THE MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLITECHNIC NATIONAL UNIVERSITY

ACCEPT
Rector of
Lviv Polytechnic
National University
_____Bobalo Yu.
"_26_05_____ 2020

EDUCATIONAL-PROFESSIONAL PROGRAM
"COMPUTER CONTROL SYSTEMS FOR MOVING OBJECTS (AUTOMOBILE TRANSPORT)"
THE SECOND (MASTER'S) LEVEL OF HIGHER EDUCATION

BRANCH OF KNOWLEDGE	12 information technology
SPECIALTY	122 computer science and information technology
PROGRAM	Computer Control Systems for Moving Objects (Automobile Transport)
QUALIFICATION	Master of Science in Computer Control Systems for Moving Objects (Automobile Transport)

Considered and approved
by Lviv Polytechnic
National University
Scientific Council
"_26_05_____ 2020
Protocol № 63

Lviv 2020

LETTER OF AGREEMENT
educational-professional programs

The level of higher education	The second (master's)
Branch of knowledge	12 information technology
Specialty	122 computer science
Specialization	Computer Control Systems for Moving Objects (Automobile Transport)
Qualification	Master of Science in Computer Control Systems for Moving Objects (Automobile Transport)

DEVELOPED AND APPROVED

Scientific and methodical
Commission 122 the speciality
"Computer science"
Protocol number 5
"05" 12 2019
The Chairman of the 122 speciality
_____ U. Marikutsa

RECOMMEND

The scientific-methodical Council
of the University
Protocol number 47
"22" 02 2019
The head of the SMC
_____ A. Zagorodniy

AGREED

The Vice-Rector on scientific and
pedagogical
Lviv Polytechnic National University
_____ O.Davydchak
05 12 2019

Head of educational and methodical
Department
_____ V.Sviridov
24 12 2019
Director of Educational-Scientific
Institute of computer Technologies,
Automation and Metrology
_____ M. Mykyichuk
02 12 2019

CREATED BY

Developed by the working group of the Scientific and Methodological Commission of the specialty 122 "Computer Sciences" of the National University "Lviv Polytechnic" in the composition of:

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guarantor _____ Roman Modla

The project of the educational-professional programs are discussed and approved at the meeting of the Scientific Council of the Educational-Scientific Institute of computer Technologies, Automation and Metrology

Protocol number __7__ from __02__ __12__ 2019

Chairman of the Scientific Council _____ / M. Mykyichuk /

APPROVED AND GIVEN EFFECT

The Rector of the Lviv Polytechnic National University

__16__ __07__ 2020 № 347-1-10

1. Profile programs master's degree on a speciality "Computer science" specialization "Computer control systems for moving objects (road transport)"

1 – General information	
The full name of the institution of higher education and the structural unit	**Lviv Polytechnic National University**
The full name of the qualification in the original language	Master of Computer Science with a degree in computer control systems for the moving objects (road transport)
The official name of educational program	Computer control systems for moving objects (road transport)
Type of diploma and the volume of educational program	A master's degree, unit, 90 ECTS, term of studies is 1.5 years
The availability of accreditation	Accredited By The Ministry Of Education
Cycle/level	The NQF of Ukraine – 7 level, FQ-EHEA-second cycle, QF-LLL-7 level
Prerequisites	The Bachelor's degree
Language (s) of teaching	Ukrainian language
Basic concepts and their definitions	The program uses the basic concepts and their definitions according to the law of Ukraine "on higher education"
2 – the goal of the educational program	
	Provide theoretical knowledge and practical skills sufficient for successful performance of professional duties in the specialty 122 "Computer Science" in the specialization "Computer control systems for moving objects (road transport)", prepare students for further employment and training in educational and scientific programs.
3-characteristics of the educational program	
Subject area (industry knowledge, speciality)	Information Technology, Computer Science
The orientation of the educational program	The program is based on well-known provisions and results of modern scientific and technical research in information technology, computer technology and programming, embedded systems and the Internet of Things, digital methods of signal and image processing, intelligent technologies for moving objects control, computer modelling of motor transport systems, experiment planning and research planning.
The main focus of educational programs and specializations	Special education and professional training in computer science area. Keywords: embedded systems, Internet of Things, information systems, navigation systems, electronic car control units, analysis and processing of signals and images, mathematical modelling of car control systems.
Features of the program	The program focuses on development of the promising areas for the introduction of information technology in road transport, as well as modern technologies in the field of the Internet of Things.

