MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

APPROVED BY

Rector of NTU "KhPI"

_____ Y. Sokol

«____»_____2019

EDUCATIONALLY- PROFESSIONAL PROGRAM "ELECTRONICS"

The first (Bachelor) Level

by specialty**: 171 «Electronics»**

Knowledge field title **17 «Electronics and Telecommunications»**

Qualification**: Bachelor of Electronics**

APPROVED BY

Academic of Scientific Council

Chairman of the Scientific Council

_____

Protocol №_____ of

«____» _____2019

Kharkiv 2019

INTRODUCTION

Developed on the basis of the standard of higher education, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated November 13, 2018, No. 1246, the design team on specialty 171 "Electronics" of the educational and scientific institute of power engineering, electronics and electromechanics of the National Technical University "Kharkiv Polytechnic institute "consisting of:

1. Krivosheev Sergiy Yuryevich, candidate of technical sciences, professor, deputy head of the department of industrial and biomedical electronics;

2. Butova Olga Anatolievna, candidate of technical sciences, associate professor of the department of industrial and biomedical electronics;

3. Kulichenko Vyacheslav Viktorovich, candidate of technical sciences, associate professor of industrial and biomedical electronics.

Head of the security group from specialty 171 "Electronics":

Tomashevskyi Roman Sergeevich, _____
candidate of technical sciences,
associate professor, director of the educational-scientific institute of power engineering, electronics and electromechanics

APPROVAL PAGE

Educationally- scientific program "ELECTRONICS"

Higher education degree	**First (bachelor) Level**
Branch of knowledge	**17 Electronics and telecommunications**
Specialty	**171 Electronics**
Specialization	**171-01 Industrial Electronics,** **171-02 Biomedical Electronics**
Qualification	**Bachelor of Electronics**

APPROVED
The support group
for the specialty 171

Head of the group
_____ R.S Tomashevskyi
November 30, 2018

RECOMMENDED
Methodical Council of NTU "KhPI"
Deputy Chairman of the methodical council
_____ R.P Mygushchenko
November 30, 2018.

APPROVED AND PROVIDED

By order of the rector of the National Technical University "Kharkiv Polytechnic Institute" from "____" _____ № _____.

CONTENTS

1. Profile of the educational program by specialty 171 "Electronics"

1 - General Information	
Full name of higher educational institution and structural unit	National Technical University "Kharkiv Polytechnic Institute" Institute of Educational and Scientific of Power Engineering, Electronics and Electromechanics Department of Industrial and Biomedical Electronics
Higher education and the name of the qualification in the language of the original	Ступінь вищої освіти - бакалавр Освітня кваліфікація – бакалавр з електроніки Кваліфікація в дипломі – бакалавр з електроніки
The official name of the educational program	Educationally - professional program of the First (Bachelor) Level of "Electronics" higher education level
Type of diploma and volume of educational program	Bachelor's degree, unitary, 240 ECTS credits, 4 years
Availability of accredita-tion	- Certificate of Accreditation: Series: Sun No 2192181 dated September 6, 2017 Ministry of Education and Science of Ukraine; Validity: until July 1, 2023
Cycle / Degree	NQF of Ukraine - 7th degree FQ-EHEA is the first cycle, EQF-LLL - degree 6 (Bachelor)
Prerequisites	Complete general secondary education or secondary specialized education
Language (s) of teaching	Ukrainian
Validity of educational programsи	According to the validity period of the certificate of accreditation
Internet address of the permanent description of the educational program	http://www.kpi.kharkov.ua/ukr/ http://www.kpi.kharkov.ua/ukr/faculty/e/
2 - The purpose of the educational program	
The combination of a high level of professional training in the field of electronics and telecommunications specializing in the field of electronics and telecommunications with the formation of specialists in the scientific and technological outlook and providing a broad outlook in the social, humanitarian, fundamental (natural sciences) and professional fields. The achievement of the stated goal is based on the principles of continuity and individualization of learning, the fundamental and integral provision of knowledge, practical orientation and awareness of the place of the received competencies, symbiosis of scientific and systemic approaches, etc.	

