

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

APPROVED

by the University Academic Council
Igor Sikorsky Kyiv Polytechnic Institute
(2023, January 23, protocol No. 1)
Head of Academic Council
Mykhailo ILCHENKO

MEDICAL ENGINEERING

EDUCATIONAL AND PROFESSIONAL PROGRAM

The second (master's) level of higher education

Specialty: 163 Biomedical Engineering
Field of knowledge: 16 Chemical engineering and bioengineering
Qualification: Master of Biomedical Engineering

Becomes effective by the Decree of Rector
of Igor Sikorsky Kyiv Polytechnic Institute
as of date 2023, May 17, No. HOH/165/2023

Kyiv – 2023

PREAMBLE

DEVELOPED by the project team:

Head of the project group:

Andriy SOLOMIN, Ph.D. (Physics and Mathematics), Associate Professor, Associate Professor of Biomedical Engineering Department.

Members of the project team:

Vitaliy MAKSYMENKO, D.Sc. (Medicine), Full Prof., Professor of Biomedical Engineering Department.

Vladyslav SHLYKOV, D.Sc. (Engineering), Associate professor, Head of the Biomedical Engineering Department.

Larisa TARASOVA, Ph.D. (Engineering), Associate Professor, Associate Professor of Biomedical Engineering Department.

Oleksandr STYCHYNSKYI, D.Sc. (Medicine), Head of the Department of Electrophysiology and X-ray Surgical Methods of Treatment of Arrhythmias of the Amosov National Institute of Cardiovascular Surgery of National Academy of Medical Sciences of Ukraine.

Svitlana VOVYANKO, Ph.D. (Engineering), Associate Professor, Associate Professor of Biomedical Engineering Department.

Oleksandr POLISHCHUK, graduate student of Biomedical Engineering Department.

Head of Biomedical Engineering Department.

Vladyslav SHLYKOV, D.Sc. (Engineering), Associate professor

AGREED:

The Scientific and Methodical Board of Igor Sikorsky Kyiv Polytechnic Institute in specialty 163 Biomedical Engineering (protocol No 1/23 from January 10, 2023)
Head of the Scientific and Methodical Board of Speciality Vitaliy MAKSYMENKO

The Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute (2023, January 19, protocol No. 4)
Head of the Methodological Council Yurii YAKYMENKO

CONSIDERED:

1. Remarks and proposals, outlined in the educational and professional program of the second (master's) level of higher education, which was approved by the University Academic Council Igor Sikorsky Kyiv Polytechnic Institute (protocol No.10 of 2021, December 13) and put into effect by the Decree of Rector of Igor Sikorsky Kyiv Polytechnic Institute, as of date 2022, February 15, No. HOH/75/2022, posted on the website
https://bmi.fbmi.kpi.ua/wp-content/uploads/2022/10/163_OPPM_MI_21.06.2022.pdf
2. Resolution of the Cabinet of Ministers of Ukraine No.1392 dated 16.12.2022 "On making changes to the list of fields of knowledge and specialties for which higher education applicants are trained".

The educational and professional program was discussed at the meeting of Scientific and Methodical Board.

The current edition of the educational and professional program "Medical Engineering" of the second (master's) level of higher education was discussed and approved by the scientific and pedagogical staff of Biomedical Engineering Department at the meeting of Biomedical Engineering Department (protocol No.7, dated 28.12.2022).

CONTENT

1. Profile of the educational program.....	5
2. List of components of the educational program.....	11
3. Structural and logical scheme of the educational program	12
4. Form of attestation of higher education applicants	13
5. Matrix of correspondence of program competences to the components of the educational program.....	14
6. Matrix of provision of program learning outcomes by relevant components of the educational program.....	15

