

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
" IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE "**

APPROVED

Academic Council of Igor Sikorsky Kyiv  
Polytechnic Institute

(Protocol № 10 of November 4, 2019)

**COMPUTER-INTEGRATED TECHNOLOGIES AND  
NAVIGATION AND CONTROL SYSTEMS**

**EDUCATIONAL PROFESSIONAL PROGRAM**

**first (bachelor's) level of higher education**

<b>specialty</b>	<b>151 Automation and computer-integrated technologies</b>
<b>field of knowledge</b>	<b>15 Automation and instrumentation</b>
<b>qualification</b>	<b>Bachelor of Automation and Computer Integrated Technology</b>

Changes and additions were approved by the NMCU 151  
Automation and computer-integrated technologies  
(Protocol № 2 of "27" May 2020)

The educational program with changes and additions is  
put into effect from 2020/2021. year  
(№ 1/231 of "08" July 2020)

Kyiv - 2020

## **PREAMBLE**

### **DEVELOPED by the project team:**

#### *Project team leader:*

Pavlovskiy Oleksii Mykhailovych, Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Orientation and Navigation Devices and Systems

#### *Project team members:*

Burau Nadiya Ivanivna, Doctor of Technical Sciences, Professor, Head of the Department of Instruments and Systems of Orientation and Navigation

Avrutov Vadym Viktorovych, Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Instruments and Systems of Orientation and Navigation

Golovach Serhiy Volodymyrovych, Candidate of Technical Sciences, Chief Specialist in the direction of JSC Elmiz

Platov Ilya Mikhailovich, student of group PG-01mn of the department of devices and systems of orientation and navigation

The department of devices and systems of orientation and navigation is responsible for preparation of applicants for higher education according to the educational program.

### **AGREED:**

The first edition of the educational program was approved by the Methodical Council of KPI. Igor Sikorsky (protocol № 7 from March 29, 2018)

Changes and additions to the educational program are agreed Scientific and Methodological Commission of the University of specialties 151 Automation and computer-integrated technologies

(Protocol № 2 of "27" May 2020)

Chairman of the NMCU 151 Automation and computer-integrated technologies

\_\_\_\_\_ Anatolii ZHUCHENKO

**INCLUDED:**

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# 1. PROFILE OF THE EDUCATIONAL PROGRAM

in specialty 151 "Automation and computer-integrated technologies"

<b>1 - General information</b>	
Complete ZVO and institute / faculty	National Technical University of Ukraine, Igor Sikorsky Kyiv Polytechnic Institute, Faculty of Instrument-Making
Higher education degree and title of qualification in the original language	Degree - bachelor Qualification - Bachelor of Automation and Computer-Integrated Technologies
Level with NRC	NRC of Ukraine - level 6, QF-EHEA - the first cycle, EQF-LLL - level 6
The official name of the educational program	Computer-integrated technologies and navigation and control systems
Type of diploma and scope of educational program	Bachelor's degree, single, 240 credits, term of study 3 years, 10 months
Availability of accreditation	Accreditation certificate, series ND № 1192549 issued on 25.09.2017 on the basis of the order of the Ministry of Education and Science of Ukraine №1565, according to the decision of the Accreditation Commission from 27.06.2013, protocol №105 order of the Ministry of Education and Science of Ukraine №2494-1 from 01.07.2017, valid until 01.07.2017 .2023y.
Prerequisites	Presence of complete general secondary education or diploma of EQL "junior specialist", PR "junior bachelor"
Language (s) of instruction	Ukrainian / English
Term of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	<a href="https://osvita.kpi.ua/section/Educational%20programs">https://osvita.kpi.ua/section "Educational programs"</a> <a href="http://kafpson.kpi.ua/metot.html">http://kafpson.kpi.ua/metot.html</a> <a href="https://pbf.kpi.ua/ua/category/documents/">https://pbf.kpi.ua/ua/category/documents/</a>
<b>2 - The purpose of the educational program</b>	
Fundamental training of specialists in the field of automation and computer-integrated technologies, capable of complex solution of complex problems and problems of design, improvement, modernization, operation and maintenance of automation, control, orientation and navigation, monitoring, diagnostic systems. Able to carry out and ensure professional interaction of representatives of the scientific and technical community aimed at integrating university education into the European educational and scientific space in the conditions of sustainable innovative scientific and technical development of society.	

