MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"IGOR SIKORSKY KYIV POLYTECHNICINSTITUTE"

APPROVED
by Academic Council
of Igor Sikorsky Kyiv Polytechnic Institute
(protocol No._3_ from _15.03.2021_)
Head of Academic Council
_____Mykhaylo ILCHENKO

ELECTRONIC DEVICES AND EQUIPMENT

EDUCATIONAL PROGRAM
for first (Bachelor) level of higher education

Specialty	**171 Electronics**
Field of knowledge	**17 Electronics and telecommunications**
Qualification	**Bachelor in Electronics**

Came into force from 2021/2022
academic year
Order of Rector of Igor Sikorsky
Kyiv Polytechnic Institute
from 09.04.2021
No. HOH/89/2021

Kyiv - 2021

PREAMBLE

DEVELOPED by the project team:

Project team leader:

Mikhailov Sergey Rostislavovich, Associate Professor of the Department of Electronic Devices and Systems, Ph.D, Assoc. Prof.

Members of the project team:

Pisarenko Leonid Dmytrovych, Professor of the Department of Electronic Devices and Systems, Doctor of Technical Sciences, Prof.

Melnyk Ihor Vitalovych, Professor of the Department of Electronic Devices and Systems, Doctor of Technical Sciences, Prof.

Kuzmychev Anatoliy Ivanovych, Professor of the Department of Electronic Devices and Systems, Doctor of Technical Sciences, Prof..

The Department of Electronic Devices and Systems is responsible for the training of applicants for higher education according to the educational program.

AGREED:

Scientific and Methodological Commission of the University, specialty 171 Electronics

The Head of the SMCU 171 _____ Yuliia YAMNENKO
(Protocol № 4 from 02.02.2021)

Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute
The Head of the Methodological Council
_____ Yuriy YAKYMENKO
(protocol № _6_ from "_25_" ___02____ 2021)

Stakeholder suggestions taken into account:

• increase the diversity of professionally-oriented disciplines (students) while maintaining a rich fundamental component (employers).

The following changes were made to the educational program:

• to transfer a part of disciplines to selective blocks, to modernize their filling according to a profile 171 Electronics, the list of disciplines to the cathedral F-Catalog is offered.

• recommendations on updating educational programs and features of developing curricula for bachelors (KPI named after Igor Sikorsky from 30.11.2020 № NON / 35/2020 "On improving educational programs of the first (bachelor's) level of higher education") and changed the list accordingly compulsory and elective educational components.

Agreed with members of the scientific-methodical commission and the support group of the specialty 171 Electronics KPI them. Igor Sikorsky.

The educational program was considered at the meeting of the Department of Electronic Devices and Systems, Minutes № 14 of January 21, 2021.

CONTENTS

1. PROFILE OF THE EDUCATIONAL PROGRAM

1 – General information	
Full name of institution of higher education and institute / faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Faculty of Electronics
Higher education degree and title of qualification in the original language	Degree - Bachelor Educational qualification - Bachelor of Electronics
The official name of the educational program	Electronic Devices and Equipment
Type of diploma and scope of the educational program	Bachelor's degree, single, 240 credits, term of study 3 years, 10 months
Availability of accreditation	Certificate of accreditation of the specialty ND 1192560, valid until 01.07.2023
Cycle / level of higher education	National Qualifications Framework of Ukraine– level 6 QF-EHEA - the first cycle EQF-LLL – 6 level
Prerequisites	Availability of complete general secondary education The presence of a degree of junior specialist
Teaching languages	English
Validity of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/op http://eds.kpi.ua/?page_id=5040
2 – The purpose of the educational program	
Training of an electronics specialist capable of solving complex specialized problems and practical problems of design, production, operation, maintenance, repair and modernization of devices and systems of electronics, aimed at fruitful and efficient work in a sustainable innovative scientific and technological development of society and high adaptability of higher education seekers in the conditions of labor market transformation through interaction with employers and other stakeholders. The purpose of the educational program corresponds to the strategy of Igor Sikorsky Kyiv Polytechnic Institute development for 2020-2025 and the formation of the future society on the basis of the concept of sustainable development.	