1. PROFILE OF THE EDUCATIONAL PROGRAM

in specialty 163 Biomedical Engineering

1 - General information	
Full name of higher education institution and institute/faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Faculty of Biomedical Engineering
The degree of higher education and the title of the qualification in the original language	Master degree (магістр) Qualification - master in biomedical engineering (магістр з біомедичної інженерії)
The official name of the educational program	Medical engineering
Type of diploma and scope of the educational program	Master's degree. The amount of the educational component is 90 ECTS credits, the training period is 1 year, 4 months.
Availability of accreditation	National Agency for Quality Assurance of Higher Education. Accreditation certificate - No. 2673 The validity period of the certificate is 01.07.2027 Re-accreditation is expected in 2026.
Cycle / HE level	National qualification framework of Ukraine – level 7; QF-EHEA (Qualification Framework of the European Higher Education Area) – second cycle; EQF-LLL (European Qualifications Framework for Lifelong Learning) – Level 7.
Prerequisites	Having a bachelor's degree
Teaching languages	Ukrainian, English
The term of validity of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	1. Biomedical Engineering Department of Igor Sikorsky Kyiv Polytechnic Institute http://bmi.fbmi.kpi.ua/department/educational-programs 2. The educational process at Igor Sikorsky Kyiv Polytechnic Institute https://osvita.kpi.ua/op
2 - The purpose of the educational program	
<p>The purpose of the educational program is to train qualified, competitive, integrated into the European and global scientific and educational space specialists with a master's degree in the field of chemical engineering and bioengineering with a specialty 163 Biomedical engineering, capable of independent research, scientific-organizational, pedagogical-organizational and practical activity in the field of biomedical engineering and technologies, which involves the implementation of intercultural interaction with representatives of the academic and scientific and technical communities in the conditions of:</p> <ul style="list-style-type: none"> – scientific and technical progress in the field of chemical engineering and bioengineering; – sustainable development of society and economic and ecological interests of society; – internationalization of education and integration of the international component into the educational and research activities of higher educational institutions; – transformation of the labor market through interaction with stakeholders; – comprehensive professional, intellectual, social and creative development of the individual in an educational and scientific environment; – combination of engineering-technical and medical-biological knowledge regarding means and methods of creation, improvement and research of natural and artificial biological objects, materials and products for medical purposes, technologies and technical systems of diagnosis and treatment, information technologies in biology and medicine. 	

3 – Characteristics of the educational program	
Subject area	<p>Fields of knowledge - 16 Chemical engineering and bioengineering. Specialty - 163 Biomedical Engineering.</p> <p>Object of activity: means and methods of engineering and exact sciences for solving problems of biology and medicine: development, production, testing, operation of medical equipment, biomaterials, bioengineering systems and processes, medical and biological products; processing of biomedical information; technical and informational support medical technologies and systems, improvement of health, duration and quality of life.</p> <p>Learning goals: training of specialists capable of solving complex tasks and problems in the field of biomedical engineering or in the learning process, which involves conducting research and/or implementing innovations and is characterized by the uncertainty of conditions and requirements.</p> <p>Theoretical content of the subject area: fundamental and applied bases of analysis, modeling, design, development, production, testing, operation and examination, technical and information support of medical equipment, medical products and biomaterials, bioengineering systems and processes, processing and interpretation of biomedical information.</p> <p>Methods, techniques and technologies: engineering and design methods, biotechnical and medical-technical technologies, modeling, software and information technologies for processing and analyzing data in biology, medicine and medical instrumentation.</p> <p>Tools and equipment: biological and medical equipment, biomedical products and materials for medical purposes, artificial organs, computer equipment, means and systems of design, construction, modeling in biology and medicine.</p>
Orientation of the educational program	Educational and professional
The main focus of the educational program	<p>Technologies of medical physics and medical image processing, medical microprocessor systems used in medical engineering and medical instrumentation.</p> <p>Obtaining a special education in the specialty 163 Biomedical Engineering and acquiring the necessary professional competences for further professional activity based on innovative ideas and results of modern scientific research.</p> <p>Keywords: biomedical engineering, biological and medical technology, biomaterials for medical purposes, biomedical products, artificial organs and systems, diagnostic and therapeutic equipment.</p>

Features of the program	<p>The master's training program is focused on researching in the field of medical engineering. In context of the subject area, an in-depth study of medical image processing methods and technical means based on medical microprocessor systems is expected.</p> <p>The high level of the educational and scientific part of training is provided by the scientific school of biomedical engineering named after M.M.Amosov, the availability of scientific and educational laboratories, agreements on cooperation with leading clinical, medical and research institutions of the Ministry of Health and the National Academy of Sciences of Ukraine.</p> <p>The educational and professional program was brought into line with European educational programs within the framework of the international European program "TEMPUS" in 2013-2016.</p>
4 – Suitability of graduates for employment and further education	
Suitability for employment	<p>Employment under ДК 003:2010:</p> <p>2149.1 – Junior researcher (bioengineering);</p> <p>2149.2 – Biomedical engineer;</p> <p>2149.2 – Debugging and testing engineer;</p> <p>2149.2 – Engineer for implementation of new equipment and technology;</p> <p>2149.2 – Research engineer;</p> <p>2149.2 – Design engineer;</p> <p>2149.2 – Standardization and quality engineer, laboratory engineer, technological engineer;</p> <p>2310.2 – Trainee teacher;</p> <p>2310.2 – Assistant;</p> <p>2419.3 – State expert;</p> <p>2321 – Teacher of institution professional (professional-technical) education</p>
Further education	<p>Graduates can continue their studies at the third educational and scientific level of higher education. They have the right to acquire additional qualifications in the postgraduate education system.</p>