<b>3 - Characteristics of the educational program</b>	
Subject area (field of knowledge, specialty, specialization (if available))	<p><i>Object:</i> technical, software, mathematical, informational and organizational support of automation systems of objects and processes in various fields of activity with the use of modern microprocessor and computer equipment, specialized application software and information technologies.</p> <p><i>Learning objectives:</i> training of specialists capable of complex solution of problems of development of new and modernization and operation of existing automation systems and computer integrated technologies with the use of modern software and information technologies, performing theoretical researches of automation object, substantiation of choice of automation technical means, design of automation systems and development of application software for various purposes.</p> <p><i>Theoretical content of the subject area.</i> Concepts and principles of the theory of automatic control, automation systems and computer-integrated technologies.</p> <p><i>Methods, techniques and technologies.</i> The applicant must master the methods and software tools for modeling, design, automated management of complex organizational and technical objects, information technology; knowledge of technical means of automation, ability to develop application software for various purposes for automation systems.</p> <p><i>Tools and equipment:</i> modern software and hardware and computer-integrated technologies for the design, modeling, research and operation of automation systems</p>
Orientation of the educational program	Educational and professional
The main focus of the educational program	<p>The main focus of the educational program is special education and training in the field of automation and computer-integrated technologies, navigation and control systems with the possibility of acquiring the necessary professional competencies. The educational program promotes comprehensive professional, engineering, intellectual and social development in the field of navigation and control systems, automation, instrumentation.</p> <p>Keywords: automation, orientation and navigation systems, control systems, monitoring systems, computer-integrated technologies and systems, instrument making, modeling of processes and systems, programming, microelectromechanical systems and technologies</p>
Features of the program	Mastering the disciplines of the educational program is carried out in a research and practical environment, which is provided by the active scientific work of teachers, the involvement of students in scientific work. Established cooperation with employers on excursions and internships at enterprises in the industry.

<b>4 - Suitability of graduates for employment and further study</b>	
Suitability for employment	Accordingly to the Classifier of professions DK003: 2010 bachelor with specialty "151 Automation and computer-integrated technologies" should be prepared for the following positions: 2131.2. Computer software engineer 2131.2. Computer systems engineer 2131.2. Engineer of automated production management systems 2139.2. Computer application engineer 2149.2 (22326) Debugging and testing engineer; 7241 (14977) Debugger of devices, equipment and systems of automatic control, regulation and management (adjuster of instrumentation and automation); 3114. Technician from the configured computer system; 3121. Technician-programmer 3121. Specialist in software development and testing Jobs. Corresponding (to the Classifier of Professions DK 003: 2010) positions of enterprises, institutions and organizations.
Further training	Continuation of education according to the master's program at the second educational-scientific (educational-professional) level of higher education. Acquisition of additional qualifications in the system of postgraduate education. Lifelong learning for development and self-improvement in professional and scientific fields of activity, as well as in other related fields of knowledge.
<b>5 - Teaching and assessment</b>	
Teaching and learning	The program provides personality-oriented and problem-oriented learning. Forms of training organization: lectures (in particular, video lectures), practical and seminar classes, computer workshops and laboratory works; course projects and works; technology of blended learning, practice and excursions; consultations with the teacher, individual lessons, application of information and communication technologies such as, online lectures, distance courses, etc., on separate educational components; , performance of qualifying work of the bachelor.
Evaluation	Assessment of students' knowledge is carried out in accordance with the Regulations on the rating system for assessing the learning outcomes of KPI students. Igor Sikorsky for all types of classroom and extracurricular work. Assessment is based on: written and oral exams, tests, modular tests, home tests, laboratory reports, current control, defense of course projects, defense of qualifying work, etc.
<b>6 - Program competencies</b>	
Integral competence	Ability to solve complex specialized problems and problems of automation, navigation and control systems and practical problems characterized by complexity and uncertainty of conditions, during professional activities or in the learning process, which involves the application of theories and methods of the industry.
<b>General Competences (LC)</b>	
ZK 1	Ability to apply knowledge in practical situations.
ZK 2	Ability to communicate in the state language both orally and in writing.
ZK 3	Ability to communicate in a foreign language.
ZK 4	Ability to use information and communication technologies.
ZK 5	Ability to search, process and analyze information from various sources.
ZK 6	Ability to carry out safe activities.
ZK 7	Ability to preserve the environment.
ZK 8	Ability to work in a team.