3 – Characteristics of educational program	
Subject area	*Object of activity:* physical processes and phenomena in electronic devices, modern materials and components of electronics, vacuum, plasma, quantum, microwave and functional electronic devices, analogue devices and digital electronics, microprocessor and microcontroller devices. *Learning objectives:* training of professionals capable of successful professional and research and innovation activities in the field of development, design, production, operation, maintenance, repair and modernization of electronic devices, devices and systems based on acquired theoretical and practical knowledge and skills, ways of thinking, views, values and other personal qualities sufficient to solve complex specialized theoretical and practical problems. *Theoretical content of the subject area:* concepts and principles of physical foundations of electronics, information technology, vacuum and plasma electronics, signal processing theory, analogue and digital circuitry technological bases of electronics, quantum electronics, functional electronics, microwave electronics, microprocessor technology, fundamental principles, concepts of construction, modeling, design and optimization of modern electronic devices and systems. *Methods, techniques and technologies:* research of processes in electronic devices and systems; planning an experiment with processing the results; modern computer and information technologies; application of technologies of mathematical and physical-topological modeling, cloud computing in the design of electronic devices and systems. *Tools and equipment*: electronic devices and systems, control and measuring equipment, electronic systems for various purposes, including technological, vacuum and plasma, microwave, functional, laser and optoelectronic, registration and display of information, technical vision, microcontrollers control systems, software for analysis, calculation and modeling of processes in electronic devices and systems.
Orientation of the educational program	Educational and professional

The main focus of the educational program	General higher education in the field of electronics, in particular, its physical bases, materials and components, vacuum and plasma electronics, technological bases of electronics, quantum electronics, functional electronics, microwave electronics, laser technology, microprocessor technology, mastering additional fundamental and professional-oriented which together provides the acquisition of the necessary competencies for further professional activity. Aimed at developing the applicant's ability to identify and solve complex problems in the field of knowledge 17 "Electronics and Telecommunications", in the specialty 171 Electronics. The program gives students the opportunity to freely choose academic disciplines in accordance with the profile of the department. The educational program includes disciplines of the cycle of general and professional training, including 25% of disciplines selected by the applicant for higher education to form an individual educational trajectory. **Keywords:** Electronic devices and equipment; Vacuum and plasma electronics; Quantum electronics; Functional electronics; Microwave electronics; Microprocessor technique; Technological electronic equipment.
Features of the educational program	The program is based on the requirements of the European Qualifications Framework for Lifelong Learning (EQF-LLL). The program provides a broad profile of bachelors in various fields of modern electronics: vacuum and plasma, microwave, information, functional, technological, quantum electronics and laser technology. The program involves the involvement of electronics professionals and stakeholders in the educational process. To implement international mobility with a double university degree under bilateral agreements, the educational program is agreed among partner universities (Technical University of Dresden, Germany; Korean Institute of Science and Technology, South Korea).

4 – Suitability of graduates for employment and further study	
Suitability for employment	In accordance with the professional requirements and the State Classification of Occupations SC 003: 2010 graduates can work in the following positions: 3114 Technicians in the field of electronics and telecommunications - alarm technician; - design technician (electronics); - technician-technologist (electronics). 3119 Other technical specialists in the field of physical sciences and technology - navigational information collection manager; - laboratory assistant (electronics); - technician for preparation of technical documentation (electronics); - specialist in technical expertise (electronics). 3123 Controllers and regulators of industrial robots - debugging and testing technician; - robot controller. 3132 Operators of radio and telecommunication equipment - radio electronics. 3139 Other operators of optical and electronic equipment - technicians for diagnostic equipment; - technician-operator of electronic equipment; - technician-technologist for the production of optical and opto-electronic devices. 3111 Laboratory assistant and technicians related to chemical and physical research - technician-technologist (electronics). 3439 Other technical specialists in the field of management - specialist in the organization of consumer services. According to the International Standard Classification of Occupations 2008, graduates may work in positions corresponding to the following groups: 31 Science and engineering associate professionals; 312 Mining, manufacturing and construction supervisors.
Further training	The bachelor of electronics has the right to study master's programs in electronics and interdisciplinary programs close to electronics (automation, instrumentation, telecommunications, radio engineering and others).

