

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
"Igor Sikorsky KYIV POLYTECHNICAL INSTITUTE»**

APPROVED

Academic Council of the Igor Sikorsky KPI  
(Doc. № 10 from 13.12.2021)

Head of the Academic Council

Mykhailo ILCHENKO

**AUTOMATED AND ROBOTIC  
MECHANICAL SYSTEMS**

**EDUCATIONAL AND PROFESSIONAL PROGRAM**

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

<b>specialty</b>	<b>131 Applied Mechanics</b>
<b>field of knowledge</b>	<b>13 Mechanical engineering</b>
<b>qualification</b>	<b>Bachelor of Applied Mechanics</b>

Entered into force in 2022/2023 by  
order of the rector  
Igor Sikorsky KPI  
from 15.02.2022 № HOH/75/2022

## **PREAMBLE**

### **Developed by the project group:**

#### *Project team leader:*

Oleksandr HUBAREV, Professor of Applied Fluid mechanics and Mechanotronics department, Doctor of Technical Sciences, Professor

#### *Members of the project team:*

Oleg LEVCHENKO, of Applied Fluid mechanics and Mechanotronics department, Ph.D., Associate Professor

Oksana GANPANTSUROVA, Associate Professor of of Applied Fluid mechanics and Mechanotronics department, Ph.D., Associate Professor

Oleksandr UZUNOV, professor of of Applied Fluid mechanics and Mechanotronics department, Doctor of Technical Sciences, Professor

Kostiantyn BIELIKOV, senior teacher of Applied Fluid mechanics and Mechanotronics department, Ph.D.

Alyona MURASHCHENKO, senior teacher of of Applied Fluid mechanics and Mechanotronics department, Ph.D.

#### *Stakeholder representatives:*

Georgy HRABOVSKY, Deputy Director of the Kyiv Institute of Automation

Sofiiia KOSMINA, master, graduate of 2019 (graduate student in 2021)

Yegor MOROZ, candidate of VO (3rd year)

The head of the department of Applied Hydroaeromechanics and Mechanotronics is responsible for the training of higher education students in the educational program.

### **APPROVED:**

Scientific and Methodological Commission of the University in the specialty 131 Applied Mechanics

Head of the SMCU 131

Mykola BOBYR

(Doc. № 4 of 08.12. 2021)

Methodical Council of Igor Sikorsky KPI

Deputy Head of the Methodical Council

Anatolii MELNYCHENKO

(Doc. № 2 of 09.12. 2021)

## **CONSIDERED:**

Feedback, reviews, proposals and recommendations of stakeholders: SE "Antonov", SC "FESTO", Institute of Hydromechanics of NAS of Ukraine, Concern "Nikmas", SPC "Kiev Institute of Automation", "Hydrosila Group Ltd".

Recommendations of the working group of the chair of AHM and SE "ANTONOV" on the dual form of education.

Recommendations of the working group of the chair of AHM and SPC "Kyiv Institute of Automation" on the subject of course projects and the volume of laboratory work.

Results of the discussion of the educational process with 4th year students.

The results of self-analysis of the educational process of the chair of AHM for 2021.

Recommendations for organizing and detailing multi-credit educational components by semesters.

The update of the educational program has been agreed with the stakeholders, and the positive feedback provided on the program remains relevant.

The educational program was discussed after receiving all the wishes and suggestions, approved at an extended meeting of the Department of chair of AHM (Doc. №6 of 06 December 2021).

