that contain combinational circuits, digital memory machines and operating machines, as well as typical computer components, using modern LSI and VLSI; know and understand the scientific principles that underlie functioning of digital media; combine theory and practice, make decisions and develop strategies for the design and development of computer tools; to be able to apply knowledge of technical characteristics, design features, purpose and rules of operation of technical devices; to ensure the design and development of quality technical devices.

Course content. Main notions and principles of computer logic. Information basics of computer technology. Switching (Boolean) function. Algebra of switching functions. Methods for minimizing switching functions. Synthesis of combinational circuits in different hardware bases. Basic theory of digital machines with memory. Methods for the synthesis of digital machines with memory. Analysis of logic and dynamic processes in digital machines. Typical computer digital circuits. Introduction to the theory of calculus. Forms of presenting and coding numbers in computers. Operations with a fixed and floating point. Synthesis of operating machines. Digital machines as a basis for building computers.

Planned academic activity: lectures – 34 hrs, practical classes – 34 hrs, laboratory works – 17 hrs, independent work – 155 hrs, total – 240 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); workshops and laboratory works (using computer modeling, master classes, practical work), independent work (individual tasks, course project).

Assessment forms: oral quiz, defense of practical and laboratory works, testing, defense of course projects, final control.

Type of semester control: examination, course project.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Doctor of Technical Sciences, Full Professor T. O. Hovorushchenko.

INFORMATION TECHNOLOGY

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	1
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to know and use the latest technologies in the field of computer engineering; apply knowledge of information technology to identify, formulate and solve technical tasks of the professional field using the methods that are most suitable for achieving the goals; use information technology for effective communication at the professional and social levels; use basic knowledge of modern information technology to solve tasks of design and use of software and hardware of computer systems and networks; administer, use, adapt and operate existing information and computer engineering technologies; solve tasks in the field of computer and information technologies, determine the limitations of these technologies.

Course content. Computer structure. Information storage devices. Physical and logical sections. Installing operating systems. Installing drivers. Software installation. Software update. Backup. Peripheral settings. Basic principles of local area network organization. Adjusting SOHO routers and Wi-Fi access points. Organizing shared access to computer resources.

Planned academic activity: lectures – 17 hrs, laboratory works – 34 hrs, independent work – 99 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works (using trainings, master classes, practical work), independent work (individual tasks).

Assessment forms: defense of laboratory works, testing.

Type of semester control: pass/ fail test.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor I. V. Hurman.

PHILOSOPHY

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	7
Number of ECTS credits	4
Course study mode	Full-time

Learning outcomes. Students who have successfully completed the course must be able to: identify and solve problems of ideological and philosophical nature as well as make analysis and synthesis of tools specific to the professional field; to typologize the history of philosophy; to characterize basic approaches to understanding life, analyze forms, levels and methods of cognition; to determine essential characteristics of society; to conceptualize basic principles of logic, ethics and aesthetics as philosophical sciences; to know the nomenclature of philosophy; to implement philosophical methodology in scientific cognition; to think on the system level, to know and understand scientific theses.

Course content. Philosophy, its subject and role in society. Historical types of philosophy. Ukrainian philosophy. Philosophical theory of being. Consciousness. The philosophy of cognition (epistemology). Society as an object of philosophical analysis. The philosophy of history. Philosophical anthropology. Axiology. Logic.

Planned academic activity: lectures – 17 hrs, practical classes – 34 hrs, independent work – 69 hrs, total – 120 hrs.

Teaching forms (methods): lectures (using problem study and visualization methods), practical classes (using trainings, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, testing.

Type of semester control: pass/ fail test.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Doctor of Philosophy, Full Professor N. K. Petruk.

CULTURE STUDIES, CULTURE OF SPEECH, ETHICS AND AESTHETICS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	6
Number of ECTS credits	4
Course study mode	Full-time

Learning outcomes. Students who have successfully completed the course must have a system of knowledge about the world cultural process; get to know universal cultural values, moral and aesthetic needs; preserve and multiply moral, cultural, scientific values and achievements; communicate orally and in writing on professional topics in Ukrainian; have skills of interpersonal interaction in the Ukrainian language; make presentations, scientific and technical reports about the obtained results and outcomes; constantly raise the level of speech culture; work conscientiously and achieve the set goal in compliance with the requirements of professional ethics.