4 – the suitability of graduate educational program to employment and further study	
Suitability for the employment	Jobs in the public and private sectors in various fields of activity, in particular: in universities or research organizations and institutions, IT companies, industrial enterprises.
Further training	All programs Ph.d. field of knowledge "information technology".
5 – Teaching and evaluation	
Teaching and learning	Lectures, laboratory work, practical classes, independent work based on textbooks, manuals and lecture notes, monographs, scientific articles, consultations with teachers, preparation of master's thesis.
Evaluation	Written and oral examinations, laboratory reports, presentations, current control, protection of course projects (works), protection of master's work.
6 – Software competence	
Integrated competence (INT)	The ability to solve complex scientific problems and practical problems during professional and scientific activities in the field of "Information Technology" or in the learning process, which involves the use of theories and methods of digital signal and image processing, synthesis of digital vehicle control systems, mathematical modeling of car control systems, intelligent control technologies, embedded systems and the Internet of Things, experiment planning and research results processing.
Professional competence of the specialty (FC)	1) thorough knowledge of basic sciences, to the extent necessary for the development of professional and scientific disciplines. 2) thorough knowledge in the field of information technology, necessary for the development of science-oriented disciplines. 3) the ability to apply professional knowledge and practical skills to solve typical problems of the specialty. 4) ability to assess the impact of scientific development on the environment and responsibility for the negative impact and safety of the developed technical solution. 5) the ability to formulate, analyze and synthesize solutions to scientific problems at the abstract level by decomposing them into components that can be studied separately in their more and less important aspects. 6) the ability to outline priorities that serve to solve the scientific problem. 7) the ability to use knowledge of the subject area, basic sciences, skills and abilities to determine the purpose and objectives for the selection of technical, informational and organizational support in the design of information systems. 8) ability to apply information and communication technologies, programming skills and computer integrated environments for modeling and solving optimization problems of engineering and research activities. 9) understanding the causal links of society and the ability to use them in professional and social activities. 10) the ability to develop embedded systems based on controllers and microcontrollers.
Professional competency specializations	1) ability to perform collection, analysis and systematization of scientific and technical information;

(FKS)	2) the ability to use and implement new technologies, participate in the modernization and reconstruction of equipment, devices and systems of the car, embedded Internet of Things; 3) the ability to apply professional knowledge in the process of solving scientific problems, building mathematical models of automotive control systems and Internet of Things systems; 4) the ability to use modern methods and approaches to optimize automotive control systems; 5) the ability to use modern methods of signal and image processing in automotive systems and Internet of Things systems; 6) the ability to design complex embedded systems; 7) the ability to identify and use the necessary tools to organize the project development process and carry out project management; 8) the ability to effectively carry out planning, implementation of project actions and project decisions based on normative and methodological provisions, standards and norms of a particular application area for IT project management, to form requirements for compliance of the information system with the technical task; 9) the ability to develop systems for collecting, processing, finding patterns and trends in data; ability to develop expert systems.
7-Program learning outcomes	
Learning outcomes	LO1. The student is able to responsibly treat the work performed and achieve the goal in compliance with the requirements of professional ethics. LO2. The student is able to realize the need for lifelong learning in order to deepen the acquired and acquire new professional knowledge. LO3. Student able to speak (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion. LO4. Student able to assess the content and scope of resources management tasks for information systems at all stages of their life cycle based on the basic principles of marketing and management. LO5. The student is able to use a variety of methods, including information technology, for effective communication at the professional and social levels. LO6. The student is able to search for information in various sources to solve problems of specialization. LO7. The student is able to apply knowledge and understanding for the tasks of analysis and synthesis of specialization. LO 8. The student is able to evaluate the stage and final results of the project and adjust the project parameters, develop project documentation for projects, perform actions to assess the results of the project. LO 9. The student knows and understands the impact of technical solutions in the public, economic, social and environmental context. LO10. The student has a thorough knowledge of scientific concepts, theories and methods necessary for the study and synthesis of automotive control systems and embedded Internet of Things. LO11. The student knows the life cycle of integrated automotive control systems and embedded IoT systems; content and sequence of procedures for constructing functional and structural schemes.