ZK 9	The ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human rights and freedoms in Ukraine.
ZK 10	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 to use different types and forms of physical rest and lead a healthy lifestyle.
<b>Professional competencies of the specialty (FC)</b>	
FC 1	Ability to apply knowledge of mathematics to the extent necessary for the use of mathematical methods for analysis and synthesis of automation systems.
FC 2	Ability to apply knowledge of physics, electrical engineering, electronics and microprocessor technology, to the extent necessary to understand the processes in automation systems and computer-integrated technologies.
FC 3	Ability to perform analysis of automation objects based on knowledge of the processes occurring in them and apply the methods of automatic control theory for research, analysis and synthesis of automatic control systems.
FC 4	Ability to apply methods of systems analysis, mathematical modeling, identification and numerical methods for the development of mathematical models of individual elements and automation systems in general, to analyze the quality of their operation using the latest computer technology.
FC 5	Ability to justify the choice of technical means of automation on the basis of understanding the principles of their work, analysis of their properties, purpose and technical characteristics, taking into account the requirements for the automation system and operating conditions; to establish technical means of automation and control systems.
FC 6	Ability to use the latest technologies in the field of automation and computer-integrated technologies to solve professional problems, in particular, design of multilevel control systems, data collection and archiving to form a database of process parameters and their visualization using human-machine interface.
FC 7	Ability to justify the choice of technical structure and be able to develop application software for microprocessor control systems based on local automation, industrial logic controllers and programmable logic arrays and signal processors.
FC 8	Ability to design automation systems taking into account the requirements of relevant regulations and international standards.
FC 9	Ability to freely use modern computer and information technologies to solve professional problems, to program and use applied and specialized computer-integrated environments to solve automation problems.
FC 10	Ability to take into account social, environmental, ethical, economic aspects, requirements of labor protection, industrial sanitation and fire safety in the formation of technical solutions.
FC 11	Taking into account the commercial and economic context in the design of automation systems.
FC 12	Ability to theoretically calculate and model sensitive elements for orientation, navigation and control systems
FC 13	Ability to justify and select sensing elements for orientation, navigation and control systems
FC 14	Ability to calculate and design parts and mechanical components of automated systems of orientation, navigation and control, develop ergonomic design and create computer 3D models of devices.
FC 15	Ability to apply modern methodological, instrumental and algorithmic tools to improve the accuracy of orientation, navigation and control systems, their sensing elements and inertial measuring modules for stationary and moving objects.