Course content. The emergence of culture and art. Leading trends and features of cultural development. Language as a social phenomenon. Stylistic varieties of the Ukrainian language. Scientific, official and publicist functional styles. Problems of professional terminology. Culture of oral and written speech. Aesthetics. Philosophy of art. Ethics. Ethics of business communication

Planned academic activity: lectures – 17 hrs, practical classes – 34 hrs, independent work – 69 hrs, total – 120 hrs.

Teaching forms (methods): lectures (using problem study and visualization methods), practical classes (using information technology, trainings, practical work), independent work (individual tasks).

Assessment forms: oral quiz, testing, written tasks, continuous written assessment, control papers.

Type of semester control: pass/ fail test.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua..
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Department of Philosophy and Political Science.

CIVIC SOCIETY, ECONOMICS AND MANAGEMENT

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	5
Number of ECTS credits	4
Course study mode	Full-time

Learning outcomes. Students who have successfully completed the course must be able to: to exercise their rights and duties as members of society, to realize the values of civic (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine;to know and understand the impact of technical solutions in the economic context; to know and use the basics of economics and project management; to develop and manage projects, evaluate and ensure the quality of the work performed.

Course content. The evolution of civic society and stages of its formation. Theories of civic society. Models of civic society. Statehood and civic society. Historical milestones in the development of civic society in Ukraine. The role of the Ukrainian cultural intelligentsia in preserving the historical traditions of statehood. Socialization of civic society. Intellectual activity in civic society. Issues of civic society in the context of global issues and current challenges. Economic categories and economic laws. The economic system of society. Forms of organization of social production. Property relations. Money and the monetary system. Capital and hired labor. Market economy. Enterprise and entrepreneurship. Production costs, profits, business analytics. Economic factors influencing the development of civic society and the state. Administration and management. Fundamentals of project management, project quality, project team. The place and influence of social activists and non-governmental organizations on the management and development of the state.

Planned academic activity: lectures – 17 hrs, practical classes – 34 hrs, independent work – 69 hrs, total – 120 hrs.

Teaching forms (methods): lectures (using computer modeling, visualization methods (slides), explanation, talk), practical classes (using practical work, problem solving, situational tasks, discussions), independent work (individual tasks).

Assessment forms: oral quiz, individual tasks presentations, written tasks (testing).

Type of semester control: pass/ fail test.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Economic Sciences, Associate Professor L. S. Liubokhynets, Candidate of Economic Sciences, Associate Professor A. V. Meish.

DATA PROCESSING AND MULTIMEDIA SYSTEMS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	5
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to substantiate the choice of methods for collecting, storing, transmitting and protecting information in software and hardware of computer systems and networks including multimedia systems; administer, use, adapt and operate existing information and computer engineering technologies with information security; ensure the protection of information processed in computer and cyberphysical systems and networks in order to implement the established information security policy; use organizational, technical, algorithmic and other methods and means of information protection.

Course content. Basic concepts and definitions of information theory. Coding as a process of presenting information in the digital form. Features of effective coding. Optimal coding. Shannon-Fano coding. Huffman coding. Error-correcting coding. Shannon's theorem for a discrete noisy channe. The connection between the code correcting capability with the code distance. Noise-tolerant error detection codes. Error correction codes. Parity code. Hemming code. Cyclic code. Symmetric and asymmetric cryptosystems. DES, AES, RSA, Diffie-Hellman cryptosystems. General notions of multimedia. Text, graphics, sound and video in multimedia. Processing text, audio, graphic, video information in multimedia.

Planned academic activity: lectures – 17 hrs, laboratory works – 17 hrs, practical work – 34 hrs, independent work – 82 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works and workshops (using computer modeling, trainings, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, defense of laboratory and practical works, testing, final test.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor L. O. Kovtun.

PROGRAMMING

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	1-2
Number of ECTS credits	14
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to use modern methods and programming languages for the development of algorithms and software; develop software for embedded and distributed applications, mobile and hybrid systems using C / C++; use programming skills, algorithm development technologies and computer programs in high-level languages to solve tasks of design and use of software and hardware of computer systems and networks.

Course content. Basics of programming. Programming paradigms. Algorithms and solving problems. Fundamental data structures. Structured programming. Structures of programming languages. Recursion. Programming of dynamic data structures. Algorithms and data structures. Exception handling. Exceptions and their processing.

Planned academic activity: lectures – 34 hrs, practical classes – 70 hrs, laboratory works – 87 hrs, independent work – 229 hrs, total – 420 hrs.

Teaching forms (methods): verbal, visual, practical, problem-based, interactive methods, use of information technology, mathematical modeling, testing, defense of projects and developments.