5 – Teaching and assessment		
Teaching and learning	General learning style - task-oriented. Training is conducted in the form of lectures, seminars, practical classes, laboratory classes, individual lessons. Independent work of students involves the possibility of consultation with the teacher. During the teaching, information and communication technologies (e-learning, online lectures, OCW, distance courses) are used for certain educational components: - lectures, practical and seminar classes, computer workshops, laboratory and calculation works, internships, interactive workshops - in classroom, remote, mixed format; - conducting classrooms with the involvement of professionals-practitioners in the field, including in the territories of partner companies; - participation in scientific, scientific and technical international and interdisciplinary conferences, seminars, projects, trainings; - independent work with the use of methodological and scientific information sources; - participation in research project development groups; - consultations with scientific and pedagogical workers. The study ends with the writing and public defense of the diploma project.	
Evaluation	Current and semester control in the form of laboratory reports, presentations, written modular tests. Semester control in the form of written and oral examinations and presentation of qualification work. Current and semester tests are assessed in accordance with the criteria of the Regulations on the system of assessment of learning results in Igor Sikorsky Kyiv Polytechnic Institute.	
6 – Program competencies		
Integral competence	Ability to solve complex specialized and practical problems, characterized by complexity and uncertainty of conditions, during professional activities in the field of electronics, or in the learning process, which involves the application of theories and methods of electronics.	
General Competencies (GC)	GC 1	Ability to apply knowledge in practical situations
	GC 2	Knowledge and understanding of the subject area and understanding of professional activity
	GC 3	Ability to communicate in the state language both orally and in writing
	GC 4	Ability to communicate in a foreign language
	GC 5	Skills in the use of information and communication technologies
	GC 6	Ability to learn and master modern knowledge
	GC 7	Ability to search, process and analyze information from various sources
	GC 8	Interpersonal skills
	GC 9	Ability to work in a team

	GC 10	Safe activities skills
	GC 11	Ability to evaluate and ensure the quality of work performed
	GC 12	Definiteness and perseverance in the tasks and responsibilities
	GC 13	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.
	GC 14	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. active recreation and a healthy lifestyle
Professional Competencies (PC)	PC 1	Ability to use knowledge and understanding of scientific facts, concepts, theories, principles and methods for the design and application of devices and systems of electronics
	PC 2	Ability to analyze the subject area and regulatory documentation required for the design and application of devices and systems of electronics
	PC 3	Ability to integrate knowledge of fundamental sections of physics and chemistry to understand the processes of solid-state, functional, quantum and energy electronics
	PC 4	Ability to take into account social, environmental, ethical, economic and commercial considerations that affect the efficiency and results of engineering activities in the field of electronics
	PC 5	Ability to apply appropriate mathematical, scientific and technical methods, modern information technology and computer software, skills in working with computer networks, databases and Internet resources to solve engineering problems in the field of electronics
	PC 6	Ability to identify, classify, evaluate and describe processes in electronics devices and systems using analytical methods, modeling tools, prototypes and experimental research results
	PC 7	Ability to apply creative and innovative potential in the synthesis of engineering solutions and in the development of instrument designs, devices and systems of electronics

	PC 8	Ability to solve engineering tasks in the field of electronics taking into account all aspects of development, design, production, operation and modernization of electronic devices and systems
	PC 9	Ability to determine and evaluate characteristics and parameters of electronic materials equipment, analog and digital electronic devices for the design of microprocessor and electronic systems
	PC 10	Ability to apply in practice industry standards and quality standards of operation of devices and systems of electronics
	PC 11	Ability to monitor and diagnose the state of equipment, use modern electronic components and hardware, perform maintenance, repair electronic devices and systems, install, configure and repair analogue, digital and optical modules, develop and manufacture printed circuit boards, develop software for microcontrollers
	PC 12	To integrate knowledge of fundamental sections of physics and chemistry to understand the processes of vacuum, plasma, quantum, microwave electronics and laser technology
	PC 13	Ability to implement modern technologies for the production of solid-state, vacuum, plasma, quantum and microwave electronic devices based on new materials, including nanomaterials.
	PC 14	Ability to develop devices and systems for vacuum, plasma, quantum, microwave and functional electronics
7 – Program learning outcomes		
O1	Describe the principle of operation using scientific concepts, theories and methods and test the results in the design and application of devices and systems of electronics	
O2	Apply knowledge and understanding of differential and integral calculus, algebra, functional analysis of real and complex variables, vectors and matrices, vector calculus, differential equations in ordinary and partial derivatives, Fourier series, statistical analysis, information theory, numerical methods for solving theoretical and applied problems of electronics	
O3	Find solutions to practical problems of electronics by applying appropriate models and theories of electrodynamics, analytical mechanics, electro-magnetism, statistical physics, solid state physics, gas discharge physics, quantum physics	