<b>7 - Program learning outcomes</b>	
PRN 1	Know linear and vector algebra, differential and integral calculus, functions of many variables, functional series, differential equations for functions of one and many variables, operational calculus, function theory of complex variables, probability theory and mathematical statistics, theory of random processes in the volume required for use mathematical apparatus and methods in the field of automation
PRN 2	Know physics, electrical engineering, electronics and circuitry, microprocessor technology at the level required to solve typical problems and problems of automation
PRN 3	Be able to apply modern information technologies and have the skills to develop algorithms and computer programs using high-level languages and object-oriented programming technologies, create databases and use Internet resources.
PRN 4	Understand the essence of the processes occurring in the objects of automation (by industry) and be able to analyze the objects of automation and justify the choice of structure, algorithms and control schemes based on the results of the study of their properties
PRN 5	Be able to apply the methods of automatic control theory for research, analysis and synthesis of automatic control systems.
PRN 6	Be able to apply methods of system analysis, modeling, identification and numerical methods for the development of mathematical and simulation models of individual elements and automation systems in general, to analyze the quality of their operation using the latest computer technology
PRN 7	Be able to apply knowledge of the basic principles and methods of measuring physical quantities and basic technological parameters to justify the choice of measuring instruments and evaluate their metrological characteristics.
PRN 8	Know the principles of operation of technical means of automation and be able to justify their choice based on the analysis of their properties, purpose and technical characteristics, taking into account the requirements for the automation system and operating conditions; have skills in setting up technical means of automation and control systems
PRN 9	Be able to design multi-level control systems and data collection to form a database of process parameters and their visualization using human-machine interface, using the latest computer-integrated technologies.
PRN 10	Be able to justify the choice of structure and develop application software for microprocessor control systems based on local automation tools, industrial logic controllers and programmable logic arrays and signal processors.
PRN 11	Be able to perform work on the design of automation systems, know the content and rules of design materials, the composition of project documentation and the sequence of design work, taking into account the requirements of relevant regulations and international standards.
PRN 12	Be able to use a variety of specialized software to solve typical engineering problems in the field of automation, in particular, mathematical modeling, computer-aided design, database management, computer graphics methods.
PRN 13	Be able to take into account social, environmental, ethical, economic aspects, labor protection requirements, industrial sanitation and fire safety in the formation of technical solutions. Be able to use different types and forms of physical activity for active recreation and healthy living.
PRN 14	Be able to use in production and social activities the fundamental concepts and categories of state formation to substantiate their own worldviews and political beliefs, taking into account the processes of socio-political history of Ukraine, legal principles and ethical norms.
PRN 15	Know the theory for calculating and modeling sensing elements for orientation, navigation and control systems.
PRN 16	Know the selection criteria of sensitive elements and their characteristics for orientation, navigation and control systems

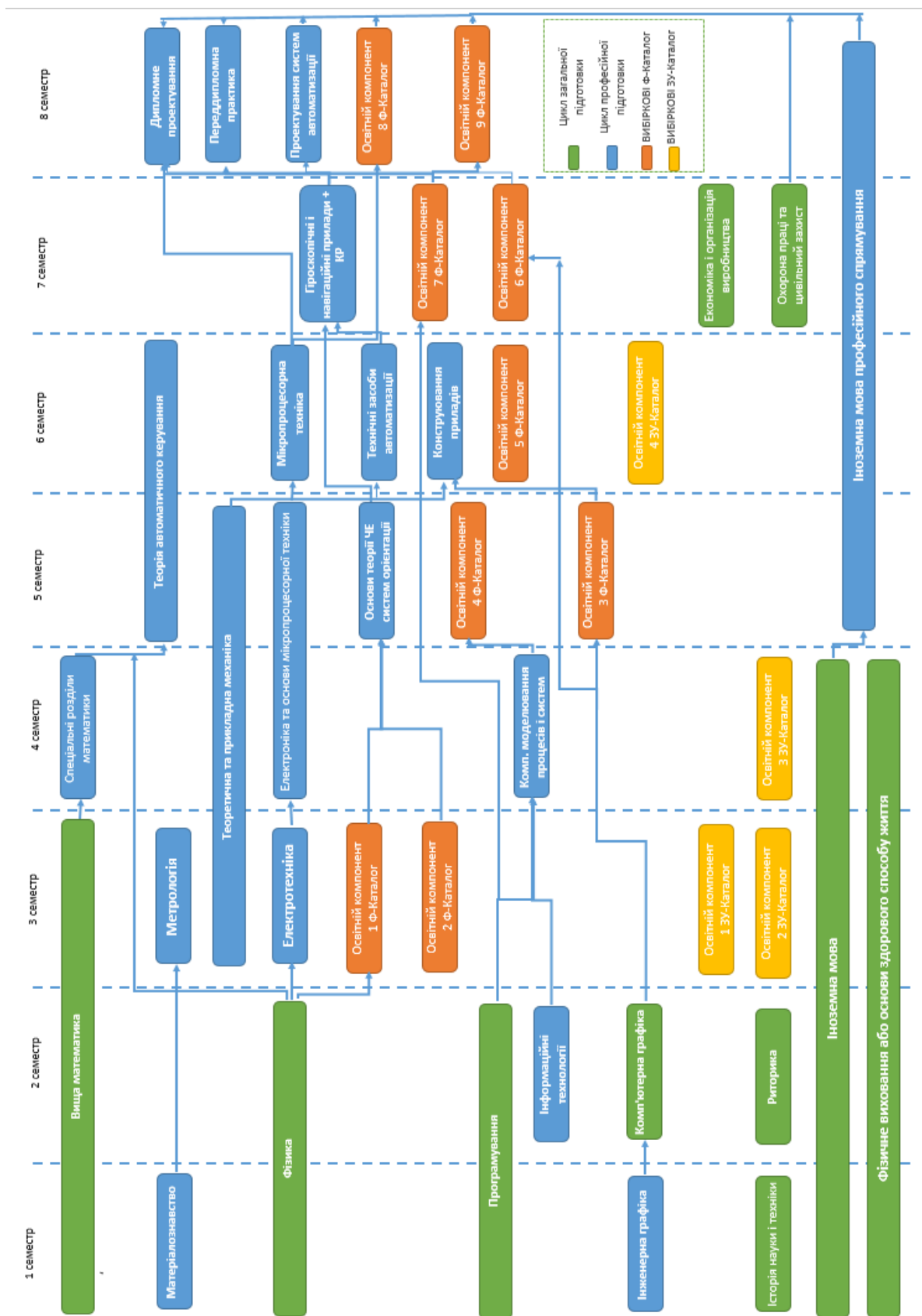
PRN 17	Be able to calculate and design parts and mechanical components of automated systems of orientation, navigation and control, develop ergonomic design and create computer 3D models of devices.
PRN 18	Apply methodological, instrumental and algorithmic tools to improve the accuracy of orientation, navigation and control systems, their sensing elements and inertial measuring modules for stationary and moving objects.
PRN 19	Know modern CAD used for the development of components and elements of systems of orientation, navigation and control systems
<b>8 - Resource support for program implementation</b>	
Staffing	In accordance with the personnel 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 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 dated 10.05.2018.
Logistics	In accordance with the personnel 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 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 dated 10.05.2018. Use of equipment for lectures in the format of presentations, network technologies, in particular on the Sikorsky distance learning platform, demonstration industry equipment during laboratory workshops
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of VO (Annex 5 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 10.05.2018 Use of the Scientific and Technical Library of KPI
<b>9 - Academic mobility</b>	
National credit mobility	Possibility of concluding agreements on academic mobility, double diplomacy
International credit mobility	Opportunity to participate in academic mobility programs abroad on the basis of bilateral agreements between Igor Sikorsky KPI and educational institutions of partner countries, in particular under the Erasmus + program
Training of foreign applicants for higher education	Opportunity to teach in a foreign language or after studying by foreign students of the Ukrainian language course

