

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

APPROVED

Academic Council

Igor Sikorsky Kyiv Polytechnic Institute

(record # 5, June 06, 2020)

Head of Academic Council

\_\_\_\_\_ Mykhailo ILCHENKO

**EDUCATIONAL AND PROFESSIONAL PROGRAM  
«Electronic micro- and nanosystems and technologies»**

**The first (Bachelor) level of higher education**

**Specialty: 153 Micro- and nanosystems and technologies**

**Knowledge field: 15 Automation and instrument engineering**

**Qualification: Bachelor in Electronic micro- and nanosystems and technologies**

Put into effect  
by the Rector's Order  
1/231, July 08, 2020

Kyiv – 2020

## Preamble

Developed by the workgroup:

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Approved by:

Chairman of the scientific and methodological subcommittee on the speciality  
«Micro- and nanosystems and technologies»

Subcommittee head \_\_\_\_\_ Volodymyr TYMOFEYEV  
(record #3, June 10, 2020)

University methodological council

Council head \_\_\_\_\_ Yuriy YAKIMENKO  
(record #10, June 18, 2020)

1. PROFILE OF THE EDUCATIONAL PROGRAM,  
specialty: 153 Micro- and nanosystems and technologies

1 – General information	
Full name of University, Institute/Faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Faculty of Electronics
Level of higher education and qualification in original language	Bachelor Qualification: Bachelor in Electronic micro- and nanosystems and technologies
Educational program official title	Electronic micro- and nanosystems and technologies
Diploma type and program length	Bachelor diploma, 240 credits ECTS, study duration – 3 y 10 m (4 study years)
Accreditation	Specialty accreditation certificate HД 1192559, valid through July 01, 2023
High education level	Ukraine national qualification matrix – 7 level QF-EHEA – first cycle EQF-LLL – 6 level
Prerequisites	High-school education
Language(s) of study	Ukrainian/English
Term of the educational program	Till next accreditation
Education program permanent URL	<a href="http://ee.kpi.ua/edu/opp_bach_en.pdf">http://ee.kpi.ua/edu/opp_bach_en.pdf</a> .
2 – Purpose of the education program	
<p>Training of specialists in micro- and nanosystem technology and micro- and nanoelectronics, able to solve complex problems in the field of professional and research-innovative activities, as well as to solve complex specialized tasks of pedagogical and scientific-innovative activities, involving interaction with representatives of academic and scientific and technical communities in the context of comprehensive professional, intellectual, social and creative development of the individual in the educational and scientific environment, the formation of high adaptability of higher education in the transformation of the labour market through interaction with employers and other stakeholders.</p>	
3 – Education program characteristic	
Knowledge area	<p>Specialists in micro- and nanosystem technology <i>study and operate with:</i> micro- and nanosystems physical processes and phenomena; properties of micro- and nanoelectronics materials, technological processes, principles of electronic components operation, standard schemes of functional devices; materials and technologies for electronic devices manufacturing, micro- and nanosystem technology of various purposes, including physical, solar and biomedical; computer technology and specialized software, methods, information technologies and technical means for calculating parameters, characteristics and modelling of micro- and nanosystem technology products, methods, information technologies for determining and forecasting the state of biological objects by micro- and nanoelectronic systems.</p>

	<p><i>The theoretical content</i> of the subject area includes concepts and principles of materials science fundamentals, solid state physics, solid state electronics, biophysics, theory of electronic circuits, physical foundations of micro- and nanosystem technology, biomedical electronic systems, signal theory, probability theory and mathematical statistics, computation information, mathematical modelling and optimization, algorithm theory, programming and information technology.</p> <p><i>The purpose of training</i> is to acquire competencies sufficient for professional activities in the field of materials and technologies, solving specialized complex practical and technological problems of development, design, production, installation, operation, maintenance, repair and modernization of electronic devices for physical and biomedical purposes, micro - and nanosystem technology and solar energy, characterized by complexity and uncertainty of conditions.</p> <p><i>The graduate learns</i> to use methods and technologies of design and application in professional activities of devices, devices and systems of micro- and nanosystem technology of various, including biomedical purposes, to apply computer equipment and measuring equipment.</p> <p>The program includes courses for choice in the following areas:</p> <ul style="list-style-type: none"> <li>• Electronic biomedical systems and technologies;</li> <li>• Information technologies in electronic and nanosystems design.</li> </ul>
Education program target	Emphasis on the design, development and programming using information technology of modern electronic micro- and nanodevices and systems, including biomedical, development, design and manufacturing of electronic devices and systems for physical and biomedical purposes, micro- and nanosystem technology, as well as their operation, maintenance and modernization.
Education program primary focus	<p>The educational program is aimed at the formation of applicants' competencies, acquisition of theoretical and practical knowledge, skills and abilities necessary for the application of information technology design in the process of solving practical and technological problems of development, production, operation and modernization of electronic devices and systems, micro- and nanosystem technology, electronic biomedical systems.</p> <p>Keywords:</p> <p>Design information technologies in electronics, micro- and nanoelectronic devices and components, low-dimensional structures, microelectronic information systems, electronic biomedical systems and technologies</p>
Education program special features	<p>The program is based on the requirements of the European Qualifications Framework for Lifelong Learning <i>EQF-LLL</i>.</p> <p>To implement international mobility with a double university degree under bilateral agreements, the educational program is agreed with partner universities.</p>