	LO12. The student knows of hardware and software for analysis and synthesis of automotive control systems and embedded Internet of Things. LO13. The student knows knowledge of computer methods for modeling and optimization of automotive control systems and embedded IoT systems. LO14. The student knows how to assess the adequacy and effectiveness of information systems and technologies, using the methodology of object-oriented analysis and design, as well as tools to support the software life cycle. LO15. The student knows of models of information flows, repositories and data spaces, knowledge bases using charting techniques and standards for the development of information systems. LO16. The student knows of methods and means of signal and image processing, basic approaches to signal conversion from one area to another, methods and means of digital filtering and compression of signals and images. LO17. The student knows the principles of construction and operation of electronic car control systems, remote car control systems, multiplex car systems. LO18. The student is able to use modern programming methods and tools to study the feasibility of implementing automotive control systems and embedded Internet of Things in order to meet the information needs of users. LO19. The student is able to use multi-channel digital oscilloscopes and diagnostic scanners to study electronic car control systems. digital oscilloscope. LO20. The student is able to perform chip tuning of electronic car control systems to optimize their characteristics. LO21. The student is able to choose the necessary method of signal conversion, perform signal conversion from one area to another, perform digital filtering and compression of signals, in particular, image signals. LO22. Student able to assess the adequacy of the proposed recommendations for the creation and maintenance of safe working and living conditions, ensuring civil protection artificial safety, and responding to emergencies and eliminating their consequences for a given information system.
Skill (UM)	1) be able to use modern programming methods and tools to study the feasibility of implementing automotive control systems and embedded Internet of Things in order to meet the information needs of users; 2) be able to apply knowledge and understanding for the tasks of analysis and synthesis of specialization; 3) be able to use multi-channel digital oscilloscopes and diagnostic scanners to study electronic vehicle control systems; 4) be able to perform chip tuning of electronic car control systems to optimize their characteristics; 5) be able to choose the necessary method of signal conversion, perform signal conversion from one area to another, perform digital filtering and compression of signals, in particular, image signals;

	6) be able to evaluate the stage and final results of the project and adjust the project parameters, develop project documentation for projects, take action to assess the results of the project; 7) be able to search for information in various sources to solve problems of specialization.
Communication (Com)	1) ability to communicate, including oral and written communication in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish); 2) the ability to use a variety of methods, including modern information technologies, to effectively communicate on a professional and social level.
Autonomy and responsibility (AiV)	1) ability to adapt to new situations and take appropriate decisions; 2) ability to realize the need for lifelong learning with the aim of deepening the acquired and gaining new expertise; 3) ability to responsibly treat of work, make decisions, achieve the goal of compliance with the requirements of professional ethics; 4) ability to demonstrate understanding of the basic ecological principles, labor protection and safety and their application of self-government.

8 – resource providing program	
The specific characteristics of the personnel software	100% of the teaching staff involved to teaching professionally oriented disciplines of specialty have scientific degrees.
Specific characteristics of logistics	The use of modern equipment of leading companies, including Cypress, Vipa, Microl, Owen, Zenon, Launch, National Instruments. Stand for research of electronic control systems of the Opel Vectra car. Stand for research of remote security systems with GPS and GSM channels. Stand for the study of 10-channel multiplex automotive system with frequency division multiplexing.
The specific characteristics of the informational and methodological support	The use of a virtual learning environment of the National University "Lviv Polytechnic" and author's developed materials of the teaching staff.
9 – academic mobility	
National credit mobility	On the basis of bilateral agreements between Lviv Polytechnic national University and technical universities of Ukraine.
International credit mobility	On the basis of bilateral agreements between the Lviv Polytechnic national University and higher educational institutions of foreign countries.
Foreign applicants for higher education	It is possible, after studying the course.