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# 1. CURRICULUM PROFILE

<b>1 – General information</b>	
Full name of the higher education institution and institute / faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" Educational and Scientific Institute of Mechanical Engineering
Degree of higher education and title of qualification in the original language	Degree – bachelor Qualification - Bachelor of Applied Mechanics
Official name of the educational program	Automated and robotic mechanical systems
Type of diploma and scope of educational program	Bachelor's degree, single, 240 ECTS credits, term of study 3 years 10 months
Availability of accreditation	Certificate of accreditation of the specialty ND 1192553, valid until 01.07.2023, issued by the Ministry of Education and Science of Ukraine
Cycle / level of higher education	NRC of Ukraine - level 6 QF-EHEA - the first cycle EQF-LLL - 6 level
Prerequisites	Availability of complete general secondary education
Teaching language(s)	Ukrainian
Duration of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	<a href="https://osvita.kpi.ua/op">https://osvita.kpi.ua/op</a> <a href="https://mmi.kpi.ua/">https://mmi.kpi.ua/</a> <a href="http://pGC 0.kpi.ua/uk/">http://pGC 0.kpi.ua/uk/</a>
<b>2 – Purpose of the educational program</b>	
Training of highly qualified specialists capable of solving basic scientific and technical problems in the field of mechanical engineering in creating automated and robotic mechanical systems in the conditions of sustainable innovative scientific and technical development of society and formation of high adaptability of higher education seekers in labor market transformation through interaction with employers and other stakeholders. Create conditions for comprehensive professional, intellectual, social and creative development of the individual at the highest levels of excellence in the educational and scientific environment in accordance with the development strategy of Igor Sikorsky KPI for 2020-205 [ <a href="https://kpi.ua/2020-2025-strategy">https://kpi.ua/2020-2025-strategy</a> ].	
<b>3 – Characteristics of the educational program</b>	
Subject area	<b>Object of activity:</b> structures, machines, equipment, mechanical and biomechanical automated systems and complexes, processes of their design, manufacture, research and operation; <b>Learning objectives:</b> professional engineering activities in the field of design and automation of production, operation of automated mechanical systems, machines and equipment, robotic means and complexes, automation of technologies of machine-building productions; <b>Theoretical content of the subject area:</b> general laws of theoretical

	<p>mechanics and their applied applications, theoretical principles of machine design, control and automation of mechanical systems, machine-building technologies, fluid and gas mechanics, machine parts and structures, forecasting the performance of technical systems;</p> <p><b>Methods, techniques and technologies:</b> physical and mathematical methods for calculating statics, dynamics and stability of elements and structures; analytical, numerical and algorithmic methods of automated control of mechanical systems, modelling of kinematics and dynamics of machines, analysis of stress-strain state of structural elements; methods of design, control, research, development of technologies for the manufacture and assembly of elements of machines and structures; information technology in engineering research, design and production; methods and means of numerical software control of technological equipment; technologies of automated machine-building productions;</p> <p><b>Tools and equipment:</b> executive, control, controlling and power supply devices of automated mechanical systems, machines, tools, technological and control devices, sensors and controllers, control and measuring devices, numerical software control systems, drives of machine and robotic systems.</p>
Orientation of the educational program	Educational and professional
Main focus of the educational program	<p>Special education in the field of applied mechanics - automated and robotic mechanical systems.</p> <p><b>Keywords:</b> mechatronics, automation in mechanical engineering, hydraulic and pneumatic automation, logistic systems, robots and manipulators, hydraulic and pneumatic machines, hoisting and transport machines, design, engineering, modelling, control.</p>
Features of the educational program	<p>The object of professional orientation is an automated physically heterogeneous system with algorithms of operation and control, due to the fundamental laws of mechanics, hydraulics, hydromechanics applied in accordance with the proposed design and circuit solutions. Ability to build an individual trajectory by choosing a certificate program.</p>
<b>4 – Suitability of graduates for employment and further study</b>	
Suitability for employment	<p>According to the State Classification of Occupations DK 003: 2010 graduates can work in the positions of professionals in mechanics and other positions in the field of physical sciences and technology, in particular:</p> <p>2145 - Professionals in the field of mechanical engineering 2149 - Professionals in other fields of engineering</p>
Further study	<p>Opportunity to study at the second (master's) level of higher education and / or to acquire additional qualifications in the system of postgraduate education.</p>