## 2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code n / a	Components of the educational program (academic disciplines, course projects (works), practices, qualification work)	Number of credits	Form of final control
1	2	3	4
<b>1. Mandatory (regulatory) components of the OP</b>			
<b>General training cycle</b>			
ZO 1	History of science and technology	2	test
ZO 2	Principles of oral professional speech (rhetoric)	2	test
ZO 3	Higher mathematics	18	exam
ZO 4	Physics	10	exam
ZO 5	Computer Graphics	4	test
ZO 6	Programming	10	exam
ZO 7	Physical education or the basics of a healthy lifestyle	5	test
ZO 8	Foreign Language	6	test
ZO 9	Economics and organization of production	4	test
ZO 10	Labor protection and civil protection	4	test
<b>Cycle of professional training</b>			
ON 1	Materials science	5	test
ON 2	Engineering graphics	4.5	test
ON 3	Information Technology	5	test
ON 4	Electrical engineering	4	test
ON 5	Metrology	4	test
ON 6	Theoretical and applied mechanics	11.5	test
ON 7	Special sections of mathematics	8	exam
ON 8	Computer modeling of processes and systems	8	exam
ON 9	Electronics and basics of microprocessor technology	8	exam
ON 10	Design of devices of automation systems	3.5	test
ON 11	Course project on Design of devices of automation systems	1.5	
ON 12	Fundamentals of the theory of European orientation systems	5	exam
ON 13	Theory of automatic control	10	exam
ON 14	Microprocessor technology	6	exam
ON 15	Technical means of automation	5	exam
ON 16	Gyroscopic and navigation devices	9	exam
ON 17	Course work with gyroscopic and navigation devices	1	
ON 18	Design of automation systems	4	test
ON 19	Pre-diploma practice	6	test
ON 20	Diploma design	6	
<b>2. Selective components of the OP</b>			
<b>General training cycle</b>			
ZV 1	Educational component 1 of the Memory Catalog	2	test
ZV 2	Educational component 2 of the memory-catalog	2	test
ZV 3	Educational component 3 of the Memory Catalog	2	test
ZV 4	Educational component 4 of the Memory Catalog	2	test
ZV 5	Foreign language for professional purposes	6	test
<b>Cycle of professional training</b>			

