

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
KHARKIV NATIONAL AUTOMOBILE AND HIGHWAY UNIVERSITY

EDUCATIONAL AND PROFESSIONAL PROGRAMME

«AUTOMATED MANAGEMENT OF TECHNOLOGICAL PROCESSES»

the second (master's) level of higher education

by speciality 174 Automation, computer-integrated technologies and robotics

fields of knowledge 17 Electronics, automation and electronic communications

qualification Master in automation and computer-integrated technologies

APPROVED

BY KhNAHU SCIENTIFIC COUNCIL

protocol No 55/23 of «30» June 2023

Chairman of the Scientific Council



signature

V.O. Bohomolov

first name and surname

The educational programme

will be implemented in 2023

order No 87 of «03» July 2023

Rector



signature

V.O. Bohomolov

first name and surname

Kharkiv 2023

PREFACE

1. Developed by the project team:

Leonid Nefiodov, DSci, prof.,
professor of the ACIT department

name and surname, position


signature

, guarantor of the EP

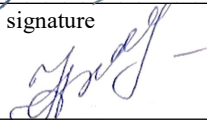
Yuriy Petrenko, DSci, prof.,
professor of the ACIT department

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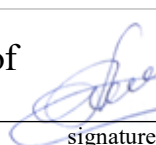
Nataliia Fil, PhD, associate professor of
the ACIT department

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Angela Binkovska, PhD, associate professor of
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2. Recommended by the Methodological Commission of the Mechanical Faculty

Protocol No 9 of «12» May 2023.

3. Approved by the Methodological Council

Protocol No 8 of «7» June 2023.

4. Reviewer:

Ihor Nevliudov, Doctor of Technical Sciences, Professor, Head of the Department of Computer-Integrated Technologies, Automation and Mechatronics at Kharkiv National University of Radio Electronics.

**1. PROFILE OF THE EDUCATIONAL PROGRAMME
IN SPECIALITY 174 “AUTOMATION, COMPUTER-INTEGRATED
TECHNOLOGIES AND ROBOTICS”**

1 – General information	
Name of the higher education institution and structural unit	Kharkiv National Automobile and Highway University; Mechanical Faculty; Department of Automation and Computer-Integrated Technologies
Degree of higher education and title of qualification in the original language	Higher education degree – Master. Master's degree in automation and computer-integrated technologies
Official name of the educational programme	Educational and professional programme of the second (master's) level of higher education
Diploma type and programme duration	Master's degree, single, 90 ECTS credits, duration of study 1 year 4 months
Accreditation status	Accredited up to 01.07.2028
Programme cycle/level	NQF of Ukraine – level 7; FQ-EHEA – cycle 2; EQF LLL – level 7
Prerequisites	Bachelor's degree is required
Language(s) of teaching	Ukrainian, English
Duration of the educational programme	Until the end of the study period or the next programme update
Internet address for permanent posting of the educational programme description	https://www.khadi.kharkov.ua/education/katalog-osvitnikh-program/151-avtomatizacija-ta-kompjuterno-integrovani-tekhnologiji/
2 – Objective of the educational programme	
<p>The <i>objective</i> of the educational programme is to train professionals of the second level of higher education capable of complex solution of tasks and problems of creation, improvement, modernization, operation, and maintenance of automation systems in road and transport industries, their components, cyber-physical systems, digital transformation technologies that are behind the tasks of Industry 4.0, facilitate the process of rapid adaptation of products and services of enterprises and companies, and ensure the transition from the physical world to the digital one.</p>	