2. Distribution of content educational-professional programs groups of components and cycle training

# p/n	Cycle training	The volume of the workload in the applicant's higher education (loans/%)			
		The required components of the educational-professional programs	Optional components of the educational-professional programs		Total for the entire period of training
1	2	3	4		5
1.	The cycle of General preparation	**3/3,3**	**3/3,3**		**6/6.6**
2.	Cycle training	**64/71,1**	**20/22,3**		**84/93,4**
Total for the entire period of training		**67/74,4**	**23/25,6**		**90/100**

3. List of component educational-professional programs

Code	The name component of OP	Volume component in ECTS	The form of the final control
1	2	3	5
The required components of the specialty			
And the cycle of General preparation			
MC1	Information marketing and management	3	examination
	Total cycle:	**3**	
II. Cycle training			
MC2	Car Electrical and Electronic Equipment	7	examination
MC3	Innovative information technology (with course paper)	9	differential. test
MC4	Computerized Control and Diagnostics Systems in Transportation *	8	examination
MC5	Professional and Civil Security	3	differential test
MC6	Design and Programming of the Onboard Computer Systems (with course paper)	7	examination
	Research Practice on Master's Thesis	7,5	differential test
	The Performance of the Master's Thesis	18	
	Defense of Master's Thesis	4,5	

Optional components of the educational-professional programs			
	The cycle of General preparation	3	differential. test
	The cycle of Professional Training	5	differential. test
	Total cycle:	**8**	
blocks components			
II. Cycle training			
Components selectively block 1: **Internet of Things on transport**			
EC10	Digital Signal Processing and Image Analysis	5	exam
EC11	Automotive Sensor Systems	5	exam
EC12	Modern Electronic Car Technologies	5	exam
	Total cycle:	**15**	
	Together, the sample components	**22**	

Components of selective blok2: **Industrial Internet of Things**			
EC13	Design and programming of automation system controllers	5	exam
EC14	Digital Signal Processing in IoT systems	5	exam
EC15	Artificial intelligence for robotic systems	5	exam
	Total cycle:	**15**	
	Together, the sample components	**22**	

4. The form of certification of applicants for higher education

Certification of applicants for higher education is examining the compliance of the level and volume of knowledge, skills and competencies the applicant's higher education, which trained for the educational program, the requirements of the standards of higher education.

Certification of graduates of specialty 122 "computer science" specialization " Computer control systems for moving objects (road transport)" is held in the form of protection the degree of work and ends with the issuance of documents of the standard pattern of awarding him the degree awarding qualifications: Master of Computer Science with a degree in computer control systems for the moving objects (road transport). Certification is carried out openly and publicly.

5. Structure, content and consistency between Learning Outcomes, Teaching Methods, and Assessment for Mandatory/Elective Courses of the Study Programme "Computer Control Systems for Moving Objects (Automobile Transport)"

Mandatory /Elective Courses	Learning Outcomes	Teaching Methods	Assessment
MC1. Information Marketing and Management	**LO1.** The student is able to responsibly treat the work performed and achieve the goal in compliance with the requirements of professional ethics	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	Students have an individual interview with an instructor on obtained results.
	LO3. Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	**Project-based learning.** Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained results.
	LO4. Student able **to assess** the content and scope of resources management tasks for information systems at all stages of their life cycle based on the basic principles of marketing and anagement.	**Case-based learning:** Students applying course knowledge to devise one or more solutions or resolutions to problems of resources management for information system presented in a realistic story or situation.	Students prepare a written report with recommendations for resource management of the information system.
MC2. Car Electrical and	**LO2.** The student is able to realize the need for lifelong learning in order to	**Project-based learning.** Students as individuals applying principles, strategies, and	Students have an individual interview with an instructor on obtained results.