O4	Evaluate the characteristics and parameters of electronic materials, understand the basics of solid-state electronics, vacuum and plasma electronics, technological foundations of electronics, quantum electronics, functional electronics, microwave electronics, analogue and digital circuitry, microprocessor technology
O5	Use information and communication technologies, applied and specialized software products to solve problems of design and debugging of electronic systems, demonstrate skills of programming, analysis and display of measurement and control results
O6	Apply experimental skills (knowledge of experimental methods and the order of experiments) to test hypotheses and study the phenomena of electronics, be able to use standard equipment, plan, make diagrams; analyze, model and critically evaluate the obtained results.
O7	Analyze complex analogue and digital information-measuring systems with extended architecture of computer and telecommunication networks taking into account the specification of selected technical means of electronics and relevant technical documentation.
O8	Define and identify mathematical models of technological objects in the development of new complex electronic systems in the computer environment and the choosing of the optimal solution.
O9	Design complex real-time systems and means of collecting and processing information, consistent with the specified information and software by using software for embedded systems based on microcontrollers.
O10	Develop technical means for the construction and diagnosis of technical condition of electronic devices and systems, organize and conduct scheduled and unscheduled repairs, adjustment and reconfiguration of electronic equipment in accordance with current production requirements.
O11	Argue the legal framework for the implementation of electronic devices and systems; evaluate the benefits of engineering developments, their environmental friendliness and safety; to defend their own worldviews and beliefs in production or social activities.
O12	Use documentation related to professional activities, using modern technologies and office equipment; use English, including special terminology, to communicate with specialists, conduct literary searches and read texts on technical and professional topics.
O13	Be able to acquire new knowledge, advanced technologies and innovations, find new non-standard solutions and means of their implementation; meet the requirements of flexibility in overcoming obstacles and achieving goals, rational use and regulation of time, discipline, responsibility for their decisions and activities.
O14	Adhere to the norms of modern Ukrainian business and professional language.
O15	Demonstrate skills of independent and collective work, leadership qualities, organize work in a limited time with an emphasis on professional integrity.
O16	Apply understanding of the theory of stochastic processes, methods of statistical processing and data analysis in solving professional problems.

O17	Demonstrate skills in conducting experimental research related to professional activities; to improve measurement methods; control the reliability of the obtained results; systematize and analyze the data obtained experimentally.
O18	Apply methods of mathematical modeling and optimization of electronic devices and systems for the development of automated and robotic production systems.
O19	Introduce new low-waste, energy-saving and environmentally friendly technologies for the production of solid-state, vacuum, plasma, quantum and microwave electronic devices in the electronics industry.

8 – Resource support for program implementation

Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of higher education, 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.
Material and technical support	In accordance with the technological requirements for financial and technical support of educational activities at the relevant level of higher education, 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, particularly on the Sikorsky distance learning platform, demonstration industry equipment during laboratory workshops
Information, educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities at the relevant level of HE (Annex 5 to the License Conditions), 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 from 10/05/2018. Use of the Scientific and Technical Library of Igor Sikorsky Kyiv Polytechnic Institute