3 – Programme description	
Subject area (field of knowledge, speciality, specialisation)	<p>17 Electronics, automation and electronic communications 174 Automation, computer-integrated technologies and robotics</p> <p>The objects of study and activity of masters in automation and computer-integrated technologies are: objects and processes of control (technological processes, production, organizational structures), technical, information, mathematical, software and organizational support of automation systems for road, and transport industries.</p> <p>Learning objectives: training specialists of the second level of higher education capable of complex solution of challenging tasks and issues of creation, improvement, modernisation, operation and maintenance of automation systems, their components, cyber-physical systems, digital transformation technologies that are behind the tasks of Industry 4.0, facilitate the process of rapid adaptation of products and services of enterprises and companies of road and transport industries, as well as ensure the transition from the physical world to the digital one.</p> <p>Theoretical content of the subject area: concepts and principles of automatic control theory, principles of development of automation systems and computer-integrated technologies.</p> <p>Methods, techniques and technologies. Methods of analysis, synthesis, design, adjustment, modernization, operation, and maintenance of automation systems and computer-integrated technologies, cyber-physical production; methodology of scientific research of control objects and automation systems of complex organizational and technical objects.</p> <p>Tools and equipment. Digital and network technologies, microprocessors, programmable logic controllers (PLCs), embedded digital devices and systems (Embedded Systems), intelligent mechatronic and WLAN-compatible components of the Internet of Things (IoT) technology, specialized software for designing, developing and operating automation systems.</p>

Orientation of the educational programme	The emphasis of the programme is on training specialists capable of comprehensively solving challenging tasks and problems of creating, improving, modernizing, operating and maintaining automation systems for road and transport industries, their components, cyber-physical systems, digital transformation technologies that are behind the Industry 4.0 challenges, facilitate the process of rapid adaptation of products and services of enterprises and companies in the road and transport industries, and ensure the transition from the physical to the digital world.
Main focus of the educational programme and specialisation	Training of highly qualified specialists who are proficient in the methods of analysis, synthesis, design, adjustment, modernization, operation, and maintenance of automation systems and computer-integrated technologies, cyber-physical production; methodology of scientific research of control objects and automation systems of complex organizational and technical objects of road, and transport industries. <i>Keywords:</i> automated control systems, mathematical and computer modelling, intelligent control, robotics, Internet of Things, cyber-physical systems; Industry 4.0, mechanical engineering, construction, road machinery and equipment.
Programme features	The educational programme provides in-depth theoretical and practical training using specialized software for the design, development, and operation of automation systems in the fields of instrumentation and automation of construction and road machinery and equipment, digital and network technologies, microprocessors, programmable logic controllers, embedded digital devices and systems, and Internet of Things technologies.
4 – Suitability of graduates for employment and further education	
Suitability for employment	Graduates of the educational programme acquire competencies that allow them to be employed at enterprises of any organizational and legal form (state, municipal, commercial, non-profit) and in any type of economic activity (primarily mechanical engineering, road construction and transport). Positions that can be held by a master's degree holder in speciality 174 “Automation, computer-integrated technologies and robotics” correspond to, but are not limited to, the following list according to the Classification of professions SK 003:2010: 2131.2 Automated production control systems engineer

	<p>2131.2 Computer systems engineer 2131.2 Computer software engineer 2132.2 Research engineer in computerized systems and automation 2139.2 Computer application engineer 2143.1 Junior Researcher (Electrical Engineering) 2143.2 Relay protection and electrical automation engineer 2143.2 Design engineer (electrical engineering) 2144.2 Information and telecommunication systems engineer 2144.2 Information and telecommunication technology engineer 2145.2 Engineer in mechanization and automation of production processes 2147.2 Technical diagnostics engineer 2149.1 Junior Researcher (Engineering) 2149.2 Systems management and maintenance engineer 2149.2 Mechatronic 2149.2 Engineer for the introduction of new equipment and technology 2359.1 Junior researcher (in other fields of study).</p>
Further education	<p>Opportunity to continue studies at the third (educational and scientific) level, the third cycle of the FQ-EHEA, QF-LLL level 8, NQF level 9, to improve qualifications (including in other specializations) in the postgraduate education system, and to receive additional postgraduate education.</p>
5 – Teaching and assessment	
Teaching and learning	<p>Teaching is conducted in the form of lectures, practical and laboratory classes, independent work with the recommended literature with the possibility of consultations with the teacher, completion of calculation and graphic works, term papers and projects, preparation of a qualification work.</p> <p>It provides for problem-based learning, research-based learning, self-study, distance learning through course pages on the KhNAHU educational website, project work in teams, and training through internships at institutions and enterprises in the engineering, road and transport industries that use automation systems and tools and computer-integrated technologies in their activities.</p>
Assessment	<p>Assessment of students' academic achievements is carried out according to the national scale (excellent, good, satisfactory, unsatisfactory; passed, failed); 100-point scale and ECTS scale (A, B, C, D, E, FX, F)</p>