Electronic Equipment	deepen the acquired and acquire new professional knowledge.	procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	
	LO3. Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion	**Project-based learning.** Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained results.
	LO6. The student is able to search for information in various sources to solve problems of specialization	**Problem-based learning**.The student masters modern databases in automotive electronics	The student decides to quickly search for information for specific tasks
	LO11. The student knows the life cycle of integrated automotive control systems and embedded IoT systems; content and sequence of procedures for constructing functional and structural schemes.	**Project-based learning.**The student masters the typical algorithms of electronic control systems of modern cars with remote capabilities	The student quickly solves the problem of diagnostics and modernization of automotive electronics
MC3. Innovative Information Technology	**LO2.** The student is able to realize the need for lifelong learning in order to deepen the acquired and acquire new professional knowledge.	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	Students make oral presentations on obtained results.
	LO3. The student is able to communicate, including oral and	**Project-based learning.** Students as individuals speaking (Ukrainian,	Students make oral presentations on obtained results.

	written communication in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish).	English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	
	LO15. The student knows of models of information flows, repositories and data spaces, knowledge bases using charting techniques and standards for the development of information systems.	**Inquiry-based learning:** Students applying models of information flows, repositories and data spaces, knowledge bases in the creation of diagrams and standards for the development of information systems.	Students prepare a written report on models of information flows.
	LO17. The student knows the principles of construction and operation of electronic car control systems, remote car control systems, multiplex car systems.	**Inquiry-based learning**: Students applying the principles of construction and operation of electronic car control systems, remote car control systems, multiplex car systems.	Students prepare a written report on electronic car control systems.
	LO18. The student is able to use modern programming methods and tools to study the feasibility of implementing automotive control systems and embedded Internet of Things in order to meet the information needs of users.	**Inquiry-based learning**: Students use modern programming methods and tools to study the feasibility of implementing automotive control systems and embedded Internet of Things in order to meet the information needs of users.	Students prepare a written report on car control systems and embedded IoT.
MC4. Computerized Control and Diagnostics Systems in	**LO1.** The student is able to responsibly treat the work performed and achieve the goal in compliance with the	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems	Students have an individual interview with an instructor on obtained results.

Transportation	requirements of professional ethics	to make informed, independent decisions.	
	LO10. The student has a thorough knowledge of scientific concepts, theories and methods necessary for the study and synthesis of automotive control systems and embedded Internet of Things.	**Project training:** students as individuals gain new knowledge, skills of correction of firmware of electronic control units of the car for optimization of their work.	Students master the technique of changing various parameters of firmware and explore their impact on the final characteristics of electronic control units of the car
	LO19. The student is able to use multi-channel digital oscilloscopes and diagnostic scanners to study electronic car control systems. digital oscilloscope	**Fieldwork:**Students learn to obtain information about input signals and match their characteristics with the parameters of a multi channel	Students have practical skills in research and diagnosis of automotive electronics.
MC5. Professional and Civil Security	**LO1.** The student is able to treat the performed work responsibly and achieve the goal in compliance with the requirement	**Role plays:** Students acting out instructor-assigned roles team members, improvising the script of teamwork, in a realistic and problematic social or interpersonal situation.	Students create teams and distribute responsibilities for obtained results.
	LO22. Student able **to assess** the adequacy of the proposed recommendations for the creation and maintenance of safe working and living conditions, ensuring civil protection artificial safety, and responding to emergencies and eliminating their consequences for a given information system.	**Inquiry-based learning:** Students learning or applying material for the creation and maintenance of safe working and living conditions in order to answer a question, conduct an experiment, or interpret data.	Students prepare a written report on creating and maintaining safe working and living conditions