3 - Characteristics of the educational program	
Subject area (branch of knowledge, specialty, specialization (if any**))**	Knowledge field title: 17 «Electronics and Telecommunications» Specialty title: 171 "Electronics" Specializations: Block 01 "Industrial Electronics" Block 02 "Biomedical Electronics"
Orientation of the educational program	Educational and professional program with the focus on the formation of the broadest possible scientific and technical outlook of the future specialist. The program is balanced with regard to the social and humanitarian, fundamental and professional components of training and contains a sufficient sample component of specialization training.
The main focus of the educational program and specialization	Special education in the field of electronics and telecommunications on the specialty "Electronics" under the program "Electronics". Key words: analogue and digital circuit engineering, power electronics devices; software electronics; microcontroller devices; systems and devices for transformation, protection, processing, transmission of information and regulatory systems.
Features of the program	The educational and professional bachelor's degree program is designed for higher education graduates who seek to become specialists in the fields of engineering and scientific activity of electronics and telecommunications. The program is balanced in terms of the social and humanitarian, fundamental and professional components of training, and contains sufficient selective components of specialization training. It provides an opportunity to get basic knowledge of social and humanitarian, fundamental and natural sciences disciplines, general education disciplines and specialist training in the field of electronics and telecommunications.
4 - The purpose of the educational program	
Suitability for employment	Employment at enterprises and companies in electronics and telecommunications, electrical, electrical and electromechanical industries, as well as in branch scientific, design and design organizations and institutions. Professional opportunities of graduates (according to the Classifier of professions SK 003: 2010). The main area of employment corresponds to the codes from 2143 to 2144, 311 and 313 of the current edition of the National Classifier of Ukraine.
Further training	Possibility of continuing education at the next (master's) level of higher education (degree 8 of the NQF, the second cycle of FQ-EHEA and degree 7 of the EQF-LLL) by the corresponding educational-professional or educational-scientific programs. Possibility of postgraduate education to obtain professional qualifications in accordance with the relevant professional standards.

5 - Teaching and Assessment	
Teaching and learning	Lectures, laboratory and practical classes, scientific and practical workshops, implementation of training and real projects (project training), problem-oriented learning and in-service training, student-centered learning, dual training, distance and mixed learning, self-study and self-study, practice, preparation of qualifying work.
Assessment	Current and final control of knowledge (surveys, control and individual tasks, testing, etc.), credits and exams (oral and written), protection of educational projects with the presentation, public defense of qualification work. Rating system of assessment, oral and written examinations, testing. The evaluation system involves the use of an international system of ECTS (with grades A, B, C, D, E, F), the national system (rated "excellent", "good", "satisfactory" and "unsatisfactory"), as well as 100-point HEI systems with established conformity system.
6 - Program competencies	
Integral competence	Ability to solve complex specialized tasks and solve practical problems during professional activity in the field of electronics and telecommunications or in the process of study, which involves the application of theories and methods in electronics and telecommunications, and is characterized by complexity and uncertainty of the conditions.
General Competence (GC)	**GC 1**. Ability to apply knowledge in practical situations. **GC2.** Knowledge and understanding of the subject area and understanding of professional activity. **GC 3.** Ability to communicate in the state language both verbally and in writing. **GC 4.** Ability to communicate in a foreign language. **GC 5.** Skills of 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.** Skills of interpersonal interaction. **GC 9.** Ability to work in a team. **GC 10.** Skills for safe operation. **GC 11.** Ability to assess and ensure the quality of work performed. **GC 12.** Determination and persistence on the tasks and duties taken. **GC 13.** Ability to exercise their rights and obligations as a member of society, to realize the values of a 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 maintain and increase the moral, cultural, scientific values and achievements of society on the basis of understanding of 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, technology and technology, use different types and forms motor activity for active rest and healthy lifestyle.

