NATIONAL TECHNICAL UNIVERSITY "KHARKIV POLYTECHNIC INSTITUTE"

INSTITUTE OF COMPUTER MODELING, APPLIED PHYSICS AND MATHEMATICS

Professional Educational Program (Curriculum)

COMPUTER TECHNOLOGIES AND PROGRAMMING IN AUTOMATED CONTROL SYSTEMS

First level of higher education (Bachelor's degree in automation, computer-integrated technologies and robotics)

Specialty:

Automation, computer-integrated technologies and robotics (174)

2024, Kharkiv, Ukraine

The purpose of the educational program

The purpose of this professional educational program is to train specialists capable of comprehensively solving tasks related to the development of new automation systems, modernization, and operation of existing systems using modern hardware and software tools. This includes justifying the choice of technical means, designing corresponding information and control systems, and developing application software.

Orientation of the educational program

The educational-professional program is oriented towards training specialists capable of independently using and implementing computer-integrated technologies in the field of automation of technological processes and the control of complex technical systems and objects. The program emphasizes the formation and development of general and professional competencies in automation and control systems, combining them with training in electronics and IT, which enhances the graduate's competitiveness in the labor market and meets the needs of employers and society.

The main focus of the educational program

The focus of the program is aimed at building competencies and providing skills in the development of applied and specialized software, programmable logic controllers, and logic integrated circuits, analyzing technological objects, designing, developing, and setting up computer-integrated control systems, as well as approaches and tools for assessing their reliability and technical diagnostics.

Attention is also given to the development of human-machine interfaces and data processing and transmission systems for the automation of technological processes and production across various industries.

Key terms: automation, computer-integrated technologies, automation and control systems, applied software, technological processes and objects.

Features of the educational program

The uniqueness of the program lies in the synergistic combination of automation with electronics and IT, with a strong focus on developing skills for designing typical automation systems for technological processes and automatic control systems, as well as in creating algorithms for automation systems and their implementation through applied programming.

Students in this program acquire the necessary knowledge in both the technical and software aspects of automated systems, including the selection of technical tools and their metrological support.

The program features two structured packages of specialized disciplines that provide a deep understanding of technological process automation, computer-integrated technologies, and automatic control systems. The corresponding educational paths allow students to direct their acquired competencies towards either the creation of automation systems for technological processes (*Profile package: Computer-Integrated Production and Applied Programming*) or the in-depth study of data processing methods and automatic control systems (*Profile package: Computerized Control Systems and Automation*).

The educational program also offers students the opportunity to gain important professional skills and specialized knowledge through a wide range of elective courses in professional training, grouped into thematic blocks (Elective Professional Training in Applied Programming, Economic Direction, Object and Process Analysis and Modeling).

Employability and Further Education Opportunities for Graduates

Graduates of this program are well-prepared for employment in positions related to the design, development, and operation of automation systems in various industries. They can work as engineers or specialists in automation, control systems, and industrial process management. Potential job roles include:

– Engineer of automated production control systems
– Engineer of mechanization and automation of production processes
– Engineer for commissioning and testing of automation systems
– Computer systems engineer

– Engineer of computer applications
– Technical specialist in the field of automation
– Technician for automation of production processes
– Programmer technician
– Systems administration technician
– Specialist in software development and testing
– Engineer for the operation of emergency protection automation
– Engineer of dispatching and technological control systems
– Engineer of operational-dispatch service regimes
– Engineer for repair of automation technical tools
– Technician of a computing (information-computing) center
– Electronic equipment operator technician

The program also provides graduates with the necessary competencies for further education at the second (master's) level of higher education. They may continue their studies in fields such as automation and control systems, electronics, information technology, or related areas, further enhancing their qualifications and opening doors to academic research and teaching positions.

Teaching and Assessment

General teaching formats are: lectures, practical classes, laboratory work, internships, and Independent Study: The program includes a variety of teaching formats, such as explanatory-illustrative and learning-through-acting technologies, including project-based, self-developing, interactive, situational, and contextual learning approaches.

Assessment Methods

Exams and Differentiated Credits: Students are evaluated through formal exams and differentiated credits to assess their understanding of the material.

Defense of Laboratory Work and Course Projects: Students must present and defend their laboratory work and course projects.