Assessment forms: oral quiz, written individual and test papers, colloquiums.

Type of semester control: 1 semester – examination, 2 semester – pass/ fail test, course project.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Full Professor O. S. Savenko.

WEB TECHNOLOGIES

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	2
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to use modern methods and programming languages for the development of algorithms and software; develop software for embedded and distributed applications, mobile and hybrid systems in PHP; use programming skills, technologies for developing algorithms and computer programs, methods of creating Internet resources in high-level languages to solve tasks of design and use of software and hardware of computer systems and networks; be able to work effectively both individually and as a team; have knowledge of the basics of project management; be able to think on the system level and use creativity for new ideas, improve creative thinking.

Course content. Basic provisions and definitions of web programming. The concept of client-server architecture: the interaction of web server and browser. Hypertext markup language. Scripting languages (server and scripting languages). HTTP protocol. GitHub version control system. The concept of cross-browser layout using Bootstrap technology. Fundamentals of working with MySQL database. OOP basics: classes and objects. The concept of MVC-architecture. Laravel and Yii frameworks. The concept of content management system. Review of the most common programming patterns.

Planned academic activity: lectures – 18 hrs, practical classes – 18 hrs, laboratory work – 36 hrs, independent work – 78 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); practical and laboratory works (using computer modeling, trainings, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, defense of laboratory works, testing, final test.

Type of semester control: examination.

Educational resources:
1. Steve Prettyman, Learn PHP 7: Object-Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL, Apress Media,USA
2. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
3.University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: O. O. Pavlova.

DATABASES

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	4
Number of ECTS credits	7
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to skillfully use methods of creating databases to solve tasks of design and use of software and hardware of computer systems and networks; substantiate the choice of methods for collecting, storing, transmitting and protecting information in software and hardware of computer systems and networks; organize data collection and storage in databases and data warehouses; know the latest technologies in the field of computer engineering, the methodology of their development on the basis of local and distributed databases.

Course content. Information System Architecture. Three-tier architecture for ANSI-SPARC database. Functions and architecture of database management system. Data model (relational, non-relational, post-relational). Relational data structure and their integrity. Conceptual design. Method of ER-diagrams. Normalization of relations, the method of universal relation. Relational algebra and relational calculus. Fundamentals of SQL. SQL language Identifiers, SQL operator optimization. Transactions. Parallel execution of transactions. Data indexing in the database. Distributed information systems. Fragmentation, distribution, global conceptual schema. Transactions in distributed databases. Data replication. Database security and means of its maintenance. Post-relational databases.

Planned academic activity: lectures – 36 hrs, laboratory works – 72 hrs, independent work – 102 hrs, total – 210 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works (using computer modeling, practical work), independent work (individual tasks).

Assessment forms: oral quiz, defense of laboratory works, testing, final control.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2.University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: V. M. Stetsiuk.

SYSTEM SOFTWARE

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	5-6
Number of ECTS credits	9
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to use modern programming methods and programming languages; develop system software; develop system software for computer systems and networks; solve tasks of analysis and synthesis of system software; use basic knowledge of computer science and modern information systems and technologies, programming skills, technologies of safe work in computer networks, technologies of developing algorithms and computer programs in high-level languages using object-oriented programming for solving the tasks of design and use of system software; be able to think on the system level and use creativity for new ideas.

Course content. The organization of computing processes in CSN. The architecture of system software. Structural organization and methods of resource management in CSN. Basics of designing SS in CSN. Methodology of developing systems for dynamic and static planning and scheduling tasks in CSN. Operating systems, their structure and functions. Managing tasks, memory management, data management, IO device management. Interruptions. Process management. Modern operating systems. Virtualization. Resource management in distributed systems, GRID and CLOUD systems. Formal languages. Lexical, syntactical and semantic code analyzers.

Planned academic activity: lectures – 34 hrs, practical classes – 17 hrs, laboratory works – 68 hrs, independent work – 151 hrs, total – 270 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); practical and laboratory works (using computer modeling, practical work), independent work (individual tasks, course project).

Assessment forms: oral quiz, written papers and tests, defense of the course project.

Type of semester control: 5,6 semesters – examination, 6 semester – course project.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Full Professor O. S. Savenko

COMPUTER CIRCUIT DESIGN AND COMPUTER-AIDED DESIGN SYSTEMS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	5
Number of ECTS credits	7
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to use design automation tools and systems to develop components of computer systems and networks; know and understand the scientific principles that underlie the operation of computer tools; be able to solve tasks of analysis and synthesis of computer tools; apply knowledge of technical characteristics, design features, purpose and rules of operating technical tools of computer systems and networks to solve technical tasks of the professional field; identify, classify and describe the operation of computer components.