<b>4 – Employment and further education</b>	
Employment options	<p>Graduates may work for state and privately owned businesses, matching following International Standard Classification of Occupations 2008 groups:</p> <p>311 Physical and Engineering Science Technicians</p> <p>3211 Medical Imaging and therapeutic equipment technicians</p> <p>3252 Medical Records and health information technicians</p> <p>3114 Electronics Engineering Technicians</p>
Further education	<p>The bachelor in micro- and nanosystem engineering has the opportunity to continue education on master's programs in micro- and nanosystem engineering, electronics, interdisciplinary programs close to electronics (automation, instrumentation, telecommunications, radio engineering, master's programs in biomedical engineering and computer science and others). Acquisition of additional qualifications in the system of postgraduate education.</p>
<b>5 – Teaching and assessment</b>	
Teaching and studying	<p>Lectures, practical and seminar classes, computer workshops and laboratory works; course projects and works; technology of blended learning, practice; execution of diploma project and diploma work. Independent work with the possibility of consultation with the teacher, individual lessons, the use of information and communication technologies (e-learning, online lectures, OCW, distance learning courses) for individual educational components.</p>
Assessment	<p>Rating system, assessment, oral and written exams, knowledge testing, current control, practice reports, defence of the diploma project (works).</p>
<b>6 – Program competencies</b>	
Integral competence	<p>Ability to solve specialized problems and practical problems characterized by the complexity and uncertainty of conditions during professional activities in the field of micro- and nanosystem technology, including electronic systems for biomedical purposes, or in the learning process involving theories and methods of micro- and nanoelectronics , automation, information technology design.</p>
<b>General Competencies (GC)</b>	
GC1	<p>Knowledge and understanding of the subject area and understanding of professional activity.</p>
GC2	<p>Ability to apply professional knowledge and skills in practice.</p>
GC3	<p>Ability to use in professional activities basic knowledge in the field of natural, social sciences, humanities and economics.</p>
GC4	<p>Skills of using information and communication technologies.</p>
GC5	<p>Ability to solve complex specialized problems and practical problems in the field of micro- and nanosystem technology.</p>
GC6	<p>Ability to learn, acquire new knowledge, skills, solve problems in professional activities on the basis of analysis and synthesis.</p>
GC7	<p>Ability to work with information: to find, evaluate and use information from various sources, necessary for solving scientific and professional problems, to acquire new knowledge, skills, to solve problems in professional activity on the basis of analysis and synthesis.</p>

GC8	Interpersonal communication skills.
GC9	Ability to communicate in the state language both orally and in writing.
GC10	Foreign language proficiency.
GC11	Ability to work in a team using interpersonal skills.
GC12	Ability to carry out safe professional practical activities.
GC13	Ability to evaluate and ensure the quality of work performed.
GC14	Definiteness and perseverance in terms of tasks and responsibilities.
GC15	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 and civil rights and freedoms in Ukraine.
GC16	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.
<b>Professional competencies (PC)</b>	
PC1	Ability to use knowledge and understanding of scientific facts, concepts, theories and technologies required for the design and application of micro- and nanosystem technology.
PC2	Ability to apply and integrate knowledge of fundamental sections of physics and chemistry to understand the processes of solid-state and optical electronics and nanoelectronics, devices and devices of micro- and nanosystem technology.
PC3	Ability to perform analysis of the subject area and regulatory documentation required for the design and application of micro- and nanosystem technology, to demonstrate and use knowledge and understanding of physical and mathematical principles and methods.
PC4	Ability to use modern information technology and computer software, skills in working with computer networks, databases and Internet resources to solve engineering problems in the field of automation and instrumentation and specialty micro- and nanosystem technology.
PC5	Ability to identify, classify, evaluate and describe processes in micro- and nanosystem technology by constructing and analysing their physical and mathematical models.
PC6	Ability to demonstrate creative and innovative potential in the analysis and synthesis of engineering solutions and in the development of structural elements of microelectronics, devices and systems for physical and biomedical purposes.
PC7	Ability to provide engineering solutions in the field of automation and instrumentation, taking into account all aspects of development, design, manufacture, operation and modernization of micro- and nanosystem electronic equipment, including electronic systems for biomedical purposes.
PC8	Ability to demonstrate and use knowledge of the characteristics and parameters of materials of electronic equipment, analog and digital electronic devices, microprocessor systems and nanosystem technology.