<b>5 - Teaching and assessment</b>	
Teaching and learning	Lectures, practical and seminar classes, computer workshops and individual and group laboratory and project works; course projects and works; technology of blended learning, practice and excursions; performance of attestation work
Assessment	Oral and written examinations, testing, defence of course projects, certification work, is carried out in accordance with the Regulations on the system of evaluation of learning outcomes in Igor Sikorsky KPI for all types of classroom and extracurricular work
<b>6 - Program competencies</b>	
Integral competence	Ability to solve complex specialized problems and practical problems in applied mechanics or in the learning process, which involves the application of certain theories and methods of mechanical engineering and is characterized by complexity and uncertainty of conditions.
General competencies (GC)	GC1. Ability to abstract thinking, analysis and synthesis
	GC2. Knowledge and understanding of the subject area and understanding of professional activity
	GC3. Ability to identify, pose and solve problems
	GC4. Ability to apply knowledge in practical situations
	GC5. Ability to work in a team
	GC6. Definiteness and persistence in terms of tasks and responsibilities
	GC7. Ability to learn and master modern knowledge
	GC8. Ability to communicate in a foreign language
	GC9. Skills in the use of information and communication technologies
	GC10. Skills for safe activities
	GC11. Ability to act socially responsibly and consciously
	GC12. Ability to search, process and analyse information from various sources
	GC13. Ability to assess and ensure the quality of performed work
	GC14. 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 and civil rights and freedoms in Ukraine
	GC15. 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 different types and forms physical activity for active recreation and a healthy lifestyle
Professional competencies (PC)	PC1. Ability to analyse materials, structures and processes based on laws, theories and methods of mathematics, natural sciences and applied mechanics
	PC2. Ability to evaluate the performance parameters of materials, structures and machines in operating conditions and find appropriate solutions to ensure a given level of reliability of structures and processes, including in the presence of some uncertainty

	PC3. Ability to conduct technological and technical and economic assessment of the effectiveness of new technologies and technical means
	PC4. Ability to make the optimal choice of technological equipment, complete set of technical complexes, to have basic ideas about the rules of their operation
	PC5. Ability to use analytical and numerical mathematical methods to solve problems of applied mechanics, in particular to calculate the strength, endurance, stability, durability, rigidity in the process of static and dynamic loading to assess the reliability of parts and structures of machines
	PC6. Ability to perform technical measurements, obtain, analyse and critically evaluate measurement results
	PC7. Ability to use computerized systems of design (CAD), production (CAM), engineering research (CAE) and specialized application software to solve engineering problems in applied mechanics
	PC8. Ability to spatial thinking and reproduction of spatial objects, structures and mechanisms in the form of projection drawin GS 0 and three-dimensional geometric models
	PC9. Ability to present the results of its engineering activities in compliance with generally accepted norms and standards
	PC10. Ability to describe and classify a wide range of technical objects and processes, based on a deep knowledge and understanding of basic mechanical theories and practices, as well as basic knowledge of related sciences
	PC11. Ability to choose rational approaches and technical means to creation, testing and operation of control systems of technical objects and systems, machines and mechanisms with means of mechanics, hydropneumatic automation, electromechanics, mechatronics and robotics
	PC12. Ability to use modern approaches and tools of computer-aided design to create automated mechanical systems, machines, systems of hydropneumatic automation, electromechanics, mechatronics and robotics and their components with the implementation of specified functions, performance characteristics and efficiency indicators
	PC13. Ability to use design tools, justify and develop rational design solutions for automated mechanical systems, machines, hydropneumatic systems, electromechanics, mechatronics and robotics and their elements and units, in accordance with the specified operational, functional, economic, ergonomic and other practical tasks
	PC14. Ability to use modern approaches and tools of computer-aided design to create automated mechanical systems, machines, systems of hydropneumatic automation, electromechanics, mechatronics and robotics and their components with the implementation of specified functions, performance characteristics and efficiency indicators