Professional competence of the specialty (PC)	**PC 1**. Ability to use knowledge and understanding of scientific facts, concepts, theories, principles and methods for the design and application of devices, devices and systems of electronics. **PC 2**. Ability to carry out the analysis of the subject area and the normative documentation necessary for the design and application of devices, devices and systems of electronics. **PC 3**. Ability to integrate knowledge of the fundamental sections of physics and chemistry to understand solid-state, functional, energy and biomedical electronics, electrical engineering. **PC 4**. Ability to take into account social, environmental, ethical, economic and commercial considerations that influence the efficiency and results of engineering activities in the field of electronics. **PC 5.** Ability to apply the principles of constructing modern automated control systems for the production of electronic devices, their technical, algorithmic, information and software. **PC 6**. Ability to identify, classify, evaluate and describe processes in devices, devices and electronics systems using analytical methods, simulation tools, prototypes and experimental research results. **PC 7.** Ability to apply creative and innovative potential in the synthesis of engineering solutions and in the design of 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, devices and systems. **PC 9.** Ability to determine and evaluate the characteristics and parameters of materials electronic equipment, analog and digital electronic devices for the design of microprocessor and electronic systems. **PC 10.** The ability to apply in practice sectoral standards and standards for the quality of functioning of devices and systems of electronics. **PC 11**. The ability to control and diagnose the state of the equipment, apply modern electronic components and technical equipment, perform prevention, repair and maintenance of electronic devices and systems, mount, install and repair analogue, digital and optical modules, develop and manufacture printed circuit boards, develop software provision for microcontrollers. **PC 12.** The ability to select and apply a modern material base for the construction of electronic devices and electronic medical equipment, to create 3D models and drawings of electronic components, body designs, and products in general using CAD software packages. **PC 13.** Ability to use engineering software packages for research, analysis, processing and presentation of results, as well as for the automated design of medical devices and systems. **PC14.** Ability to apply methods and design electronic means for measuring the parameters of information signals from the human body at the cell, tissue, organ and system levels. **PC 15.** Ability to navigate in the anatomical structure of the human body, and the basic physiological processes in it, from the point of view of physics and chemistry, as well as on their basis, to be able to receive information about the state of the patient and to form the influence on human systems of factors of diverse nature with therapeutic purposes.

Professional competence of specialization (determined by the institution of higher education) (defined by the standard of higher education specialty)	**PCS 1.** Ability to apply engineering software packages support for research, analysis, processing and presentation of results, as well as for automated design of medical devices and systems. **PCS 2.** Ability to apply methods and design specialty electronic means of measuring the parameters of information signals from the human body on the cell, tissue, organ and system levels. **PCS 3.** Ability to navigate in the anatomical structure of human body, and basic physiological processes in it, from the point of view physics and chemistry, as well as on the basis of their ability to receive information about the state of the patient and shape the impact on human systems factors of diverse nature with therapeutic goals.

7 - Program learning outcomes	
Program results of training in a specialty (defined by the standard of higher education specialty)	**PRT 1.** Describe the principle of action with the help of scientific concepts, theories and methods, and verify the results when designing and applying devices, devices and systems of electronics. **PRT 2.** 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 solution of theoretical and applied electronics tasks. **PRT 3.** To find solutions to the practical problems of electronics by applying appropriate models and theories of electrodynamics, analytical mechanics, electromagnetism, statistical physics, solid state physics. **PRT 4.** Estimate the characteristics and parameters of electronics materials, to understand the basics of solid-state electronics, electrical engineering, analog and digital circuitry, transformer and microprocessor technology. **PRT 5.** Use information and communication technologies, applied and specialized software products to solve the tasks of designing and debugging electronic systems, demonstrate programming skills, analysis and display of measurement and control results. **PRT 6.** To apply experimental skills (knowledge of experimental methods and the order of conducting experiments) for testing hypotheses and research of phenomena of electronics, ability to use standard equipment, to plan, to draw up a scheme; analyze, simulate and critically evaluate the results. **PRT 7.** To analyze complex digital and analog information measuring systems with expanded architecture of computer and telecommunication networks taking into account the specification of selected electronics and related technical documentation. **PRT 8.** Identify and identify mathematical models of technological objects when developing new complex electronic systems in the computer environment and choosing the optimal solution. **PRT 9.** Design complex real-time systems and tools for collecting and processing information, agreed with specified information and software tools, using software for embedded systems based on microcontrollers. **PRT 10**. To develop technical means for constructing and diagnosing the technical condition of electronic devices and systems, to organize and carry out scheduled and unscheduled repair, adjustment and adjustment of electronic equipment in accordance with current