Defense of Internships and Qualification Work: Students also defend their internships and qualification projects to demonstrate their practical application of knowledge.
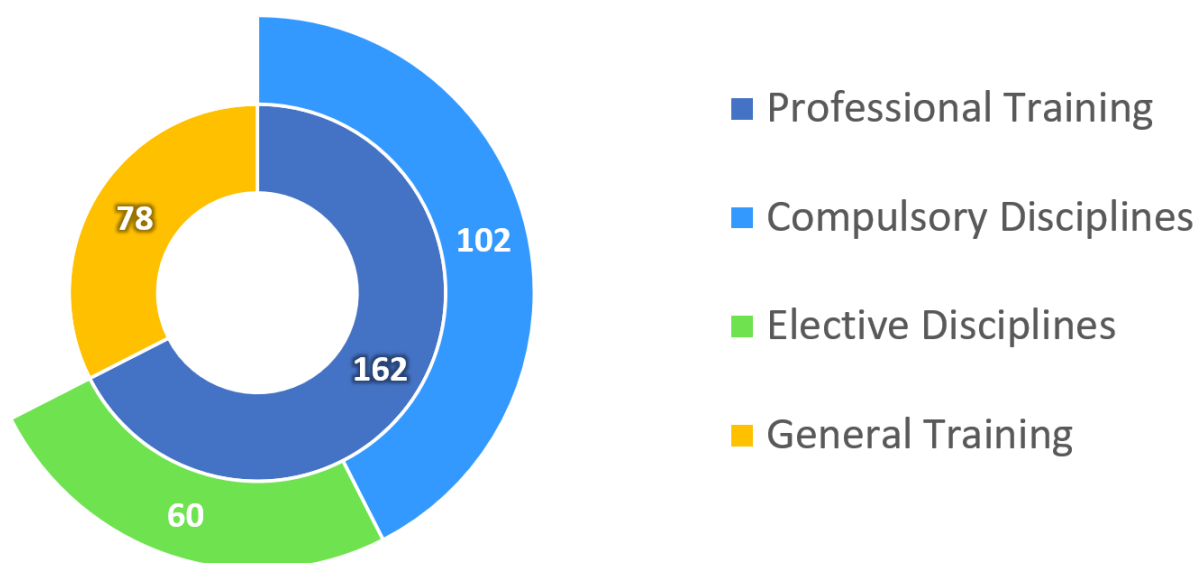
Grading System

The evaluation of students' academic achievements is carried out according to the national scale (excellent, good, satisfactory, unsatisfactory; passed, not passed), a 100-point scale, and the ECTS (European Credit Transfer and Accumulation System) scale.

Distribution of the Content of the Educational Program by Groups of Components and Training Cycles

Type of Disciplines	Volume of Academic Workload for Students (ECTS Credits / %)		
	Compulsory Educational Components	Elective Educational Components	Total for the Entire Duration of Study
General Training	78 / 33%	-	78 / 33%
Professional Training	102 / 42%	60 / 25%	162 / 67%
Total for the Entire Duration of Study	180 / 75%	60 / 25%	**240 / 100**

The Volume of Academic Workload (in ECTS Credits)

- Professional Training
- Compulsory Disciplines
- Elective Disciplines
- General Training

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Total Distribution for the Entire Duration of Study

Total 240 ECTS

- Compulsory Disciplines — 180
- Elective Disciplines — 60
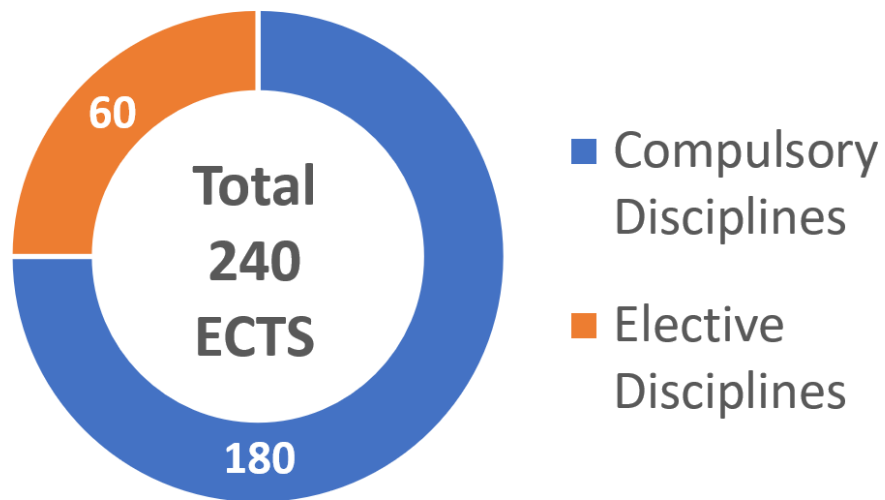
List of Components of the Educational Program