Course content. General principles of computer construction. The concept of computer architecture and structure. Architectural characteristics and classification of computers. The main stages of computer design. Basic combinatorial computing circuits. Code converters. Encoders. Decoders. Linear decoder. Pyramidal decoder. Regular structure decoder. Multiplexers. Demultiplexers. Combinatorial circular shifts. Combinatorial adders - binary, binary-decimal. Parallel, serial and combined adder. Adder sectioning. Digital comparators - serial and parallel. Memory circuits. Registers. Counters. Partitioning of counters. Counters with variable coefficient. Accumulating adder. Basic structure of the processor. Arithmetic and logical devices for adding and subtracting integers (in additional code, in direct code, using the inverse code), adding floating-point numbers, multiplication operation and its acceleration. Control devices. Microprogram automaton. Central processor command system. Making addressing systems. Central control unit. Memory devices. Automated design systems.

Planned academic activity: lectures – 17 hrs, practical classes – 17 hrs, laboratory works – 34 hrs, independent work – 142 hrs, total – 210 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); practical classes and laboratory works (using computer modeling, practical work), independent work (individual tasks).

Assessment forms: oral quiz, defense of laboratory and practical works, testing, final test, defense of the course project.

Type of semester control: examination, course project.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: V. M. Stetsiuk.

COMPUTER ARCHITECTURE

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	6
Number of ECTS credits	6
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to know and understand the scientific principles that underlie the operation of computer tools; be able to solve tasks of analysis and synthesis of computer tools and computer architecture; apply knowledge of technical characteristics, design features, purpose and rules of operation of technical tools of computer systems and networks to solve technical tasks of the professional field; identify, classify and describe the operation of computer parts; use design automation tools and systems to develop components of computer systems and networks; have the skills to conduct experiments and data collection; work effectively both individually and in a team; develop and manage projects, evaluate and ensure the quality of the performed work.

Course content. Architectural features of modern computers. Command systems. Multi-level computer memory. Associative and virtual memory. The work of a processor with external devices. Processing interruptions. Organization of direct memory access. VHDL language in designing digital equipment. Purpose, classification and characteristics of processors. Architecture of control units with rigid and flexible logic. Purpose of arithmetic and logic unit.

Planned academic activity: lectures – 17 hrs, practical classes – 17 hrs, laboratory works – 51 hrs, independent work – 95 hrs, total – 180 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); practical classes and laboratory works (using computer modeling, master classes, practical work), independent work (individual tasks), using modern IT and spftware applications.

Assessment forms: defense of laboratory works, written papers and tests.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Doctor of Technical Sciences, Full Professor V. V. Martyniuk.

SYSTEM PROGRAMMING AND INTERNET OF THINGS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	7
Number of ECTS credits	4,0
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should know the latest technologies in the field of computer engineering; use programming skills, technologies for developing algorithms and computer programs to solve tasks of design and use of software and hardware of computer systems and networks; develop software for embedded and distributed applications, mobile and hybrid systems in low-level programming languages; work conscientiously and achieve the set goal in compliance with the requirements of professional ethics.

Course content. Peculiarities of the architecture and command system of a basic processor. Software modules for high-speed data transformation in system program complexes using system programming languages (Assembler, C). System software modules with branch computing processes, resource distribution of computing system using internal information database of the operating system. Commands and registers of protected mode, synchronize primitives to interact with problem programs. Programming interruptions, memory management in real and protected modes. Typical elements of system software. Information basics of the Internet of Things. Temperature sensors. Pressure sensors. Light level sensors. Wind speed sensors. Fundamentals of control theory. Methods of information transmission in wireless networks. Process analysis in intelligent electronic devices and systems. Typical circuits of smart electronic devices. Introduction to the theory of information transfer. Forms of number representation and coding in mobile devices. Application of microcontrollers, sensors and actuators in smart electronic devices. Synthesis of intelligent systems and intelligent environment. Intelligent technologies for exchanging information between devices using wireless networks.

Planned academic activity: lectures – 17 hrs, laboratory works – 34 hrs, independent work – 69 hrs, total – 120 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); workshops and laboratory works (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, testing, defense of laboratory works.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences K. Yu. Bobrovnikova.