	production requirements **PRT 11**. To argue the legal framework when introducing electronic devices and systems; to evaluate the advantages of engineering developments, their environmental and safety; protect their own outlook and persuasion in productive or social activities. **PRT 12.** Use documentation related to professional activity, using modern technologies and office equipment; use English, including special terminology, for communicating with specialists, conducting literary search and reading texts on technical and professional subjects. **PRT 13.** To be able to master new knowledge, progressive technologies and innovations, find new non-malicious solutions and means of their implementation; meet the requirements of flexibility in overcoming obstacles and achievement of goals, rational use and standardization of time, discipline, responsibility for their decisions and activities. **PRT 14.** Adhere to the norms of modern Ukrainian business and professional language. **PRT 15.** Identify the skills of independent and collective work, leadership qualities, organize work in a limited time with the emphasis on professional integrity. **PRT 16.** Apply an understanding of the theory of stochastic processes, methods of statistical processing and data analysis in solving professional problems. **PRT 17.** Demonstrate the skills of conducting experimental research related to professional activity; improve measurement techniques; to control the authenticity of the results **PRT 18.** To apply methods of mathematical modeling and optimization of electronic systems for the development of automated and robotized production complexes.
Program results of training with specialization (defined by the institution of higher education)	**PRTS 1**. To use the obtained professional knowledge for construction of circuit-based solutions based on electrophysical processes in semiconductor devices of electronics and electronic medical technique, calculation of their static and dynamic characteristics in different operating modes. **PRTS 2.** Know the anatomical structure of the human body and the basic physiological processes occurring in it and use this knowledge to obtain information biomedical signals from the human body and to formulate the parameters of therapeutic preformed influence by physical factors (electrical and other origin). **PRTS 3.** Be able to develop software modules for the registration, processing, display and generation of signals for microcontroller systems and personal computers using modern IDE software packages. **PRTS 4.** To be able to compile and implement information input and display units in electronic devices and systems using microcontroller control systems. **PRTS 5.** Be able to develop working technical documentation, to execute design and development work with verification of conformity to standards, technical specifications and other normative documents.

8 – Resource support for the implementation of the program	
Staffing	All the scientific and pedagogical staff providing the educational-professional program in accordance with the qualification correspond to the profile and the direction of the disciplines being taught, have the necessary experience of teaching work and experience of practical

	work. In the process of organizing the learning process, professionals with experience in research / management / innovation / creative work and / or work in the specialty are involved. 100% of the teachers who provide educational activities in English have certificates in accordance with the European language education guidelines (at level B2) or qualification documents related to the use of a foreign language.
Material and technical support	Material and technical support allows you to fully provide the educational process throughout the training cycle for the educational program. The condition of the premises is certified by sanitary and technical passports, which correspond to the existing normative acts.
Information and methodological support	Information support is provided by textbooks, study aids, etc. and electronic resources (the library is provided with at least five titles of national and foreign professional periodical professional editions of the corresponding or related profile, including in electronic form). Methodical support is realized by obligatory accompaniment of educational activity with the corresponding educational and methodological materials for each educational discipline of the curriculum.
9 - Academic mobility	
National Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and the leading technical universities of Ukraine.
International Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and educational institutions of higher education of foreign partner countries.
Training foreign applicants for higher education	According to the license of NTU "KhPI" foreigners and / or stateless persons can study for the educational program. Curricula for this contingent have expanded language training in the Ukrainian language. For the teaching of academic disciplines in foreign (English), separate groups are formed for foreign citizens, stateless persons who wish to obtain higher education for the funds of individuals or legal entities, or develop individual programs. At the same time, programs of higher education establishments provide the study of such persons of the state language as a separate discipline.