Code	Components of the Educational Program (Courses, course projects (works), internships, qualification work)	Number of ECTS Credits	Form of Final Assessment
1	2	3	4
Compulsory Components of the Professional Educational Program			
1. General Training			
GT01	Foreign Language (English, German or French)	12,0	Credit/Exam
GT02	Ukrainian Language (for professional purposes)	3,0	Exam
GT03	History of Ukraine and Ukrainian Culture	4,0	Exam
GT04	Higher Mathematics	18,0	Exam
GT05	General Physics	13,0	Exam
GT06	Ecology	3,0	Credit
GT07	Philosophy	3,0	Credit
GT08	Jurisprudence	4,0	Credit
GT09	Introduction to the Specialty. Introductory Internship	3,0	Credit
GT10	History of Science and Technology	3,0	Credit
GT11	Sports and Physical Self-Improvement	12,0	Credit
2. Specialized (Professional) Training			
ST01	Descriptive Geometry and Engineering Graphics	5,0	Exam
ST02	Programming	10,0	Exam
ST03	Theory of Probability	4,0	Exam
ST04	Algorithms and Data Structures	4,0	Exam
ST05	Electrotechnics and Electromechanics	5,0	Exam
ST06	Information Theory	3,0	Credit
ST07	Metrology and Fundamentals of Measurements	4,0	Exam
ST08	Fundamentals of Electronics	5,0	Exam
ST09	Theory of Automatic Control	6,0	Exam
ST10	Fundamentals of Design Automation Systems	5,0	Exam
ST11	Fundamentals of Occupational Safety and Health	3,0	Credit
ST12	Organization of Databases	4,0	Exam
ST13	Team Project Work	3,0	Credit
ST14	Reliability and Diagnostics of Automation Systems	4,0	Credit
ST15	Microprocessor and IoT Programming	3,0	Exam
ST16	Technical Means of Automation	6,0	Exam
ST17	Software of Industrial Controllers	6,0	Exam
ST18	Fundamentals of Artificial Intelligence	4,0	Exam
PT1	Industrial internship	6,0	Credit
PT2	Pre-graduation internship	6,0	Credit
Total Volume of Compulsory Components		**174 ECTS Credits**	

Elective Components of the Professional Educational Program *	
Elective educational components of professional training (in form of one of two specialized packages of educational components)	**29 ECTS Credits**
Educational components of the student's free choice from the catalog of professional training courses (in form of one slot for component per semester beginning from 4 semester)	**19 ECTS Credits**
Educational components of the student's free choice from the university-wide catalog (in form of one slot per semester in 5, 6, 7 semesters)	**12 ECTS Credits**
Total volume of elective components	**60 ECTS Credits**
Total volume of the Professional Educational Program	**240 ECTS Credits**

* Elective components of the educational program are chosen by higher education students from the catalogs of specialties, profile training, and the university-wide catalog, which is formed from the courses offered by various departments.

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Structural-Logical Scheme of the Educational-Professional Program

TERM 1		TERM 2		TERM 3		TERM 4	
SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6	SEMESTER 7	SEMESTER 8

THE COMPULSORY EDUCATIONAL COMPONENTS OF GENERAL TRAINING (78 ECTS CREDITS)

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6	SEMESTER 7	SEMESTER 8
GT01 2.0 Foreign Language (English, German or French)	**GT01** 2.0 Foreign Language (English, German or French)	**GT01** 2.0 Foreign Language (English, German or French)	**GT01** 2.0 Foreign Language (English, German or French)	**GT11** 2.0 Sports and Physical Self-Improvement	**GT11** 2.0 Sports and Physical Self-Improvement	**GT01** 2.0 Foreign Language (English, German or French)	**GT01** 2.0 Foreign Language (English, German or French)
GT02 3.0 Ukrainian Language (for professional purposes)	**GT04** 6.0 Higher Mathematics	**GT04** 6.0 Higher Mathematics	**GT05** 3.0 General Physics				
GT03 4.0 History of Ukraine and Ukrainian Culture	**GT05** 5.0 General Physics	**GT05** 5.0 General Physics	**GT08** 4.0 Jurisprudence				
GT04 6.0 Higher Mathematics	**GT06** 3.0 Ecology	**GT07** 3.0 Philosophy	**GT11** 2.0 Sports and Physical Self-Improvement				
GT09 3.0 Introduction to the Specialty. Introductory Internship	**GT10** 3.0 History of Science and Technology	**GT11** 2.0 Sports and Physical Self-Improvement					
GT11 2.0 Sports and Physical Self-Improvement	**GT11** 2.0 Sports and Physical Self-Improvement						

PRACTICAL TRAINING COMPONENTS AND FINAL ASSESSMENT (12 AND 6 ECTS CREDITS)

				PT1 6.0 Industrial internship			**PT2** 8.0 Pre-graduation internship
							Final assessment

EDUCATIONAL COMPONENTS OF THE STUDENT'S FREE CHOICE FROM THE UNIVERSITY-WIDE CATALOG (12 ECTS CREDITS)

				FCEC GT 01 4.0 *Slot for elective course of general training from the university-wide catalog*	**FCEC GT 02** 4.0 *Slot for elective course of general training from the university-wide catalog*	**FCEC GT 03** 4.0 *Slot for elective course of general training from the university-wide catalog*	