9 – Academic mobility

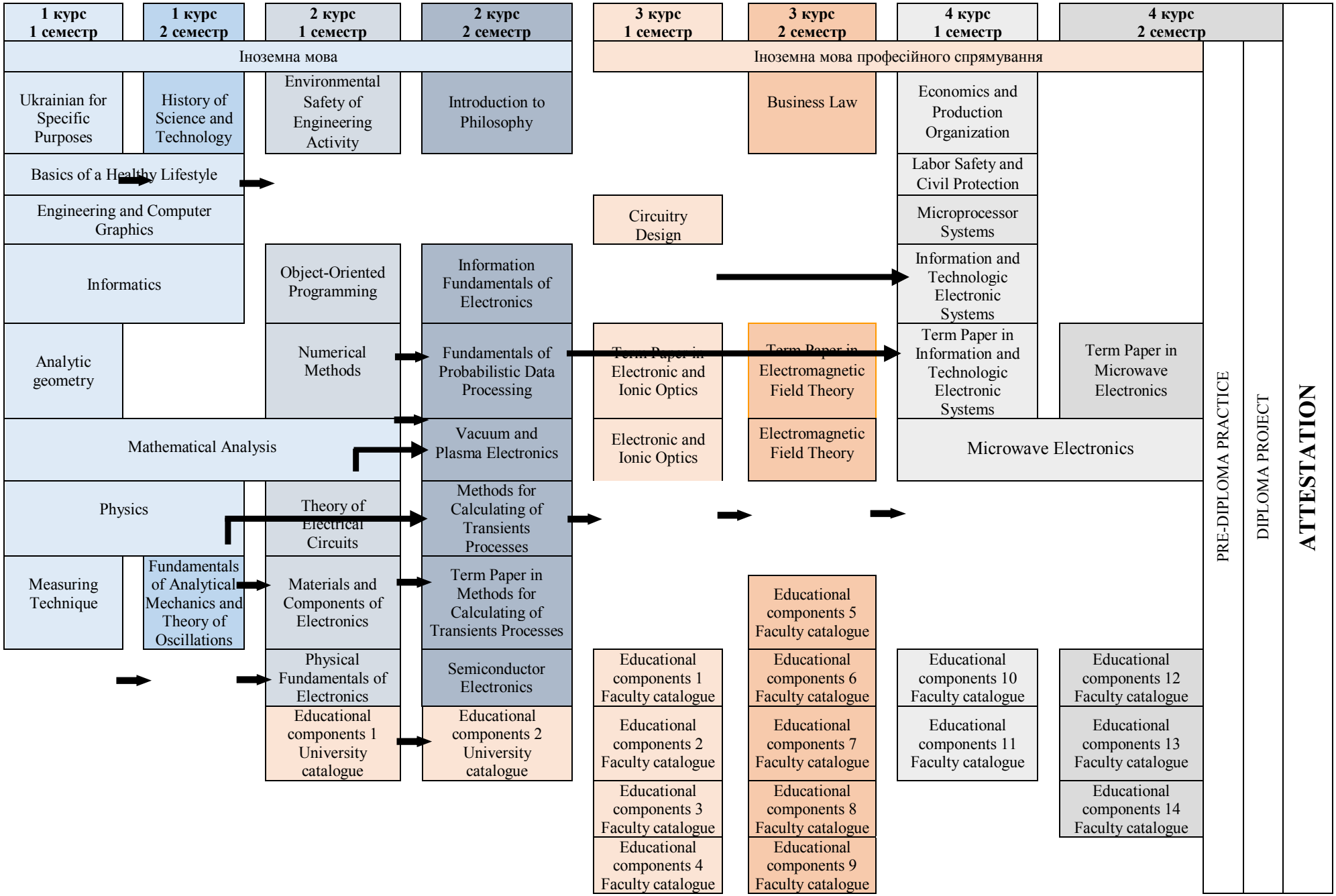
National credit mobility	It is possible, subject to the conclusion of relevant agreements between Igor Sikorsky Kyiv Polytechnic Institute and higher education institutions of Ukraine.
International credit mobility	Implemented on the basis of concluding agreements on international academic mobility (Erasmus + K2). Double degree program with the Technical University of Dresden (Germany), the Korean Institute of Science and Technology (South Korea).
Study of foreign applicants for higher education	Teaching a foreign (English) language in case of formation of separate foreign groups (in this case the Ukrainian language is studied as a foreign language). Teaching in Ukrainian in case of formation of mixed Ukrainian-foreign groups.