2. List of components of the educational-professional program

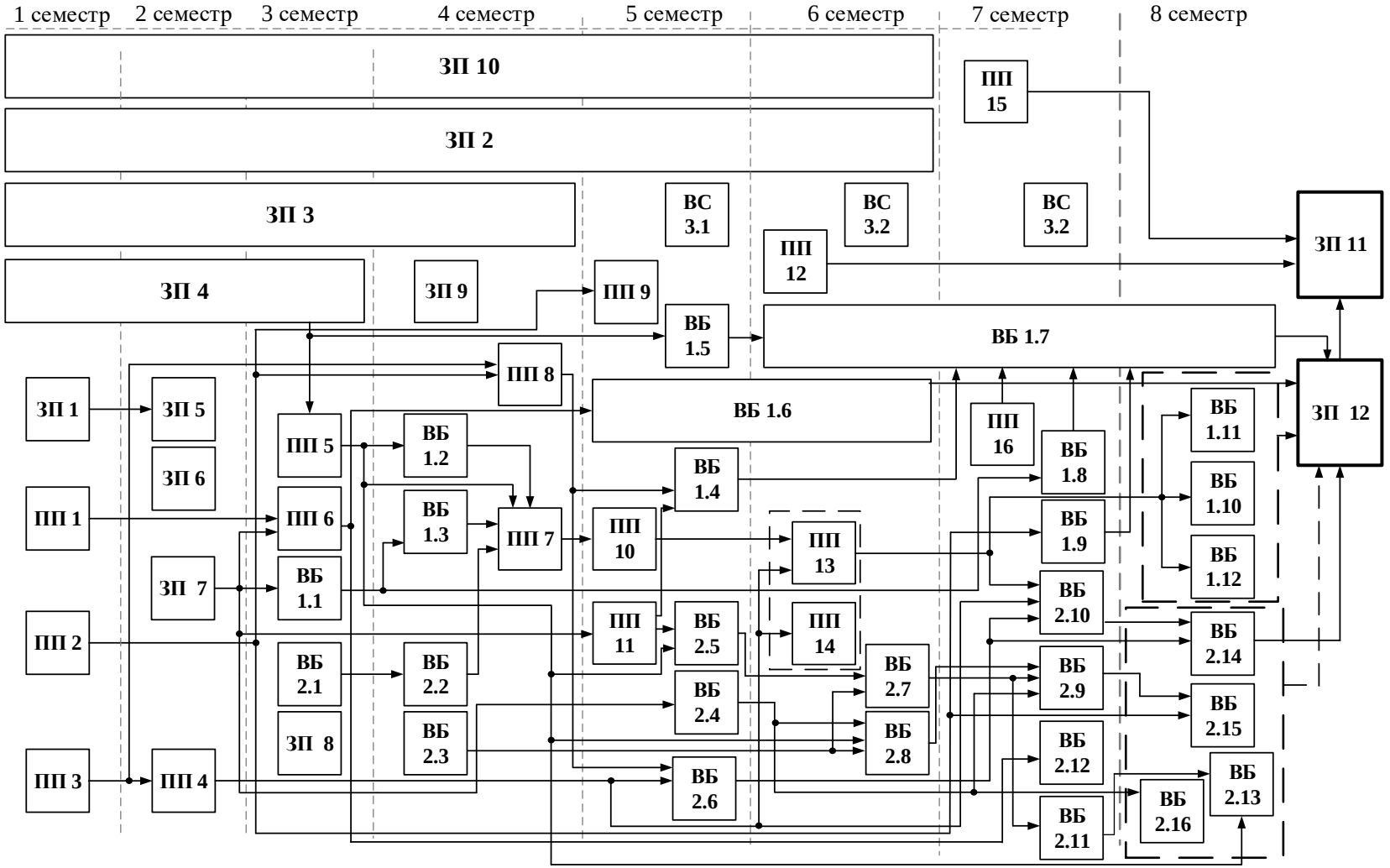
2.1. List of EP components

Key	Components of the educational program (disciplines, projects / work, practice, qualification work)	Credits ECTS	Final control forms
1	**2**	**3**	**4**
COMPULSORY COMPONENTS OF THE EDUCATIONAL PROGRAM			
General training cycle			
GT 1	History and culture of Ukraine	4	Test
GT 2	Foreign language Part. 1-6	12	Test (1-6)
GT 3	Higher mathematics Part. 1-4	19	Exam (1-4)
GT 4	Physics Part.1- 3	13	Exam (1-3)
GT 5	Ukrainian language	3	Exam
GT 6	Ecology	3	Test
GT 7	Materials science	4	Test
GT 8	Jurisprudence	3	Test
GT 9	Philosophy	3	Test
GT 10	Physical Education Part.1-6	12	Test(1-6)
Professional training in specialty			
PT 1	Descriptive geometry, engineering and computer graphics	4	Exam
PT 2	Introduction to speciality	3	Test
PT 3	Computer Science	4	Exam
PT 4	Fundamentals of programming and information technology	5	Exam
PT 5	The electric circles theory Part.1	5	Exam
PT 6	Fundamentals of designing electronic devices	6	Exam
PT 7	Analog Circuitry	6	Exam
PT 8	Computational Mathematics	5	Exam
PT 9	History of science and technology	3	Test
PT 10	Digital circuitry	5	Exam
PT 11	Sensors of electric and non-electric quantities	5	Exam
PT 12	Fundamentals of Occupational Safety and Health	3	Test
PT 13	Microprocessor techniques	6	Exam
PT 14	Systems of input and display of information	5	Exam
PT 15	Business Economics	3	Test
PT 16	Electromagnetic techniques	4	Exam
Practical training			
GT 11	Practice	6	Test
GT 12	Certification (	6	undergraduate diploma
Total volume of mandatory components:		**160**	

SELECTIVE COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (disciplines, projects / work, practice, qualification work)	ECTS credits	Final control forms
1	**2**	**3**	**4**