SYSTEM MODELING

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	4
Number of ECTS credits	8
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to identify, classify and describe the work of software and hardware, computer systems and cyberphysical systems, networks and their components through the use of analytical methods and modeling methods; analyze, synthesize and optimize computer and information technologies using mathematical models and methods; perform modeling in computer systems; apply knowledge of system modeling in solving typical tasks of design and use of software and hardware of computer systems and networks.

Course content. The theoretical basis of modeling data-processing systems. Methods of modeling. Development techniques of mathematical and simulation systems. Basis of feeding and processing information in computer systems. Modern modeling languages. Queuing systems. Markov models.

Planned academic activity: lectures – 18 hrs, laboratory works – 36 hrs, practical classses – 36 hrs, independent work – 150 hrs, total – 240 hrs.

Teaching forms (methods): verbal, visual, practical, problem-oriented, interactive methods, using IT, projects and developments.

Assessment forms: continuous assessment - defense of laboratory and practical works, oral quiz, written papers and control works, final assessment – defense of a course paper, examination.

Type of semester control: examination, course paper.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Physical and Mathematic Sciences, Associate Professor T. M. Kysil.

COMPUTER AND CYBERPHYSICAL SYSTEMS

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	7
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should know and understand the scientific principles that underlie the functioning of computer systems; be able to design systems taking into account all aspects of their life cycle and tasks, including the creation, configuration, operation, maintenance and disposal; identify, classify and describe the operation of computer and cyberphysical systems using analytical methods and modeling methods; design, implement and maintain computer systems of various types and purposes; provide design and development of high-quality software and hardware of computer systems; use design automation tools and systems to develop components of computer and cyberphysical systems; ensure the protection of information processed in computer and cyberphysical systems in order to implement the established information security policy; participate in the modernization and reconstruction of computer and cyberphysical systems, to increase their efficiency in particular; participate in the introduction of computer systems, their setting at various facilities for different purposes; have skills in conducting experiments, data collection and modeling in computer systems.

Course content. General principles of designing computer systems. Information support of computer systems. Universal computer systems. Specialized computer systems. Classification of parallel computer systems. Computer systems of SIMD class. MISD Class Computer Systems: Conveyor Computer Systems. Structural organization of computer systems of different generations. Computer systems with a fixed communication system. Organization of data transmission in computer systems. Computational processes in computer systems. Memory organization in computer systems. Work planning in computer systems. Basic concepts of fault tolerance and reliability of computer systems. Computer systems with non-traditional architecture. Cyberphysical systems.

Planned academic activity: lectures – 34 hrs, laboratory works – 34 hrs, independent work – 82 hrs, total – 150 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory works (using computer modeling, master classes, practical work), independent work (individual tasks, course project).

Assessment forms: defense of laboratory works, testing, final assessment.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences A. O. Nicheporuk.

OBJECT-ORIENTED PROGRAMMING

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	3
Number of ECTS credits	7
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should be able to use modern methods and programming languages for the development of algorithms and software; develop system and application software for computer systems and networks; provide design and development of quality software; develop software for embedded and distributed applications, mobile and hybrid systems; use programming skills, technologies for developing algorithms and computer programs in high-level languages with the use of object-oriented programming to solve tasks of design and use of software and hardware of computer systems and networks.

Course content. Applying the principles of object-oriented programming. Basic notions of C++, objects, classes, inheritance, overloading, polymorphism, processing exceptions, streams. Meta-classes, delegating, templates. Object-oriented approach to the development and implementation of application software systems, expediency and fruitfulness of systematic use of object-oriented approach at all stages of the life cycle of application system, analysis of requirements to a software system and its preliminary design, implementation, testing and further maintenance.

Planned academic activity: lectures – 34 hrs, laboratory works – 34 hrs, practical classes – 34 hrs, independent work – 108 hrs, total – 210 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory and practical works (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: oral quiz, defense of laboratory works, testing.

Type of semester control: examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor S. M. Lysenko.

COMPUTER NETWORKS, SYSTEM ADMINISTRATION AND CYBER SECURITY

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	7
Number of ECTS credits	7
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should know and understand the scientific principles that underlie the functioning of computer networks; design, implement and maintain computer networks of various types and purposes; use design automation tools and systems to develop computer network components; identify, classify and describe the operation of computer networks through the use of analytical and modeling methods; ensure the design and development of quality computer networks; design computer networks taking into account all aspects of their life cycle and the set task, including creation, adjustment, operation, maintenance and disposal; ensure the protection of information processed in computer networks in order to implement the established information security policy; participate in the modernization and reconstruction of computer networks, in order to increase their efficiency in particular; participate in the introduction of computer networks, their setting at various facilities for different purposes; use basic technologies of safe work in computer networks to solve tasks of design and use of computer networks; administer, use, adapt and operate existing information and computer engineering technologies to ensure the protection of information in computer networks in order to implement the established information security policy.