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
Compulsory (regulatory) components of the educational program			
General training cycle			
GC 1	Ukrainian for Specific Purposes	2	Final tests
GC 2	History of Science and Technology	2	Final tests
GC3	Basics of a Healthy Lifestyle	3	Final tests
GC 4	Foreign Language	6	Final tests
GC 5	Foreign Language of Professional Direction	6	Final tests Exam
GC 6	Environmental Safety of Engineering Activity	2	Exam
GC 7	Introduction to Philosophy	2	Final tests
GC 8	Business Law	2	Final tests
GC 9	Economics and Production Organization	4	Final tests
GC 10	Labor Safety and Civil Protection	4	Final tests
GC 11	Mathematical Analysis	17,5	Exam
GC 12	Analytic Geometry	4,5	Exam
GC 13	Physics	12	Exam
GC 14	Engineering and Computer Graphics	6	Exam
GC 15	Informatics	8	Final tests
Vocational training cycle			
VC 1	Measuring Technique	3,5	Final tests
VC 2	Fundamentals of Analytical Mechanics and Theory of Oscillations	4	Final tests
VC 3	Materials and Components of Electronics	4	Exam
VC 4	Physical Fundamentals of Electronics	4	Exam
VC 5	Numerical Methods	4	Final tests
VC 6	Object-Oriented Programming	3	Final tests
VC 7	Theory of Electrical Circuits	4	Final tests
VC 8	Methods for Calculating of Transients Processes	6	Exam
VC 9	Term Paper in Methods for Calculating of Transients Processes	1	Final tests
VC 10	Fundamentals of Probabilistic Data Processing	5	Final tests
VC 11	Circuit Design	6,5	Exam
VC 12	Semiconductor Electronics	4,5	Exam
VC 13	Information Fundamentals of Electronics	4	Final tests
VC 14	Vacuum and Plasma Electronics	4	Final tests
VC 15	Electromagnetic Field Theory	5,5	Exam
VC 16	Term Paper in Electromagnetic Field Theory	1	Final tests
VC 17	Electronic and Ionic Optics	5	Exam

VC 18	Term Paper in Electronic and Ionic Optics	1	Final tests
VC 19	Information and Technologic Electronic Systems	3,5	Exam
VC 20	Term Paper in Information and Technologic Electronic Systems	1	Final tests
VC 21	Microprocessor Systems	4	Exam
VC 22	Microwave Electronics	7,5	Exam
VC 23	Term Paper in Microwave Electronics	1	Final tests
VC 24	Pre-diploma Practice	6	Final tests
VC 25	Diploma Project	6	Defense
Optional components of educational program			
General training cycle			
GO 1	Educational components 1 University catalogue	2	Final tests
GO 2	Educational components 2 University catalogue	2	Final tests
Vocational training cycle			
VO 1	Educational components 1 Faculty catalogue	4	Final tests
VO 2	Educational components 2 Faculty catalogue	4	Final tests
VO 3	Educational components 3 Faculty catalogue	4	Final tests
VO 4	Educational components 4 Faculty catalogue	4	Final tests
VO 5	Educational components 5 Faculty catalogue	4	Final tests
VO 6	Educational components 6 Faculty catalogue	4	Final tests
VO 7	Educational components 7 Faculty catalogue	4	Final tests
VO 8	Educational components 8 Faculty catalogue	4	Final tests
VO 9	Educational components 9 Faculty catalogue	4	Final tests
VO 10	Educational components 10 Faculty catalogue	4	Final tests
VO 11	Educational components 11 Faculty catalogue	4	Final tests
VO 12	Educational components 12 Faculty catalogue	4	Final tests
VO 13	Educational components 13 Faculty catalogue	4	Final tests
VO 14	Educational components 14 Faculty catalogue	4	Final tests
Total amount of compulsory components:		180	
Total amount of optional components:		60	
The amount of educational components that ensure the acquisition of competencies defined by the standard of higher education		**120**	
TOTAL VOLUME OF EDUCATIONAL PROGRAM		**240**	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF ATTESTATION OF APPLICANTS OF HIGHER EDUCATION

Attestation of applicants for higher education in the educational program is carried out in the form of public defense of the qualification work in the form of a diploma project or thesis and ends with the issuance of a standard document on awarding a bachelor's degree with a bachelor's degree in electronics under the educational program "Electronic Devices and Equipment".

Attestation is open and public. The thesis project or thesis is tested for plagiarism.

Qualification work must contain a solution of a complex specialized or practical problem in the field of electronics, which is characterized by complexity and uncertainty of conditions and involves the application of theories and methods of electronics. There must be no academic plagiarism, falsification or writing off in the qualification work. Qualification work must be published for presentation on the official website of the higher education institution or its subdivision, or in the repository of the higher education institution. Publication of qualification works containing information with limited access is carried out in accordance with the requirements of current legislation.