PC9	Ability to solve engineering problems in the field of micro- and nanosystem technology, taking into account all aspects of development, design, production, operation and modernization.
PC10	Ability to demonstrate and apply in practice knowledge of industry standards and quality standards for micro- and nanosystem electronic equipment.
PC11	Ability to understand and apply technological principles of production, testing, operation and repair of micro- and nanosystem technology and biomedical equipment.
PC12	Ability to understand and take into account social, environmental, ethical, economic and commercial considerations that affect the efficiency and results of engineering activities in the field of automation and instrumentation.
<b>Professional Competencies of Variable Blocks</b>	
PC13	Ability to use knowledge of electrophysical processes occurring in solid-state devices, and theoretical foundations of microelectronic devices and systems, electronic biomedical systems, methods of signal processing and analysis, development and analysis of mathematical models for the design and construction of these devices and systems.
PC14	Ability to design a microelectronic device, micro- and nanoelectronic system, including electronic systems for biomedical purposes, according to a given electronic circuit, technological, economic and other indicators.
PC15	Ability to participate in the production, testing, installation and maintenance of devices and systems of micro- and nanoelectronics, including electronic systems for biomedical purposes.
<b>7 – Program Learning Outcome</b>	
PLO1	Apply knowledge of the principles of operation of devices and systems of micro- and nanosystem technology in their design and operation.
PLO2	Apply knowledge and understanding of mathematical methods to solve theoretical and applied problems of micro- and nanosystem technology.
PLO3	Apply knowledge and understanding of physics, relevant theories, models and methods for solving practical problems of synthesis of micro- and nanosystem technology devices.
PLO4	Evaluate the characteristics and parameters of materials of devices of micro- and nanosystem technology, know and understand the basics of solid-state and optical electronics, nanoelectronics, electrical engineering, analog and digital circuitry, microprocessor technology.
PLO5	Use information and communication technologies, applied and specialized software to solve problems of design and commissioning of biomedical equipment, solar energy, physical and biomedical electronics devices.
PLO6	Apply the skills of planning and conducting an experiment to test hypotheses and study the phenomena of micro- and nanoelectronics, be able to use standard equipment, make device diagrams, analyze, model and critically evaluate the results.
PLO7	Investigate the characteristics and parameters of micro- and nanosystem technology, devices and systems of physical and biomedical electronics,

	taking into account the objectives of the study, the requirements and specifics of the selected technical means.
PLO8	Build and identify mathematical models of technological objects, use them in the development of new micro- and nanosystem technology and the selection of optimal solutions.
PLO9	Design devices of micro- and nanosystem technology in accordance with customer requirements and available resource constraints.
PLO10	To develop technical means for diagnosing the technical condition of micro- and nanosystem technology, devices and systems of physical and biomedical electronics.
PLO11	Organize and conduct scheduled and unscheduled maintenance, adjustment of technological equipment in accordance with current production requirements.
PLO12	Analyze the legal framework for the introduction of micro- and nanosystem technology; evaluate the benefits of engineering, their environmental friendliness and safety.
PLO13	Fluently communicate orally and in writing in state and foreign languages on professional issues in compliance with the norms of modern Ukrainian business and professional language.
PLO14	Be able to learn new knowledge, advanced technologies and innovations, find new non-standard solutions and means of their implementation.
PLO15	Apply understanding of signal theory and stochastic process theory, methods of statistical processing and data analysis in solving professional problems.
PLO16	Use information technology and computer-aided design systems to develop and solve design problems for analog and digital micro- and nanoschemes and electronic systems.
PLO17	Use information technology and computer-aided design systems to develop and solve problems of designing analog and digital micro- and nanoschemes of biomedical electronics and biosystems.
<b>8 – Program resources</b>	
Staff	Implementation of the program is ensured by assigning highly qualified personnel with scientific degrees and academic titles, including teachers from foreign partner universities who have extensive experience in teaching and research work and meet the qualifications in accordance with the specialty and these staffing requirements.
Material resources	Meet requirements of high education activities accreditation by national law. Certified lab for design VLSI ICs, supported by Cadence Design Systems and Tower Semiconductors.
<b>9 – Academic mobility</b>	
National credit mobility	Possible, subject to corresponding agreements between Igor Sikorsky Kyiv Polytechnic Institute and Ukrainian universities
International credit mobility	Education program develops background suitable for international mobility (Erasmus+ K2), dual-diploma in Technical University of Dresden, Korean Institute of Science and Technology, KU Leuven, University of Lorraine, Granada University, Osaka University.