Course content. Addressing network nodes. OSI model. Protocol stacks. Computer network topologies. Cable networks. Wireless networks. Network communication equipment. Network equipment settings. LAN standards. Routing. VPN tunneling. Distributed computer networking technologies. Virtual machines. Basic concepts and terms of system administration of computer systems and networks; management of users in computer networks and policies to restrict access to information resources; network services and protocols TCP / IP, IMAP, POP3, SMTP, HTTP; Active Directory; firewall configuration in Windows and Linux; the structure of the registry in Windows; file access control in Linux; system ports and their purpose; command line utilities; backup principles. Basic concepts and terms of system administration of computer systems and networks. Management of users in computer networks and policies to restrict access to information resources.

Planned academic activity: lectures – 17 hrs, laboratory works – 34 hrs, practical classes – 17 hrs, independent work – 142 hrs, total – 210 hrs.

Teaching forms (methods): lectures (using problem study methods and visualization); laboratory and practical works (using computer modeling, master classes, practical work), independent work (individual tasks).

Assessment forms: defense of laboratory works, testing, defense of course project, final assessment.

Type of semester control: course project, examination.

Educational resources:
1. MOODLE Learning Platform. Web page: https://msn.khnu.km.ua.
2. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor Yu. P. Kliots.

DESIGN AND TECHNOLOGICAL PRACTICAL TRAINING

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	6
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should know the basics of project management; develop and manage projects; provide design and development of high-quality software and hardware of computer systems; evaluate and ensure the quality of work and networks; be aware of the need for lifelong learning in order to deepen the acquired knowledge and receive new professional knowledge, improve creative thinking; think on the system level and use creativity to find new ideas; adapt to new situations, substantiate, make and implement decisions within the scope of one's competence; have skills in conducting experiments, data collection and modeling; know the latest technologies in the field of computer engineering; know and understand the impact of technical solutions in the social, economic, social and environmental context; work effectively both individually and as a team; combine theory and practice as well as make decisions and develop a strategy for solving tasks of the professional field taking into account universal values, social, state and industrial interests; evaluate the results obtained and defend the decisions made with arguments; use information technology for effective communication at the professional and social levels; perform work well and achieve the goals in compliance with the requirements of professional ethics; develop business solutions and evaluate new technological proposals.

Course content. Quality of software and computer tools. Quality assurance of software and computer tools. Software and computer testing and setting. Marketing (promotion) of software products, information systems and technologies in social networks. Use of advertising tools and tools for automation of social networks. Branding of software products, information systems and technologies in social networks. Information targeting. Creating interesting, targeted content. Use of analytical tools to analyze users of social networks and their needs. Creating regular activities for different audiences.

Planned academic activity: independent work – 150 hrs, total – 150 hrs.

Teaching forms (methods): laboratory and practical works throughout the semester.

Assessment forms: defense (with a presentation) of the individual project.

Type of semester control: pass/ fail test.

Educational resources:
1. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor Ye. H. Hnatchuk.

PRE-GRADUATION PRACTICAL TRAINING

Course type	Compulsory
Education level	First (Bachelor's)
Language of instruction	English
Semester	8
Number of ECTS credits	5
Course study mode	Full-time

Learning outcomes. A student who has successfully completed the course should A student who has successfully completed the course should know the basics of project management; develop and manage projects; provide design and development of high-quality software and hardware of computer systems; evaluate and ensure the quality of work and networks; be aware of the need for lifelong learning in order to deepen the acquired knowledge and receive new professional knowledge, improve creative thinking; think on the system level and use creativity to find new ideas; adapt to new situations, substantiate, make and implement decisions within the scope of one's competence; have skills in conducting experiments, data collection and modeling; know the latest technologies in the field of computer engineering; know and understand the impact of technical solutions in the social, economic, social and environmental context; work effectively both individually and as a team; combine theory and practice as well as make decisions and develop a strategy for solving tasks of the professional field taking into account universal values, social, state and industrial interests; evaluate the results obtained and defend the decisions made with arguments; use information technology for effective communication at the professional and social levels; perform work well and achieve the goals in compliance with the requirements of professional ethics.

Course content. Computer system design and development. Design and development of a cyberphysical system. Computer network design and development.