Block of disciplines 01 «Industrial electronics»			
OB 1.1.	Semiconductor devices	5	Exam
OB 1.2.	The electric circles theory Part.2	4	Exam
OB 1.3.	Fundamentals of electronic technology	5	Exam
OB 1.4.	Fundamentals of Metrology and Electrical Measurement	3	Test
OB 1.5.	Electric machines and apparatus	4	Exam
OB 1.6.	Computer design of electronic devices Part.1- 2	8	Exam (1-2)
OB 1.7.	Power Electronics Part.1- 4	18	Exam (1-4)
OB 1.8.	Power semiconductor devices	4	Exam
OB 1.9.	The automatic regulation theory	6	Exam
OB 1.10.	Signal converters and interfaces	3	Test
OB 1.11	Microcontrollers	4	Exam
OB 1.12	Programming of microprocessor systems	4	Test
	Total:	**68**	
Block of disciplines 02 «Biomedical electronics»			
OB 2.1.	Physical basis of electronic equipment	5	Exam
OB 2.2.	Solid-state electronics	4	Exam
OB 2.3.	Anatomy and biophysical processes	5	Exam
OB 2.4.	Electrotechnical materials and electronic components in medicine	3	Test
OB 2.5.	Fundamentals of experimental research	4	Exam
OB 2.6.	Fundamentals of software application development	4	Exam
OB 2.7.	Methods of functional diagnostics	5	Exam
OB 2.8.	Basics of nanoelectronics	5	Exam
OB 2.9.	Diagnostic devices and systems	5	Exam
OB 2.10.	Microcontroller systems	5	Exam
OB 2.11.	Physiotherapeutic methods of influence	3	Test
OB 2.12.	Automation of the design of electronic devices and systems	4	Exam
OB 2.13.	Sources of power supply of medical equipment	4	Test
OB 2.14.	Microcontroller devices for processing medical information	4	Exam
OB 2.15	Digital signal processing	4	Exam
OB 2.16	Physiotherapeutic equipment	4	Exam
	Total:	**68**	
Student optional disciplines			
OS 1	Discipline 1	4	Exam
OS 2	Discipline 2	4	Exam
OS 3	Discipline 3	4	Exam
Total volume of Required components:		**80**	
TOTAL VOLUME OF EDUCATIONAL PROGRAM		**240**	