5. MATRIX OF CORRESPONDENCE OF SOFTWARE COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 1	GC 2	GC3	GC 4	GC 5	GC 6	GC 7	GC8	GC 9	GC 10	GC 11	GC 12	GC 13	GC 14	GC 15	VC 1	VC 2	VC 3	VC 4	VC 5	VC 6
GC 1											+	+	+		+				+	+	
GC 2		+																			
GC 3	+																				
GC 4				+	+																
GC 5														+	+						+
GC 6		+	+	+	+				+	+	+	+	+		+				+	+	
GC 7	+	+	+	+	+				+	+	+	+	+		+	+	+		+		
GC 8	+	+	+	+	+		+		+						+						
GC 9	+	+	+	+	+		+		+	+	+	+	+		+						
GC 10										+						+					
GC 11															+	+					
GC 12							+	+	+												
GC 13		+						+	+												
GC 14		+	+			+	+														
PC 1																+	+		+		
PC 2		+				+			+					+							
PC 3													+					+	+		
PC 4					+															+	
PC 5											+	+				+				+	+
PC 6											+					+	+	+	+	+	
PC 7																	+		+		
PC 8														+			+		+		
PC 9																+		+	+		
PC 10														+		+					
PC 11														+	+	+	+	+	+	+	
PC 12													+					+	+		
PC 13																		+	+		
PC 14																		+	+		

CONTINUATION OF THE MATRIX OF CORRESPONDENCE OF TH
COMPETENCES WITH THE COMPONENTS OF THE EDUCATION

	VC 7	VC 8	VC 9	VC 10	VC 11	VC 12	VC 13	VC 14	VC 15	VC 16	VC 17	VC 18	VC 19	VC 20	VC 21
GC 1					+	+	+				+	+			
GC 2															
GC 3															
GC 4															
GC 5							+						+	+	
GC 6					+	+	+				+	+	+	+	+
GC 7		+	+		+	+					+	+	+	+	+
GC 8					+	+									
GC 9					+	+							+	+	+
GC 10						+	+								
GC 11						+	+								
GC 12						+	+								
GC 13															
GC 14															
PC 1	+	+	+		+						+	+	+	+	+
PC 2															
PC 3								+	+						
PC 4															
PC 5				+			+						+	+	
PC 6				+		+		+	+		+	+			
PC 7			+	+			+	+	+				+		+
PC 8					+	+									+
PC 9					+		+					+	+		
PC 10	+				+			+			+	+	+	+	
PC 11	+				+	+	+	+			+	+	+	+	+
PC 12						+		+	+	+	+	+			
PC 13			+			+		+			+	+	+	+	
PC 14						+		+			+	+	+	+	

6. MATRIX OF PROVIDING SOFTWARE LEARNING OUTCOMES WI
COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 1	GC 2	GC3	GC 4	GC 5	GC 6	GC 7	GC8	GC 9	GC 10	GC 11	GC 12	GC 13	GC 14	GC 15	VC 1	
O1											+	+	+				
O2											+	+					
O3													+				
O4																	
O5														+	+	+	
O6																+	
O7																+	
O8											+				+		
O9															+		
O10																+	
O11						+		+	+	+							
O12				+	+									+	+		
O13		+	+		+		+										
O14	+																
O15																	
O16											+		+				
O17																+	
O18															+		
O19																	

CONTINUATION OF THE MATRIX OF PROVIDING SOFTWARE OUTCOMES WITH RELEVANT COMPONENTS OF THE EDUCATION

	VC 7	VC 8	VC 9	VC 10	VC 11	VC 12	VC 13	VC 14	VC 15	VC 16	VC 17	VC 18	VC 19	VC 20	VC 21
O1				+		+	+		+	+			+	+	
O2	+	+	+	+			+		+	+	+	+			
O3				+		+		+	+	+	+	+			
O4	+	+	+		+	+		+			+	+	+	+	+
O5							+						+	+	
O6	+				+								+	+	
O7					+		+						+	+	+
O8				+			+						+	+	
O9					+		+								+
O10					+			+					+	+	+
O11													+	+	
O12							+								
O13								+							
O14															
O15															
O16				+											
O17				+									+	+	
O18							+						+	+	+
O19						+		+					+	+	