MC6. Design and Programming of the Onboard Computer Systems	**LO3.** Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	**Project-based** learning. Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained result
	LO 8. The student is able to evaluate the stage and final results of the project and adjust the project parameters, developproject documentation for projects, perform actions to assess the results of the project	**Project-based** learning: Students as individuals using creative techniques to find original solutions to new problems or new solutions to already known problems.	The student understands features of functioning of electronic control systems of the car and can solve problems on optimization of their work
	LO20. The student is able to perform chip tuning of electronic car control systems to optimize their characteristics.	**Fieldwork**: Students having studied typica lalgorithms of functioning of electronic control systems of the car carryout chiptuning for achievemt of desirable characteristics of the car	Student gets practical skills of chiptunin go finternal combustion engines
EC10. Digital Signal Processing and Image Analysis	**LO1.** The student is able to act responsibly to the work performed and achieve the goal in compliance with the requirements of professional ethics.	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	Students have an individual interview with an instructor on obtained results.
	LO3. The student is able to communicate, including oral and written communication in Ukrainian and one of the foreign languages	**Inquiry-based learning:** Students learning or applying material for the creation and maintenance of safe working and living conditions in order to	Students prepare a written report on creating and maintaining safe working and living conditions.

	(English, German, Italian, French, Spanish).	answer a question, conduct an experiment, or interpret data.	
	LO16. The student knows of methods and means of signal and image processing, basic approaches to signal conversion from one area to another, methods and means of digital filtering and compression of signals and images.	**Project-based learning**. Students study methods and means of signal and image processing, make justifications for their choice for each case.	Students prepare a written report on the rationale for choosing a method of signals processing.
	LO21. The student is able to choose the necessary method of signal conversion, perform signal conversion from one area to another, perform digital filtering and compression of signals, in particular, image signals.	**Project-based learning**. Students as individuals prepare written work on the chosen topic and task, which involves a holistic solution to a practical problem.	Students prepare a written report on the task of signal processing.
EC11. Automotive Sensor Systems	**LO3.** Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	**Project-based learning.** Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained results.
	LO7. The student is able to apply knowledge and understanding for the tasks of analysis and synthesis of specialization	**Project-based learning.** Students, as individuals, apply knowledge and understanding to the tasks of analysis and synthesis of specialization.	Students make oral presentations on obtained results.

	LO17. The student knows the principles of construction and operation of electronic car control systems, remote car control systems, multiplex car systems.	**Inquiry-based learning:** Students learning or applying module units to create electronic car control systems, remote control systems, multiplex car systems.	Students prepare a written report on the creation and maintenance of electronic car control systems, remote control systems, multiplex car systems.
EC12. Modern Electronic Car Technologies	**LO1.** The student is able to act responsibly to the work performed and achieve the goal in compliance with the requirements of professional ethics	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	Students have an individual interview with an instructor on obtained results.
	LO3. Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	**Project-based learning.** Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained results.
	LO12. The student knows of hardware and software for analysis and synthesis of automotive control systems and embedded Internet of Things.	**Inquiry-based learning:** Students learning or applying hardwareand software for analysis and synthesis automotive control systems and embedded Internet of Things	Students prepare a written report on the use of hardware and software for analysis and synthesis of automotive control systems and embedded Internet of Things
	LO13. The student knows knowledge of computer methods for modeling and optimization of automotive control systems and embedded IoT systems.	**Inquiry-based learning:**students use computer methods to model and optimize automotive control systems and embedded IoT systems.	Students prepare a written report on the modeling and optimization of automotive control systems and embedded IoT systems.

EC13. Design and Programming of Automation System Controllers	**LO3.** The student is able to act responsibly to the work performed and achieve the goal in compliance with the requirements of professional ethics.	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions.	Students have an individual interview with an instructor on obtained results.
	LO5. The student is able to use a variety of methods, including information technology, for effective communication at the professional and social levels.	**Project-based learning.** Students as individuals operating with abstract concepts based on information about the properties of specific objects to find new knowledge about such objects and the relationship between them.	Students undergo intermediate testing on the topic of the course
	LO14. The student knows how to assess the adequacy and effectiveness of information systems and technologies, using the methodology of object-oriented analysis and design, as well as tools to support the software life cycle.	**Project-based learning**. Students learning how to organize a computational experiment for a given process or phenomenon in the object and make sound professional judgments in real-world situations.	Students prepare a written report on development and research of an automatic control system based on a PLC
EC14. Digital Signal Processing in IoT	**LO1.** The student is able to act responsibly to the work performed and achieve the goal in compliance with the requirements of professional ethics.	**Project-based learning.** Students as individuals applying principles, strategies, and procedures for critical thinking to solve non-trivial practical problems to make informed, independent decisions	Students have an individual interview with an instructor on obtained results.
	LO3. The student is able to communicate, including oral and written	**Inquiry-based learning:** Students learning or applying material for the creation	Students prepare a written report on creating and maintaining safe