2.2 Structural and logical scheme Education Program



ЗП-GT
ППП-PT
ВБ-OB
ВС- OS

2.3 Distribution of the content of the educational program into groups of components and training cycles

№	Training cycle	Volume of study load of the applicant of higher education (ECTS credits /%)		
		Required components of the educational and professional program	Optional components of the educational-professional program	Total for the whole period of study
1	General training	88 / 36,67	-	**88 / 36,67**
2	Professional training	72 / 30	-	**72 / 30**
3	Optional disciplines	-	80 / 33,33	**80 / 33,33**
Total for the whole period of study		**160 / 66,67**	**80 / 33,33**	**240 / 100**

3. Form of certification of applicants for higher education

Certification of graduates of the educational program of specialty 171 **"Electronics"** is carried out in the form of protection of qualification bachelor's work and ends with issuing a document of a standard sample on awarding the bachelor's degree with the qualification: "**Bachelor of Electronics**" in specialties "**Industrial Electronics**" and "**Biomedical Electronics**".

The qualification work on academic plagiarism with the use of software and hardware is underway. Disclosure of qualifying work at a depositary of a higher educational establishment or its subdivision. Public defense of the qualification work takes place at the open meeting of the examination committee.

4.Matrix of compliance of program competencies to the components of the educational program

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	GT 7	GT 8	GT 9	GT 10	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	PT 11	PT 12	PT 13	PT 14	PT 15	PT 16	GT 11	GT 12
GC 1			●	●			●				●	●			●	●				●						●	●	●
GC 2							●				●	●										●			●		●	●
GC 3	●				●													●				●			●		●	●
GC4		●											●	●									●	●			●	●
GC 5													●	●		●							●	●				●
GC 6												●							●									●
GC 7									●										●		●							●
GC 8		●			●			●	●	●												●						●
GC 9										●															●			●
GC 10																						●						●
GC 11																									●		●	●
GC 12			●					●																				●
GC 13						●			●	●																		●
GC 14	●					●		●	●	●												●					●	●
PC 1											●										●						●	●
PC2											●					●												●
PC 3				●			●								●													●
PC 4						●			●													●			●			●
PC 5												●	●	●		●		●					●	●				●

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	GT 7	GT 8	GT 9	GT 10	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	PT 11	PT 12	PT 13	PT 14	PT 15	PT 16	GT 11	GT 12
PC 6															●		●			●						●		●
PC 7																●												●
PC 8																	●			●			●	●		●	●	●
PC 9															●		●			●							●	●
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PC 15																					●	●					●	●
PCS 1																		●					●	●				●
PCS2																●	●				●		●				●	●
PCS3																					●	●					●	●

	OB 1.1.	OB 1.2.	OB 13.	OB 1.4.	OB 1.5.	OB 1.6.	OB 1.7	OB 1.8.	OB 1.9	OB 1.10.	OB 1.11.	OB 1.12.	OB 2.1.	OB 2.2.	OB 2.3.	OB 2.4.	OB 2.5.	OB 2.6.	OB 2.7	OB 2.8.	OB 2.9	OB 2.10.	OB 2.11.	OB 2.12.	OB 2.13.	OB 2.14.	OB 2.15	OB 2.16.
GC 1	●	●	●	●				●	●			●	●	●		●												
GC 2					●																							
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GC 12																												
PC 1	●		●					●					●	●												●		●
PC2																								●				
PC 3	●	●	●									●	●	●	●	●				●								
PC 4																												
PC 5						●			●		●	●						●						●	●	●		
PC 6				●	●		●										●		●				●			●		