1	2	3	4
<b>Selective components of OP</b>			
PV 1	Educational component 1 F-Catalog	3.5	test
PV 2	Educational component 2 F-Catalog	3	test
PV 3	Educational component 3 F-Catalog	6	test
PV 4	Educational component 4 F-Catalog	5	test
PV 5	Educational component 5 F-Catalog	5.5	test
PV 6	Educational component 6 F-Catalog	5.5	test
PV 7	Educational component 7 F-Catalog	5	test
PV 8	Educational component 8 F-Catalog	6	test
PV 9	Educational component 9 F-Catalog	6.5	test
<b>The total amount of mandatory components:</b>		<b>180</b>	
<b>Total volume of sample components:</b>		<b>60</b>	
<b>The amount of educational components that ensure the acquisition of competencies of certain SVO</b>		<b>212</b>	
<b>TOTAL VOLUME OF THE EDUCATIONAL PROGRAM</b>		<b>240</b>	

### 3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



## **4. FORM OF FINAL CERTIFICATION OF HIGHER EDUCATION APPLICANTS**

Graduation certification of applicants for higher education under the educational-professional program "Computer-integrated technologies and navigation and control systems" specialty 151 Automation and computer-integrated technologies is carried out in the form of public defense of the qualification work and ends with the issuance of a standard document Bachelor with qualification: Bachelor of Automation and Computer-Integrated Technologies in the educational-professional program "Computer-Integrated Technologies and Navigation and Control Systems".

The bachelor's thesis should demonstrate the graduate's ability to develop devices and means of automation, object orientation systems, automated navigation systems, global and local positioning systems, the use of modern approaches and element base, modernization of classical systems, research and retrieval of information from a given topics.

The bachelor's qualification work is subject to mandatory testing for academic plagiarism and must be posted on the website of the higher education institution.

Graduation certification is open and public.

## 5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCES TO COMPONENTS OF THE EDUCATIONAL PROGRAM

	30 1	30 2	30 3	30 4	30 5	30 6	30 7	30 8	30 9	30 10	ON 1	ON 2	ON 3	ON 4	ON 5	ON 6	ON 7	ON 8	ON 9	ON 10	ON 11	ON 12	ON 13	ON 14	ON 15	ON 16	ON 17	ON 18	ON 19	ON 20		
	1	2	3	4	5	6	7	8	9	10	11	12	thirteen	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
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## 6. MATRIX FOR PROVIDING PROGRAM LEARNING OUTCOMES WITH RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	30 1	30 2	30 3	30 4	30 5	30 6	30 7	30 8	30 9	30 10	ON 1	ON 2	ON 3	ON 4	ON 5	ON 6	ON 7	ON 8	ON 9	ON 10	ON 11	ON 12	ON 13	ON 14	ON 15	ON 16	ON 17	ON 18	ON 19	ON 20
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRN 1	+											+						+			+	+							+	+
PRN 2		+									+				+	+	+			+								+	+	+
PRN 3			+		+	+		+				+	+													+			+	+
PRN 4						+		+				+	+									+	+						+	+
PRN 5			+		+							+	+									+	+			+			+	+
PRN 6	+		+		+							+	+					+				+	+						+	+
PRN 7		+				+		+			+				+	+	+				+					+		+	+	+
PRN 8		+									+				+	+	+				+					+		+	+	+
PRN 9			+		+							+	+													+			+	+
PRN 10			+		+							+	+			+										+			+	+
PRN 11			+		+	+		+		+		+	+			+			+							+			+	+
PRN 12			+		+							+	+										+			+			+	+
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