	PC15. Ability to use modern tools to develop mathematical and simulation models of automated mechanical systems, machines, hydropneumatic systems, electromechanics, mechatronics and robotics and their components to determine the rational design and operating parameters, modes and conditions of operation, evaluation of functionality and efficiency computer simulation
<b>7 - Program learning outcomes</b>	
LO1.	Choose and apply for solving problems of applied mechanics suitable mathematical methods
LO2.	To use knowledge of theoretical bases of mechanics of liquids and gases, heat engineering and electrical engineering for the decision of professional problems
LO3.	Perform calculations for strength, endurance, stability, durability, rigidity of machine parts
LO4.	Evaluate the reliability of parts and structures of machines in the process of static and dynamic loading
LO3.	Perform calculations for strength, endurance, stability, durability, rigidity of machine parts
LO6.	To create and theoretically substantiate the design of machines, mechanisms and their elements on the basis of methods of applied mechanics, general principles of design, the theory of interchangeability, standard methods of calculating machine parts
LO7.	Apply regulatory and reference data to monitor compliance of technical documentation, products and technologies with standards, specifications and other regulatory documents
LO8.	Know and understand the basics of information technology, programming, practical use of application software to perform engineering calculations, information processing and experimental results research
LO9.	Know and understand related fields (fluid and gas mechanics, heat engineering, electrical engineering, electronics) and be able to identify interdisciplinary links in applied mechanics at the level required to meet other requirements of the educational program
LO10.	Know the design, methods of selection and calculation, basics of maintenance and operation of drives of machine tools and robotic equipment
LO11.	Understand the principles of automated control systems of technological equipment, including microprocessors, choose and use the optimal means of automation
LO12.	Have skills in the practical use of computer-aided design (CAD), production preparation (CAM) and engineering research (CAE)
LO13.	Evaluate the technical and economic efficiency of production
LO14.	Carry out the optimal choice of equipment and equipment of technical complexes
LO15.	Take into account by making decisions the main factors of man-made impact on the environment and the main methods of environmental protection, labor protection and life safety
LO16.	Communicate freely on professional issues orally and in writing in the state and foreign languages, including knowledge of special terminology and interpersonal skills
LO17.	Take into account and choose rational technologies for the manufacture of structural elements and assembly of units and devices in the development of new and modernization of known design solutions
LO18.	To develop rational constructive decisions of the automated mechanical systems, machines, systems of hydropneumatic automation, electromechanics, mechatronics and robotics and their elements and units, according to the set characteristics by the solving of practical problems
LO19.	Design automated mechanical systems, machines, systems of hydropneumatic automation, electromechanics, mechatronics and robotics and their components with the use of computer tools,