	OB 1.1.	OB 1.2.	OB 13.	OB 1.4.	OB 1.5.	OB 1.6.	OB 1.7	OB 1.8.	OB 1.9	OB 1.10.	OB 1.11.	OB 1.12.	OB 2.1.	OB 2.2.	OB 2.3.	OB 2.4.	OB 2.5.	OB 2.6.	OB 2.7	OB 2.8.	OB 2.9	OB 2.10.	OB 2.11.	OB 2.12.	OB 2.13.	OB 2.14.	OB 2.15	OB 2.16.
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PC 8																												
PC 9			●				●	●								●												
PC 10																												
PC 11				●													●				●					●		●
PC 12						●						●												●				
PC 13									●	●	●	●						●				●					●	
PC 14															●				●	●	●					●		
PC 15															●	●			●		●		●					●
PCS 1									●	●	●	●						●				●					●	
PCS2															●				●	●	●					●		
PCS 3															●	●			●		●		●					●

5 Matrix providing program learning outcomes (PLOs) by the relevant components of the educational program

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	GT 7	GT 8	GT 9	GT 10	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	PT 11	PT 12	PT 13	PT 14	PT 15	PT 16	GT 11	GT 12
PRT 1																	●			●						●		●
PRT 2			●	●											●			●									●	●
PRT 3				●			●								●											●	●	●
PRT 4							●										●			●	●					●	●	●
PRT 5												●	●	●		●							●	●			●	●
PRT 6						●															●							●
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PRT 14	●				●			●																				●
PRT 15									●	●															●			●
PRT 16																		●									●	●
PRT 17																					●							●
PRT 18																		●									●	●

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	GT 7	GT 8	GT 9	GT 10	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	PT 11	PT 12	PT 13	PT 14	PT 15	PT 16	GT 11	GT 12
PRTS1																●							●	●		●	●	●
PRTS2																●	●				●						●	●
PRTS3														●									●	●			●	●
PRTS4																							●	●			●	●
PRTS5											●	●				●											●	●

	OB 1.1.	OB 1.2.	OB 13.	OB 1.4.	OB 1.5.	OB 1.6.	OB 1.7	OB 1.8.	OB 1.9	OB 1.10.	OB 1.11.	OB 1.12.	OB 2.1.	OB 2.2.	OB 23.	OB 2.4.	OB 2.5.	OB 2.6.	OB 2.7	OB 2.8.	OB 2.9	OB 2.10.	OB 2.11.	OB 2.12.	OB 2.13.	OB 2.14.	OB 2.15	OB 2.16.
PRT1																												
PRT2		●							●																		●	
PRT3	●	●	●		●								●	●														
PRT4	●		●					●					●	●		●				●								
PRT5									●	●	●	●						●			●	●				●	●	
PRT6				●												●	●								●			
PRT7																					●							●
PRT8									●										●				●					
PRT9										●	●	●						●				●				●		
PRT10																									●			●
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PRT12						●				●	●	●						●			●							
PRT13																												
PRT14																												
PRT15																												
PRT16																	●						●					●
PRT17					●												●											
PRT18									●	●																	●	

	OB 1.1.	OB 1.2.	OB 13.	OB 1.4.	OB 1.5.	OB 1.6.	OB 1.7	OB 1.8.	OB 1.9	OB 1.10.	OB 1.11.	OB 1.12.	OB 2.1.	OB 2.2.	OB 2.3.	OB 2.4.	OB 2.5.	OB 2.6.	OB 2.7	OB 2.8.	OB 2.9	OB 2.10.	OB 2.11.	OB 2.12.	OB 2.13.	OB 2.14.	OB 2.15	OB 2.16.
PRTS	●	●	●				●	●					●	●														
PRTS2															●				●	●	●		●					●
PRTS3										●	●	●										●		●		●	●	
PRTS4										●	●													●				
PRTS5	●	●	●			●	●						●	●														