6 – Programme competences	
Integral competence	Ability to solve challenging problems and problems of automation and computer-integrated technologies in professional activities and/or in the process of study, which involves research and/or innovation and is characterized by complexity and uncertainty of conditions and requirements.
General competences (GC)	<p>GC 1. Ability to conduct research at the appropriate level.</p> <p>GC 2. Ability to generate new ideas (creativity).</p> <p>GC 3. Ability to think abstractly, to analyse and synthesize.</p> <p>GC 4. Ability to work in an international context.</p> <p>GC 5. Ability to communicate in Ukrainian and foreign languages.</p>
Professional competences (PC)	<p>PC 1. Ability to automate complicated technological objects and complexes, create cyber-physical systems based on intelligent control methods and digital technologies using databases, knowledge bases, artificial intelligence methods, robotic and intelligent mechatronic devices.</p> <p>PC 2. Ability to design and implement highly reliable automation systems and their application software to implement control and information processing functions, to protect intellectual property rights for new design and engineering solutions.</p> <p>PC 3. Ability to apply simulation and optimization methods to study and improve the efficiency of systems and processes for managing complex technological, organizational and technical objects.</p> <p>PC 4. Ability to analyse production and technological systems and complexes as objects of automation, determine methods and strategies for their automation and digital transformation.</p> <p>PC 5. Ability to integrate knowledge from other fields, apply a systematic approach and take into account non-technical aspects when solving engineering problems and conducting research.</p> <p>PC 6. Ability to apply modern methods of automatic control theory to the development of automated control systems for technological processes and objects.</p> <p>PC 7. Ability to apply specialized software and digital technologies to solve complex problems and issues of automation and computer-integrated technologies.</p> <p>PC 8. Ability to design the functional, technical and information structure of computer-integrated control systems for organizational and technological complexes using</p>

	<p>network and information technologies, software and hardware control systems, industrial controllers, mechatronic components, robotic devices and human-machine interface tools.</p> <p>PC 9. Ability to apply modern Industry 4.0 technologies to automate and manage complex organizational and technical facilities and systems in the road and transport industries.</p> <p>PC 10. Ability to present the results of research activities, prepare scientific publications, participate in scientific discussions at scientific conferences, symposia and carry out pedagogical activities in educational institutions.</p> <p>PC 11. Ability to apply the acquired knowledge and skills to work in the road and transport industries, to be ready to implement in practice in specific conditions measures to protect the public in emergency situations and employees from occupational hazards.</p> <p>PC 12. Ability to invent and innovate in the field of automation and computer-integrated process control in instrumentation, road and transport industries, ability to ensure the protection of intellectual and industrial property rights.</p>
7 – Programme learning outcomes (PLO)	
Programme learning outcomes (PLO)	<p>LO 01 Create automation systems, cyber-physical production based on the use of intelligent control methods, databases and knowledge bases, digital and network technologies, robotic and intelligent mechatronic devices.</p> <p>LO 02. Create highly reliable automation systems with a high level of functional and information security of software and hardware.</p> <p>LO 03. Apply specialized conceptual knowledge, including modern scientific achievements, as well as critical understanding of modern problems in the field of automation and computer-integrated technologies to solve complex problems of professional activity.</p> <p>LO 04. Apply modern approaches and methods of simulation and optimization to research and create effective automation systems for complex technological and organizational and technical objects.</p> <p>LO 05. Develop computer-integrated control systems for complex technological and organizational and technical objects, applying a systematic approach, taking into account non-technical components of automation objects assessment.</p>