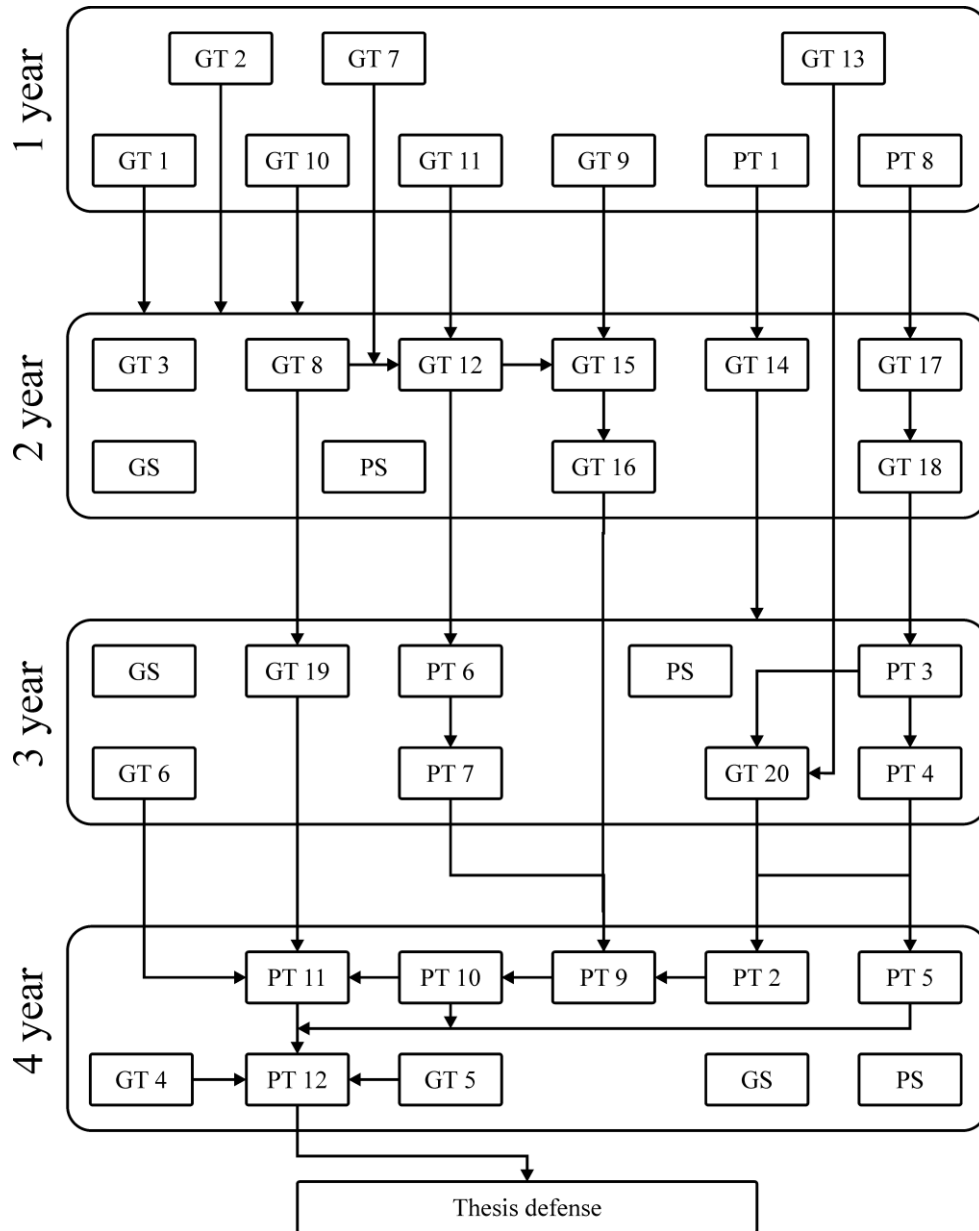


Study of foreign students	Possibility to teach in English, subject to corresponding agreements between Igor Sikorsky Kyiv Polytechnic Institute and foreign universities.
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## 2. Education program contents