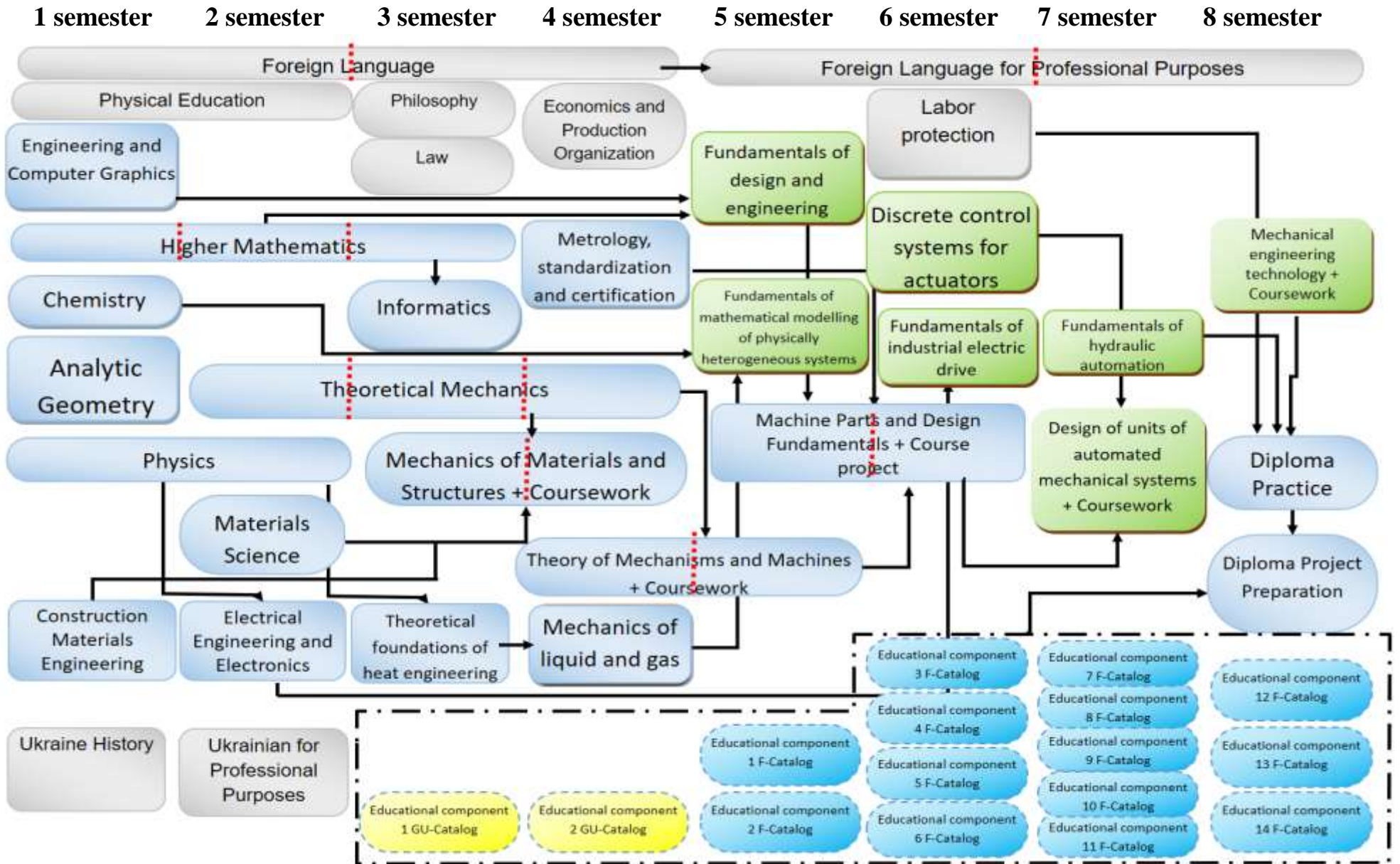
and provide functions, performance characteristics and performance indicators of design objects	
LO20. To determine rational design and operational parameters, efficiency, modes and conditions of operation of automated mechanical systems, machines, systems of hydropneumatic automation, electromechanics, mechatronics and robotics and their components, by computer and imitation modelling	
LO21. To build rational technical solutions for automation of the set functions by means of hydroautomatics and electromechanics with providing of certain parameters, modes and conditions of operation as a part of the automated mechanical systems and machines	
LO22. To develop rational technical solutions of control systems of technical objects and systems, machines and mechanisms with means of mechanics, hydropneumatic automation, electromechanics, mechatronics and robotics with provision of certain parameters, modes and conditions of operation of automated mechanical systems and machine	
<b>8 - Resource providing for program implementation</b>	
Human resources	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 in the current version. Teachers of professional disciplines 21, with a scientific degree 21, a doctor degree 6, professors 6.
Material and technical providing	In accordance with the technological requirements for material and technical providing of educational activities of the appropriate level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. Use of equipment for lectures in the format of presentations, network technologies, in particular on the Sikorsky distance-learning platform.
Informational, educational and methodical providing	In accordance with the technological requirements for educational, methodological and informational providing of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. Use of the Scientific and Technical Library of Igor Sikorsky KPI.
<b>9 - Academic mobility</b>	
National credit mobility	Based on bilateral agreements between the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" and technical universities of Ukraine
International credit mobility	On the basis of bilateral agreements between the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" and educational institutions of partner countries, agreements on international academic mobility
Training of foreign applicants for higher education	Teaching in English for individual groups with the provision of learning Ukrainian as a foreign language or after studying by foreign students of the Ukrainian language course in joint groups with Ukrainian students