	communication in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish).	and maintenance of safe working and living conditions in order to answer a question, conduct an experiment, or interpret data.	working and living conditions.
	LO5. The student is able to use a variety of methods, including information technology, for effectivecommunicati on at the professional and social levels.	**Project-based** learning. Students as individuals use creative techniquest of indeffective communication at different levels.	Students have an individual interview with an instructor on obtained results.
	LO16. The student knows of methods and means of signal and image processing, basic approaches to signal conversion from one area to another, methods and means of digital filtering and compression of signals and images.	**Project-based learning.** Students study methods and means of signal and image processing, make justifications for their choice for each case.	Students make oral presentations on obtained results.
EC15. .Artificial Intelligence for Robotic Systems	**LO3.** Student able **to speak** (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	**Project-based learning.** Students as individuals speaking (Ukrainian, English) at a high level by using professional terminology and understanding the context to quickly, unambiguously, and concisely express an opinion.	Students make oral presentations on obtained results.
	LO12. The student knows of hardware and software for analysis and synthesis of automotive control systems and embedded Internet of Things.	**Project-based learning**. Students as individuals gaining new knowledge, skills, and abilities by developing information sources to solve specific application problems.	Students undergo intermediate testing on the topic of the course

	LO18. The student is able to use modern programming methods and tools to study the feasibility of implementing automotive control systems and embedded Internet of Things in order to meet the information needs of users.	**Project-based learning**: Students learning how to organize a computational experiment for a given process or phenomenon in the object and make sound professional judgments in real-world situations.	Students prepare a written report on the implementation of an individual task using artificial intelligence methods in robotic systems