THE COMPULSORY EDUCATIONAL COMPONENTS OF SPECIALIZED (PROFESSIONAL) TRAINING (84 ECTS CREDITS)

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6	SEMESTER 7	SEMESTER 8
ST01 5.0 Descriptive Geometry and Engineering Graphics	**ST02** 5.0 Programming	**ST04** 4.0 Algorithms and Data Structures	**ST07** 4.0 Metrology and Fundamentals of Measurements	**ST10** 5.0 Fundamentals of Design Automation Systems	**ST13** 3.0 Team Project Work	**ST16** 6.0 Technical Means of Automation	**ST18** 4.0 Fundamentals of Artificial Intelligence
ST02 5.0 Programming	**ST03** 4.0 Theory of Probability	**ST05** 5.0 Electrotechnics and Electromechanics	**ST08** 5.0 Fundamentals of Electronics	**ST11** 3.0 Fundamentals of Occupational Safety and Health	**ST14** 4.0 Reliability and Diagnostics of Automation Systems	**ST17** 6.0 Software of Industrial Controllers	
		ST06 3.0 Information Theory	**ST09** 6.0 Theory of Automatic Control	**ST12** 4.0 Organization of Databases	**ST15** 3.0 Microprocessor and IoT Programming		

ELECTIVE EDUCATIONAL COMPONENTS OF PROFESSIONAL TRAINING (29 ECTS CREDITS)

The student selects one of two specialized packages of educational components:

01 «Computerized control systems and automation»

PT1.01 – PT1.08 *Courses from the specialized package of educational components*

				PT1.01 4.0 Analog and Digital Micro- and Nanoelectronics	**PT1.03** 4.0 Fundamentals of Gathering, Processing and Transfer of Information	**PT1.04** 4.0 Systems and Data Transfer Networks	**PT1.06** 3.0 Designing and Production Technology of Automation Systems
				PT1.02 4.0 Theory of Digital Automata		**PT1.05** 4.0 Digital Signal Processing	**PT1.07** 3.0 Automatic Devices Based on Very Large Scale Integrated Circuits
							PT1.08 3.0 Programming of GPU and signal processors

02 «Computer-integrated manufacturing and applied programming»

PT2.01 – PT2.07 *Courses from the specialized package of educational components*

				PT2.01 4.0 Typical Technological Objects and Production Processes I	**PT2.01** 4.0 Typical Technological Objects and Production Processes II	**PT2.03** 4.0 Energy Saving and Environmental Protection System	**PT2.05** 3.0 Mathematical Methods of Optimization
				PT2.02 4.0 Application Software Development		**PT2.04** 4.0 Computer Simulation of Processes and Systems	**PT2.06** 3.0 Installation, repair and adjustment automation equipment and devices
							PT2.07 3.0 Automation of Technological Processes and Production

EDUCATIONAL COMPONENTS OF THE STUDENT'S FREE CHOICE FROM THE CATALOG OF PROFESSIONAL TRAINING COURSES (19 ECTS CREDITS)

The student selects professional training courses from the catalog of courses offered by the curriculum for each semester or from those proposed by partner stakeholders from the professional community

		FCEC PT 1 4.0 *Slot for elective course of professional training from curriculum catalog*	**FCEC PT 2** 4.0 *Slot for elective course of professional training from curriculum catalog*	**FCEC PT 3** 4.0 *Slot for elective course of professional training from curriculum catalog*	**FCEC PT 4** 4.0 *Slot for elective course of professional training from curriculum catalog*		**FCEC PT 5** 3.0 *Slot for elective course of professional training from curriculum catalog*
		FCECPT1.01 4.0 Theory of Electric and Magnetic Circuits	**FCECPT2.01** 4.0 Software for Control System	**FCECPT3.01** 4.0 Computer Graphics	**FCECPT4.01** 4.0 Technological Systems and Complexes		**FCECPT5.01** 3.0 *Course with an economic focus #1*
		FCECPT1.02 4.0 Computer-Integrated Technologies	**FCECPT2.02** 4.0 Object-Oriented Programming	**FCECPT3.02** 4.0 Process Measurements and Instrumentation	**FCECPT4.02** 4.0 Numerical Methods		**FCECPT5.02** 3.0 *Course with an economic focus #2*
		FCECPT1.03 4.0 Graph Theory	**FCECPT2.03** 4.0 Human Machine Interface	**FCECPT3.03** 4.0 Cryptographic Tools in Information and Computer Systems	**FCECPT4.03** 4.0 Microprocessor Means of Automatics		**FCECPT5.03** 3.0 *Course with an economic focus #3*
		FCECPT1.04 4.0 Fundamentals of Computer-Aided Design Systems (CAD)	**FCECPT2.04** 4.0 Applied Programming using Python		**FCECPT4.04** 4.0 Elements and Devices of Automation and Control Systems		

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