Code	Education program components	ECTS credits	Assessment
<b>COMPULSORY EDUCATIONAL COMPONENTS</b>			
<b>General training</b>			
GT1	Ukrainian language for professional purposes	2	Final Test
GT2	History of science and technology	2	Final Test
GT3	Sports	5	Final Test
GT4	Foreign Language	6	Final Test
GT5	Economics and organization of production	4	Final Test
GT6	Labour safety and civil defence	4	Final Test
GT7	Analytical geometry	4,5	Exam
GT8	Higher Mathematics	17,5	Exam
GT9	Physics	11,5	Exam
GT10	Engineering and computer graphics	6	Exam
GT11	Computer Science	7,5	Final Test
GT12	Numerical methods	5	Exam
GT13	Chemistry	3	Final Test
GT14	Probabilities theory foundations and data analysis	5,5	Final Test
GT15	Theory of electronic circuits	11	Exam
GT16	Course work on the theory of electronic circuits	1	Final Test
GT17	Quantum mechanics	6	Exam
GT18	Solid state physics	6	Exam
GT19	Field theory	5,5	Exam
GT20	Technological fundamentals of electronics	4	Final Test
<b>Professional training</b>			
PT1	Introduction to measurement techniques	3,5	Final Test
PT2	Functional electronics	4,5	Exam
PT3	Solid state electronics	10,5	Exam
PT4	Course work on solid-state electronics	1	Final Test
PT5	Optoelectronics	5	Final Test
PT6	Signal theory	4	Final Test
PT7	Course work on signal theory	1	Final Test
PT8	Materials and components of micro- and nanosystem technology	3	Final Test
PT9	Circuit engineering	12,5	Exam
PT10	Course project on circuit engineering	1,5	Final Test
PT11	Pre-diploma practice	6	Final Test
PT12	Bachelor thesis preparation	6	
<b>Educational components of student choice</b>			
<b>General training</b>			
GS	6 components from university-wide catalogue	14	Final Test, Exam
<b>Professional training</b>			
PS	Professional disciplines for student choice	50,5	Final Test, Exam
Compulsory credits subtotal:		175,5	
Selectable credits subtotal:		64,5	
<b>Total credits:</b>		<b>240</b>	

### 3. Structural diagram of education program



### 4. Final assessment

Graduation certification is conducted in the form of defence of the qualification work. Graduates who pass certification receive standard document on the award of Bachelor of Micro- and Nanosystems Engineering degree according to “Electronic Micro- and Nanosystems and Technologies” educational program.

Qualification work is checked for plagiarism and placed in the university repository for free access.

Graduation certification is open and public.

## 5. Program competences versus program component matrix

[illegible]

6. МАТРИЦЯ ЗАБЕЗПЕЧЕННЯ ПРОГРАМНИХ РЕЗУЛЬТАТІВ НАВЧАННЯ ВІДПОВІДНИМИ КОМПОНЕНТАМИ ОСВІТНЬОЇ ПРОГРАМИ

	GT1	GT2	GT3	GT4	GT5	GT6	GT7	GT8	GT9	GT10	GT11	GT12	GT13	GT14	GT15	GT16	GT17	GT18	GT19	GT20	PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9	PT10	PT11	PT12	
PLO1															+													+	+	+	+	+	
PLO2							+	+	+		+	+	+																				
PLO3									+				+				+	+	+	+									+	+	+	+	
PLO4																	+	+	+			+	+		+	+		+	+			+	
PLO5											+			+																		+	+
PLO6														+	+						+											+	
PLO7											+	+		+		+					+	+	+								+		
PLO8							+	+			+	+		+						+			+										
PLO9										+						+				+		+	+	+	+				+	+	+	+	
PLO10																+				+		+	+	+		+	+		+	+	+	+	
PLO11									+					+						+												+	
PLO12		+			+	+																										+	
PLO13	+			+																													
PLO14																																+	+
PLO15											+	+		+																			
PLO16										+	+	+		+												+	+				+	+	
PLO17										+	+	+		+												+	+				+	+	