Planned academic activity: independent work – 150 hrs, total – 150 hrs.

Teaching forms (methods): practical training at an enterprise.

Assessment forms: defense (with a presentation) of the individual project.

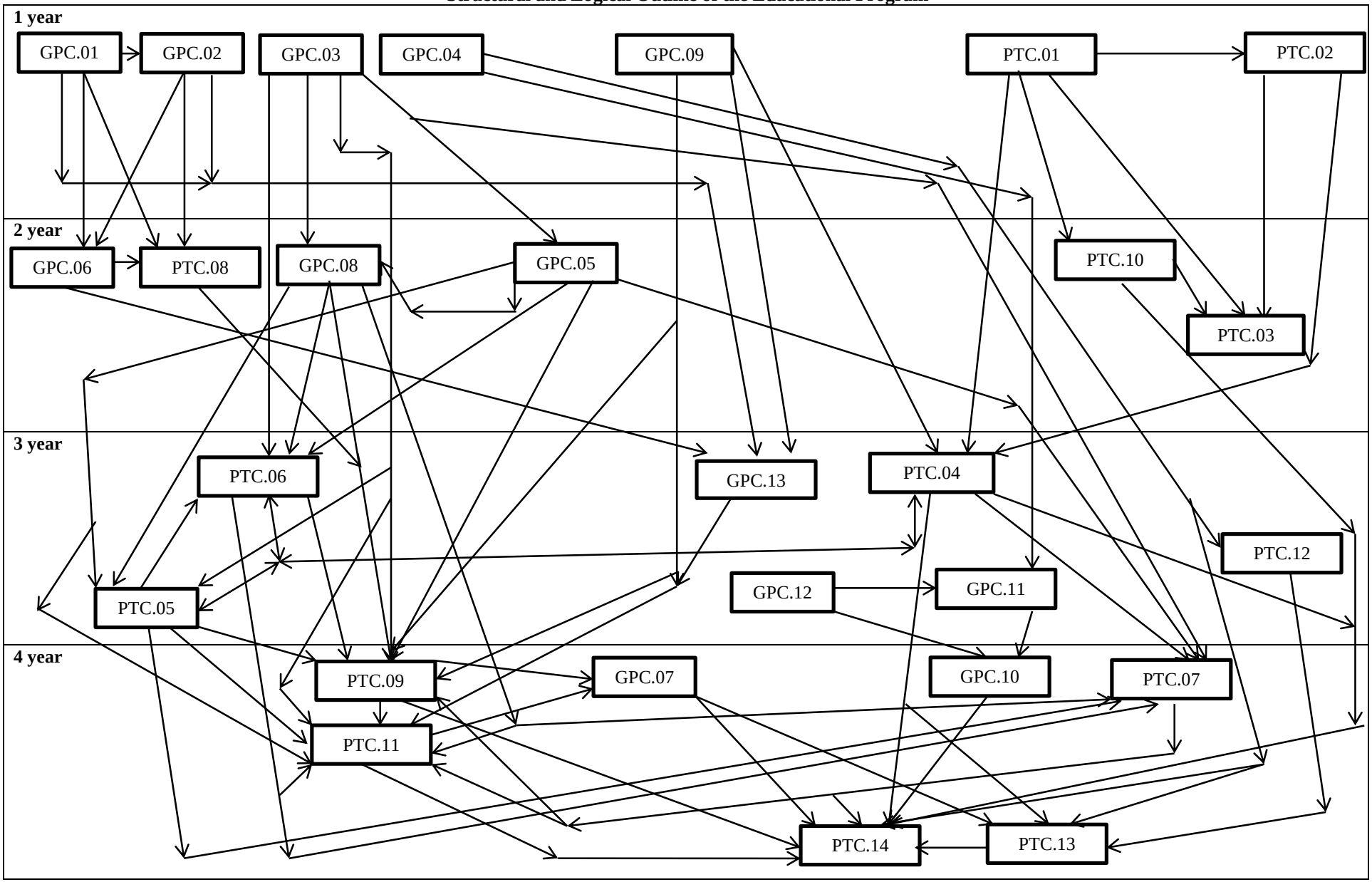
Type of semester control: pass/ fail test.

Educational resources:
1. University Electronic Library. Web page: http://lib.khnu.km.ua/asp/php_f/p1age_lib.php.

Lecturers: Candidate of Technical Sciences, Associate Professor Ye. H. Hnatchuk.