	<p>LO 06. Communicate fluently in the official and foreign languages orally and in writing to discuss professional problems and results of activities in the field of automation and computer-integrated technologies, to present research results and innovative projects.</p> <p>LO 07. Analyse production and technical systems in a particular field of activity as objects of automation and determine a strategy for their automation and digital transformation.</p> <p>LO 08. Apply modern mathematical methods, methods of automatic control theory, reliability theory and system analysis to research and development of automation systems for complex technological and organizational and technical objects, cyber-physical production.</p> <p>LO 09. Develop functional, organizational, technical and information structures of automation systems for complex technological and organizational and technical objects, develop software and hardware control systems using network and information technologies, industrial controllers, mechatronic components, robotic devices, human-machine interface and taking into account technological conditions and requirements for production management in road and transport industries.</p> <p>LO 10. Develop and use specialized software and digital technologies to create automation systems for complex organizational and technical objects, have professional knowledge of special software tools.</p> <p>LO 11. Adhere to the norms of academic integrity, know the basic legal norms for the protection of intellectual property, commercialization of the results of research, invention, and design activities.</p> <p>LO 12. Collect the necessary information using scientific and technical literature, databases and other sources, analyze and evaluate it.</p> <p>LO 13. Know and understand the fundamental and applied aspects of the sciences related to industrial, technological and natural safety.</p> <p>LO 14. Introduce and apply modern energy and resource-saving technologies in the automation of technological processes in various production sectors, in particular in the road and transport industries.</p>
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8 – Resource support of the programme	
Staffing	In accordance with the staffing requirements for ensuring the implementation of educational activities for the relevant level of HE approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No 1187, as amended by the Resolution of the Cabinet of Ministers of Ukraine No 365 dated 24.03.2021.
Material and technical support	<p>In accordance with the technological requirements for the material and technical support of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30.12.2015 № 1187, as amended by the Resolution of the Cabinet of Ministers of Ukraine №365 of 24.03.2021, the equipment and software of specialized laboratories of the departments guarantees</p> <ol style="list-style-type: none"> 1) provision of premises for conducting training sessions and control measures 2) availability of multimedia equipment for simultaneous use in classrooms. 3) availability of social and amenity infrastructure; 4) provision of higher education students with a dormitory; 5) provision of computer workstations, laboratories, equipment, facilities necessary for the implementation of educational plans.
Information and educational support	<p>The implementation of the educational programme involves</p> <ul style="list-style-type: none"> - compliance with the technological requirements for educational, methodological and information support of educational activities of the relevant level of HE approved by the Resolution of the Cabinet of Ministers of Ukraine of 30.12.2015 No. 1187, as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 365 of 24.03.2021; - availability of licensed specialised software in accordance with professionally oriented disciplines; - free access to teaching and learning materials of the university library and electronic catalogue, Moodle-based educational website, scientometric databases, etc.
9 – Academic mobility	
National credit mobility	Based on bilateral agreements between KhNAHU and Ukrainian universities.
International credit mobility	Within the framework of the EU Erasmus+ programme and on the basis of bilateral agreements between KhNAHU and educational institutions of partner countries.

Training of foreign students	This educational and professional programme is available for foreign students.
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2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAMME AND THEIR LOGICAL SEQUENCE