## 2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (academic disciplines, course projects/works, practices, qualification work)	Number of ECTS credits	Form of final control
1	2	3	4
<b>Mandatory (normative) components of EP</b>			
<b>General training cycle</b>			
GC 01	Ukrainian language for Professional Purposes	2	Test
GC 02	Ukraine in the Context of the Historical Development of Europe	2	Test
GC 03	Basics of a Healthy Lifestyle	3	Test
GC 04.1	Foreign Language. Part 1	3	Test
GC 04.2	Foreign Language. Part 2	3	Test
GC 05	Introduction to Philosophy	2	Test
GC 06	Business Law	2	Test
GC 07	Economics and Production Organization	4	Test
GC 08	Labor Safety and Civil Defence	2	Test
GC 09.1	Foreign Language for Professional Purposes. Part 1	3	Test
GC 09.2	Foreign Language for Professional Purposes. Part 2	3	Exam
<b>Professional training cycle</b>			
PC 01	Construction Materials Engineering	4,5	Exam
PC 02	Chemistry	3	Test
PC 03	Linear Algebra and Analytic Geometry	3,5	Test
PC 04.1	Further Mathematics. Part 1. Differential and Integral Calculus of one-variable functions	4,5	Exam
PC 04.2	Further Mathematics. Part 2. Differential and Integral Calculus of multi-variable functions. Differtial equations	8,5	Exam
PC 04.3	Further Mathematics. Part 3. Rows. Theory of complex function variable	4	Exam
PC 05	Engineering and Computer Graphics	4	Test
PC 06.1	General Physics. Part 1. Mechanics. Basics of Electrodynamics	5,5	Exam
PC 06.2	General Physics. Part 2. Electricity and Magnetism. Optics. Atomic Physics	4,5	Test
PC 07	Materials Science	4,5	Exam
PC 08	Electrical Engineering and Electronics	3	Test
PC 09.1	Theoretical Mechanics. Part 1. Statics	4,5	Exam
PC 09.2	Theoretical Mechanics. Part 2. Kinematics	5	Exam
PC 09.3	Theoretical Mechanics. Part 3. Dynamics	3,5	Test
PC 10	Informatics	4	Test
PC 11	Theoretical foundations of heat engineering	3	Test
PC 12.1	Mechanics of Materials and Structures. Part 1. Simple Load	6,5	Exam
PC 12.2	Mechanics of Materials and Constructions. Part 2. Complex Load, rigidity and dynamics	6,5	Exam
PC 13	Mechanics of Materials and Structures. Coursework	1	Test
PC 14	Metrology, standardization and certification	4,5	Exam
PC 15	Fluid and Gas Mechanics	3,5	Test
PC 16	Theory of Mechanisms and Machines	3,5	Test
PC 17	Theory of Mechanisms and Machines. Coursework	1	Test