Appendix B

Structural and Logical Outline of the Educational Program



Appendix C

Matrix of Compliance of Program Competences with the Components of General Preparation the Educational Program

	GPC.01	GPC.02	GPC.03	GPC.04	GPC.05	GPC.06	GPC.07	GPC.08	GPC.09	GPC.10	GPC.11	GPC.12	GPC.13
IC	+	+	+	+	+	+	+	+	+	+	+	+	+
GC1	+	+				+		+		+			
GC2	+	+	+	+	+	+			+	+			
GC3	+	+	+		+	+	+	+	+				+
GC4	+	+	+		+	+	+	+	+	+	+	+	+
GC5				+									
GC6				+							+	+	
GC7								+	+				
GC8													
GC9											+	+	
GC10			+		+		+			+	+	+	
GC11			+		+			+	+				+
GC12									+				
GC13	+	+	+		+	+		+	+				+
GC14												+	
PC1				+			+	+	+				+
PC2													
PC3													
PC4													+
PC5													
PC6													
PC7									+				
PC8							+						
PC9									+				
PC10							+						+
PC11				+									
PC12			+		+			+					
PC13									+				
PC14								+					
PC15				+				+					
PC16	+	+				+		+	+	+			
PC17								+					
PC18												+	
PC19													+
PC20									+				

Matrix of Compliance of Program Competences with the Components of Professional Training

	PTC.01	PTC.02	PTC.03	PTC.04	PTC.05	PTC.06	PTC.07	PTC.08	PTC.09	PTC.10	PTC.11	PTC.12	PTC.13	PTC.14
IC	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC1					+	+								+
GC2	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC3	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC4	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC5														+
GC6		+				+						+	+	+
GC7	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC8		+				+						+	+	+
GC9														+
GC10														+
GC11	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC12	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC13	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC14		+				+						+	+	+
PC1	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC2	+	+		+			+			+				+
PC3	+	+		+			+			+				+
PC4									+		+			+
PC5					+	+			+		+			+
PC6									+		+			+
PC7							+		+		+			+
PC8									+		+			+
PC9									+		+			+
PC10											+			+
PC11		+								+		+	+	+
PC12					+	+		+	+		+			+
PC13												+	+	+
PC14					+	+			+		+			+
PC15		+			+	+				+		+	+	+
PC16					+	+		+						+
PC17	+	+		+	+	+	+		+	+	+	+	+	+
PC18		+				+	+			+		+		+
PC19			+											+
PC20							+				+	+	+	+

Appendix D

Matrix of Providing Program Learning Outcomes (LO) with Compulsory Components of General Preparation of the Educational Program

	GPC.01	GPC.02	GPC.03	GPC.04	GPC.05	GPC.06	GPC.07	GPC.08	GPC.09	GPC.10	GPC.11	GPC.12	GPC.13
LO1			+		+			+		+			
LO2			+		+								
LO3								+	+				+
LO4							+				+	+	
LO5												+	
LO6								+	+				+
LO7	+	+	+		+	+		+		+			
LO8								+		+			
LO9			+		+			+					
LO10													
LO11				+				+	+				+
LO12				+									
LO13								+					
LO14							+				+	+	
LO15			+		+			+	+				+
LO16				+									
LO17				+				+	+		+		+
LO18								+	+				+
LO19								+	+				+
LO20				+				+	+				+
LO21								+	+		+		+
LO22	+	+	+		+	+		+					
LO23									+				
LO24													+
LO25									+				+

Matrix of Providing Program Learning Outcomes (LO) with Compulsory Components of Professional Training

	PTC.01	PTC.02	PTC.03	PTC.04	PTC.05	PTC.06	PTC.07	PTC.08	PTC.09	PTC.10	PTC.11	PTC.12	PTC.13	PTC.14
LO1					+	+			+		+			+
LO2								+	+		+			+
LO3	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO4												+	+	+
LO5		+				+				+		+	+	+
LO6	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO7	+	+		+	+	+	+			+				+
LO8		+				+	+			+		+	+	+
LO9					+	+	+		+		+			+
LO10	+	+		+			+		+	+	+			+
LO11	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO12		+				+				+		+	+	+
LO13					+	+			+		+			+
LO14							+					+	+	+
LO15	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO16		+				+				+		+	+	+
LO17	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO18	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO19	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO20	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO21	+	+	+	+	+	+	+	+	+	+	+	+	+	+
LO22								+	+		+			+
LO23	+	+	+	+			+		+	+	+			+
LO24			+						+		+			+
LO25									+		+			+