2.1. List of components of the EP

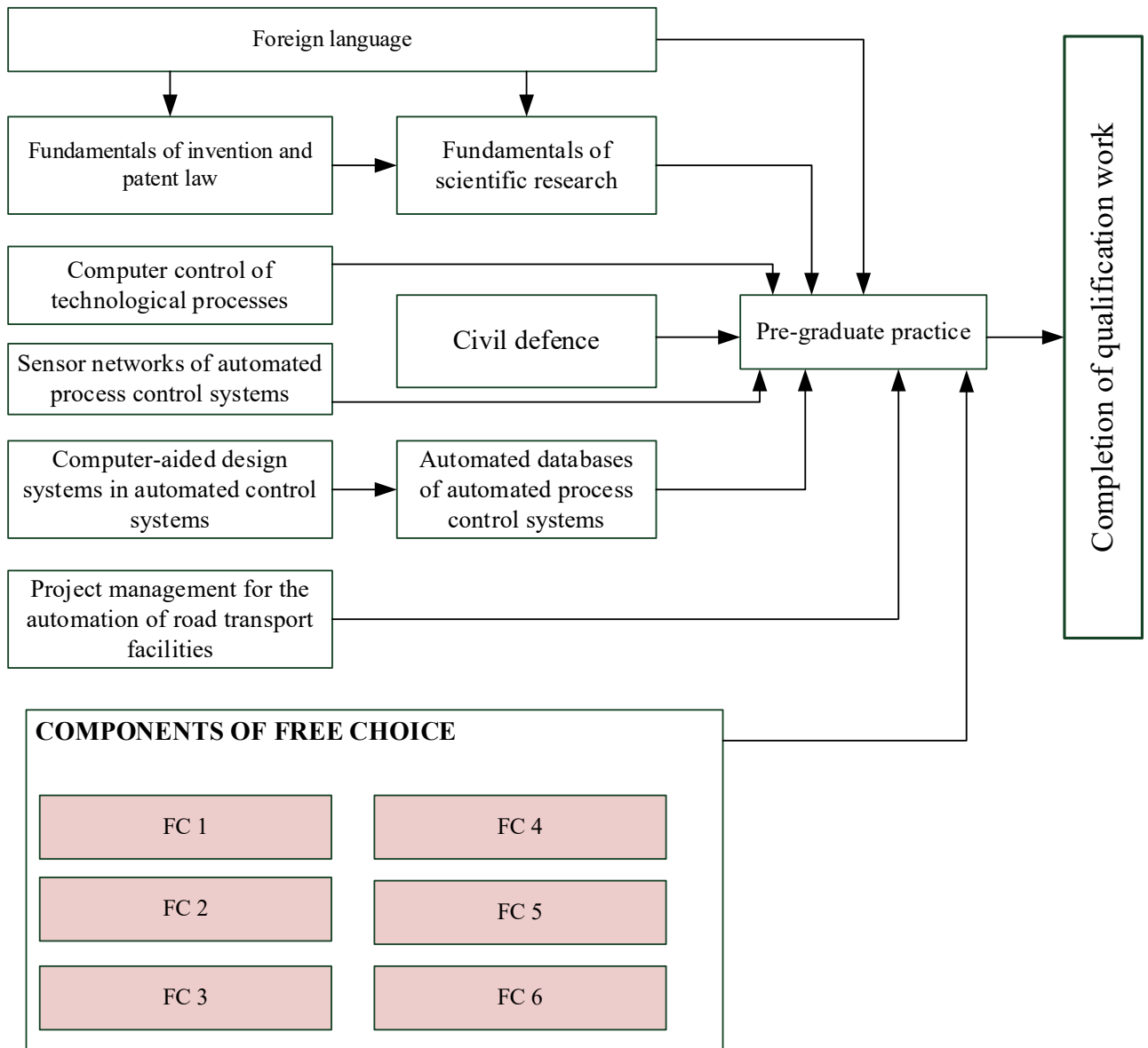
Code	Components of the educational programme (academic disciplines, course projects (works), internships, qualification work)	Number of credits	The form of the final control
I. MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAMME			
1.1. Disciplines of general education			
EC 1	Fundamentals of Invention and Patent Law	3.0	credit test
EC 2	Foreign language	4.0	exam
EC 3	Civil defence	3.0	credit test
	In total	10.0	
1.2 Disciplines of professional training			
EC 4	Computer control of technological processes	4.0	credit test
EC 5	Sensor networks of automated process control systems	4.0	exam
EC 6	Computer-aided design systems in automated control systems	4.0	exam
EC 7	Project management for the automation of road transport facilities	5.0	credit test
EC 8	Automated databases of automated process control systems	5.0	exam
EC 9	Fundamentals of scientific research	4.0	credit test
EC 10	Pre-graduate practice	6.0	credit test
EC 11	Completion of qualification work	24	
	In total	56	
Total amount of mandatory components		66	
II. COMPONENTS OF FREE CHOICE OF THE EDUCATIONAL PROGRAMME			
FC 1	Free Choice Discipline 1	4.0	credit test
FC 2	Free Choice Discipline 2	4.0	credit test
FC 3	Free Choice Discipline 3	4.0	credit test
FC 4	Free Choice Discipline 4	4.0	credit test
FC 5	Free Choice Discipline 5	4.0	credit test
FC 6	Free Choice Discipline 6	4.0	credit test
	In total	24	
Total amount of components of Free Choice:		24	
GRAND TOTAL OF THE EDUCATIONAL PROGRAMME		90.0	