1	2	3	4
PC 18	Machine Parts and Design Fundamentals	6	Exam
PC 19	Machine Parts and Design Fundamentals. Course project	1,5	Test
PC 20	Fundamentals of design and engineering	6	Exam
PC 21	Fundamentals of mathematical modeling of physically heterogeneous systems	5,5	Exam
PC 22	Discrete control systems for actuators	6	Exam
PC 23	Fundamentals of industrial electric drive	5	Exam
PC 24	Fundamentals of hydraulic automation	3	Exam
PC 25	Design of units of automated mechanical systems	4	Exam
PC 26	Design of units of automated mechanical systems. Coursework	1,5	Test
PC 27	Mechanical engineering technology	3,5	Exam
PC 28	Mechanical engineering technology. Coursework	1	Test
PC 29	Diploma Practice	6	Test
PC 30	Diploma Project Preparation	6	Defense
<b>Selective components of EP</b>			
<b>General training cycle</b>			
GS 01	Educational component 1 GU-Catalog	2	Test
GS 02	Educational component 2 GU-Catalog	2	Test
<b>Professional training cycle</b>			
PS1	Educational component 1 F-Catalog	4	Test
PS2	Educational component 2 F-Catalog	4	Test
PS3	Educational component 3 F-Catalog	4	Test
PS4	Educational component 4 F-Catalog	4	Test
PS5	Educational component 5 F-Catalog	4	Test
PS6	Educational component 6 F-Catalog	4	Test
PS7	Educational component 7 F-Catalog	4	Test
PS8	Educational component 8 F-Catalog	4	Test
PS9	Educational component 9 F-Catalog	4	Test
PS10	Educational component 10 F-Catalog	4	Test
PS11	Educational component 11 F-Catalog	4	Test
PS12	Educational component 12 F-Catalog	4	Test
PS13	Educational component 13 F-Catalog	4	Test
PS14	Educational component 14 F-Catalog	4	Test
Or			
	Certificate program "Mechatronic and robotic systems in mechanical engineering"	56	Tests: 14
Or			
	Certificate program "Hydraulic and pneumatic automation of smart systems"	56	Tests: 14
Or			
	Certificate program "Logistic Systems Engineering"	56	Tests: 14
<b>Total amount of mandatory components:</b>		180	
<b>Total amount of selective components:</b>		60	
<b>Amount of educational components that ensure the acquisition of competencies of certain SVE:</b>		144,5	
<b>TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM</b>		<b>240</b>	

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



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

Certification of applicants for higher education under the educational program "Automated and robotic mechanical systems" is carried out in the form of defense of the qualification work and ends with the issuance of a standard document on awarding him a bachelor's degree with a qualification: Bachelor of Applied Mechanics in 131 Applied Mechanics. Automated and robotic mechanical systems ". Qualification work is published before defense on the official website of the institution of higher education or graduation department, as well as in the repository of the institution of higher education. Publication of qualification works containing information with limited access is carried out in accordance with the requirements of current legislation. Graduation certification is open and public. Qualification work should not contain academic plagiarism, falsification and writing off. The graduating department provides verification of qualification work for plagiarism.

## 5. CONFORMITY MATRIX OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 01	GC2	GC3	GC 4	GC 5	GC 6	GC 07	GC 08	GC 09	PC 01	PC 02	PC 03	PC 04	PC 05	PC 06	PC 07	PC 08	PC 09	PC 10	PC 11	PC 12	PC 13	PC 14	PC 15	PC 16	PC 17	PC 18	PC 19	PC 20	PC 21	PC 22	PC 23	PC 24	PC 25	PC 26	PC 27	PC 28	PC 29	PC 30					
GC 1					+							+	+						+						+																			
GC 2																+	+			+					+				+	+	+	+	+	+					+	+				
GC 3																											+													+	+			
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PC 13																																			+						+			
PC 14																																				+	+					+		
PC 15																															+													

## 6. PROVIDING MATRIX OF PROGRAM LEARNING RESULTS BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 01	GC 02	GC 03	GC 04	GC 05	GC 06	GC 07	GC 08	GC 09	PC 01	PC 02	PC 03	PC 04	PC 05	PC 06	PC 07	PC 08	PC 09	PC 10	PC 11	PC 12	PC 13	PC 14	PC 15	PC 16	PC 17	PC 18	PC 19	PC 20	PC 21	PC 22	PC 23	PC 24	PC 25	PC 26	PC 27	PC 28	PC 29	PC 30						
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LO 2																	+				+				+							+										+			
LO 3																						+	+									+													
LO 4																						+	+						+	+												+			
LO 5													+		+				+					+			+	+														+			
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