Correspondence of Learning Outcomes with Mandatory/Elective Courses

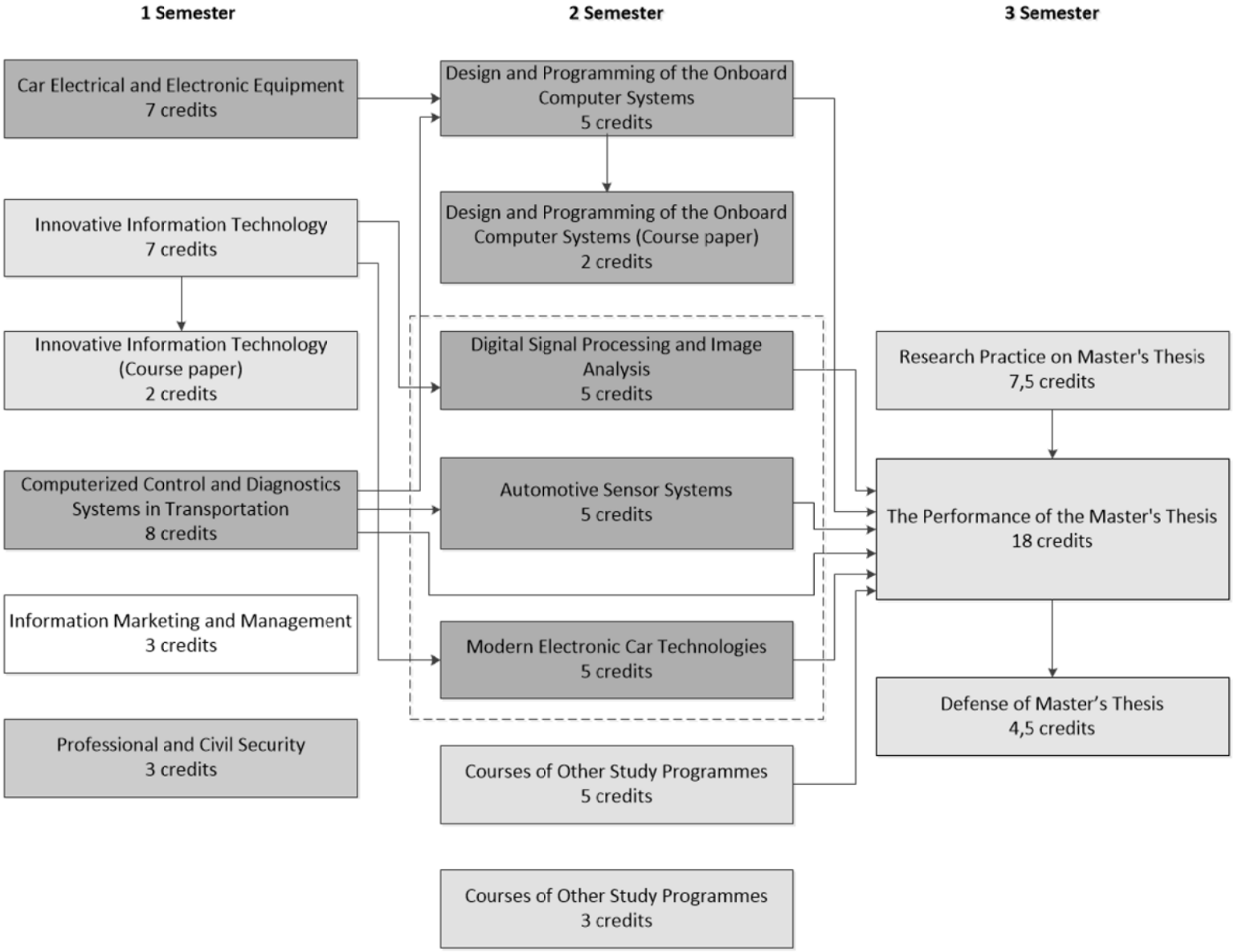
	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8	MC9	EC10	EC11	EC12	EC13	EC14	EC15
LO1	+			+	+		+	+	+	+		+		+	
LO2		+	+				+	+	+						
LO3	+	+	+			+	+	+	+	+	+	+	+	+	+
LO4	+						+	+	+						
LO5							+	+	+					+	
LO6		+					+	+	+						
LO7							+	+	+		+				
LO8						+	+	+	+						
LO9					+		+	+	+						
LO10				+			+	+	+						
LO11		+					+	+	+						
LO12							+	+	+			+			+
LO13						+	+	+	+			+			
LO14						+	+	+	+						
LO15			+				+	+	+						
LO16							+	+	+	+				+	
LO17			+				+	+	+		+				
LO18			+				+	+	+						+
LO19				+			+	+	+						
LO20						+	+	+	+						
LO21							+	+	+	+					
LO22					+		+	+	+						

Dublin Descriptors	Outcome	Intended Learning Outcomes
Knowledge and understanding	demonstration	LO10, LO11, LO12, LO13, LO16, LO17
Applying knowledge and understanding	problem solving abilities	LO7, LO18, L019, LO20
Making judgments	ability to integrate knowledge and handle complexity, formulate judgment with incomplete and limited information	LO4, LO9, LO14, LO15
Communication	communicate conclusions to specialist and nonspesialist	LO3, LO5, LO8, LO22
Learning skills	continue the study	LO1, LO2, LO6, LO21

The typical jobs for graduates are the following:

Job	The main Education components responsible for knowledge and skills developments
Master of Science in Computer Control of Mobile Facilities (Road Transport)	Information Marketing and Management Innovative Information Technology Digital Signal Processing and Image Analysis
Engineer of diagnostics and repair of automotive electronics	Computerized Control and Diagnostics Systems in Transportation Car Electrical and Electronic Equipment Automotive Sensor Systems
Engineer for the design of modern car control systems	Design and Programming of the Onboard Computer Systems Modern Electronic Car Technologies

Elective Block 1. Internet of Things on transport



Elective Block 2. Industrial Internet of Things