2.2 The university-wide catalogue of courses of free choice is available on the university's official website at:

<https://www.khadi.kharkov.ua/education/katalog-vibirkovikh-disciplin>

3. STRUCTURAL AND LOGICAL DIAGRAM OF THE EP

MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAMME



4. FORM OF ATTESTATION OF HIGHER EDUCATION STUDENTS

The attestation of graduates of the educational programme of speciality 174 “Automation, computer-integrated technologies and robotics” is carried out in the form of defence of the master's qualification work and ends with the issuance of a document of the established form on awarding a master's degree with the qualification: “Master in Automation and Computer-Integrated Technologies”.

In the process of preparing and defending the qualification work, the graduate must demonstrate knowledge and ability to analyse the properties of the automation object, justify the choice of hardware and software, perform design work, develop application software, making extensive use of modern computer technology at all stages of development.

The master's qualification work is subject to mandatory verification for academic plagiarism.

Attestation is carried out openly and publicly.

5. MATRIX OF COMPLIANCE OF PROGRAMME COMPETENCES WITH THE COMPONENTS OF THE EDUCATIONAL PROGRAMME

	EC 1	EC 2	EC 3	EC 4	EC 5	EC 6	EC 7	EC 8	EC 9	EC 10	EC 11
GC-1					+	+	+	+	+	+	
GC-2	+			+			+				
GC-3				+	+	+	+	+	+	+	
GC-4	+	+					+			+	
GC-5	+	+								+	
PC-1				+		+	+	+	+		
PC-2	+				+	+	+	+	+		+
PC-3						+	+		+	+	+
PC-4				+	+	+	+			+	
PC-5	+	+	+				+		+		+
PC-6						+					+
PC-7				+	+	+		+			+
PC-8						+		+			+
PC-9				+		+					+
PC-10	+				+					+	
PC-11			+	+	+			+		+	
PC-12	+				+					+	+

6. MATRIX OF ENSURING THE PROGRAMME LEARNING OUTCOMES (LO) WITH THE RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAMME

	EC 1	EC 2	EC 3	EC 4	EC 5	EC 6	EC 7	EC 8	EC 9	EC 10	EC 11
LO-01	+			+					+		
LO-02					+			+	+		
LO-03	+				+		+		+	+	
LO-04						+	+	+			
LO-05				+	+	+	+		+		
LO-06	+	+								+	
LO-07	+			+			+	+	+	+	
LO-08						+	+				+
LO-09				+	+	+					+
LO-10				+		+		+			+
LO-11	+				+			+			+
LO-12	+	+	+							+	
LO-13										+	
LO-14	+										+

7. MATRIX OF CORRESPONDENCE BETWEEN PROGRAMME LEARNING OUTCOMES (LO) AND COMPETENCES

	GC 1	GC 2	GC 3	GC 4	GC 5	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8	PC 9	PC 10	PC 11	PC 12
LO-1	+	+				+											
LO-2	+	+				+	+										
LO-3	+		+					+		+	+						
LO-4	+		+					+									
LO-5						+				+							
LO-6				+	+												
LO-7									+			+					
LO-8							+	+		+							
LO-9											+	+	+	+			
LO-10							+				+	+	+				
LO-11							+									+	
LO-12					+					+					+	+	+
LO-13															+	+	+
LO-14														+			+

Professor of the Department of Automation and
Computer-Integrated Technologies of KhNADU, prof.



Leonid Nefiodov