5 – Teaching and assessment	
Teaching and learning	<p>The general learning style is creatively oriented, aimed at developing the skills of generating new ideas and independently obtaining in-depth knowledge.</p> <p>The educational process is carried out on the basis of acmeological, axiological, system, competence, personally oriented and innovative and informative approach, mixed and distance learning technology.</p> <p>A creative learning style is used, stimulating creativity in cognitive activity and initiative, learning through clinical practice.</p> <p>Teaching methods: communicative, problem-searching, research, explanatory-demonstration, partial-search, method of educational projects and startups.</p> <p>Are carried out: lecture courses, seminars and practical classes (active and interactive business games, presentations, discussions, projects), computer workshops and laboratory work, course projects and works, consultations, supervision in clinical institutions, independent training in library funds, use of Internet resources, work on a qualifying master's thesis.</p> <p>Close scientific guidance and consulting of the department's leading specialists is ensured. It is expected to write scientific articles that are presented and discussed at university, all-Ukrainian and international scientific and practical conferences.</p>
Assessment	<p>Current written and oral forms of knowledge control. Current study attestations are carried out according to the student's individual study plan (twice a year). Implementation of research results in the educational process of the department. Publication of the results of one's own research in specialized scientific publications (at least one in a specialized publication determined by the Ministry of Education and Science of Ukraine). Attestation is carried out on the basis of the public defense of master's thesis according to the approved procedure.</p>
6 – Software competencies	
Integral competence	<p>The ability to solve complex tasks and problems in biomedical engineering or in the learning process, which involves researching and/or implementing innovations and is characterized by uncertainty of conditions and requirements.</p>
General competences (GC)	
GC 1	Ability to abstract thinking, analysis and synthesis.
GC 2	Ability to search, process and analyze information from various sources.
GC 3	Ability to identify, define and solve problems.
GC 4	Ability to work in a team.
GC 5	Ability to work in an international context.
Professional competences (PC)	
PC 1	Ability to solve complex problems of biomedical engineering using methods of mathematics, natural and engineering sciences.
PC 2	The ability to develop a working hypothesis, plan and set up experiments to test the hypothesis and achieve the engineering goal with the help of appropriate technologies, technical means and tools.

PC 3	The ability to analyze complex medical engineering and bioengineering problems and carry out their formalization to find quantitative solutions using modern mathematical methods and information technologies.
PC 4	The ability to create and improve the means, methods and technologies of biomedical engineering for the research and development of bioengineering objects and systems for medical and technical purposes.
PC 5	The ability to develop technical tasks for creation, as well as to model, evaluate, design and construct complex bioengineering and medical engineering systems and technologies.
PC 6	The ability to investigate biological and technical aspects of functioning and interaction of artificial biological and biotechnical systems.
PC 7	Ability to work in a multidisciplinary team.
PC 8	The ability to develop models and carry out experiments aimed at solving problems related to human health according to the specific needs of scientific research, analyze, explain the results and evaluate the value of research.
PC 9	Ability to create tools and methodologies of scientific activity, evaluate and implement the results of modern developments, solutions and achievements of engineering and exact sciences in medicine and biology.
PC 10	Ability to design and practical use of microcomputer and microprocessor systems in medical and diagnostic information and measurement technology.
PC 11	The ability to develop, plan and apply mathematical methods in the analysis and modeling of functioning of living organisms, systems and processes in biology and medicine.
PC 12	The ability to carry out research and observations on interaction of biological, natural and artificial systems (prostheses, artificial organs, etc.), to plan biotechnical tests of artificial prostheses and systems.
7 – Program learning outcomes (PLO)	
PLO 1	Be able to analyze, develop and apply technologies and equipment for the study of physiological and pathological human processes, modern diagnostic equipment and biomedical information display systems, appropriate software, justify adequate theoretical models
PLO 2	Application of calculation methods of and selection of classical and modern designs of biomaterials, elements of devices and medical systems.
PLO 3	Application of computer network design methods and tools.
PLO 4	Mastery of the design methods of digital microprocessor and biotechnical systems for medical use.
PLO 5	Mastery of methods research, design and construction of biomedical equipment objects, analysis and processing of experimental data.
PLO 6	Knowledge of general requirements for the performing of engineering, technological and scientific projects.
PLO 7	Knowledge of development principles and modern problems of creating biocompatible materials in medical practice.
PLO 8	To analyze and take into account in the professional activity the trends of scientific and technical development of the field of biomedical engineering and at the junction of various branches. Understand and apply the principles of innovative activity, in particular in the context of research work, have adaptation skills in situations related to work in the specialty
PLO 9	Understanding ethical, environmental and commercial constraints in engineering practice
PLO 10	Proficiency in a foreign language sufficient for general and professional communication

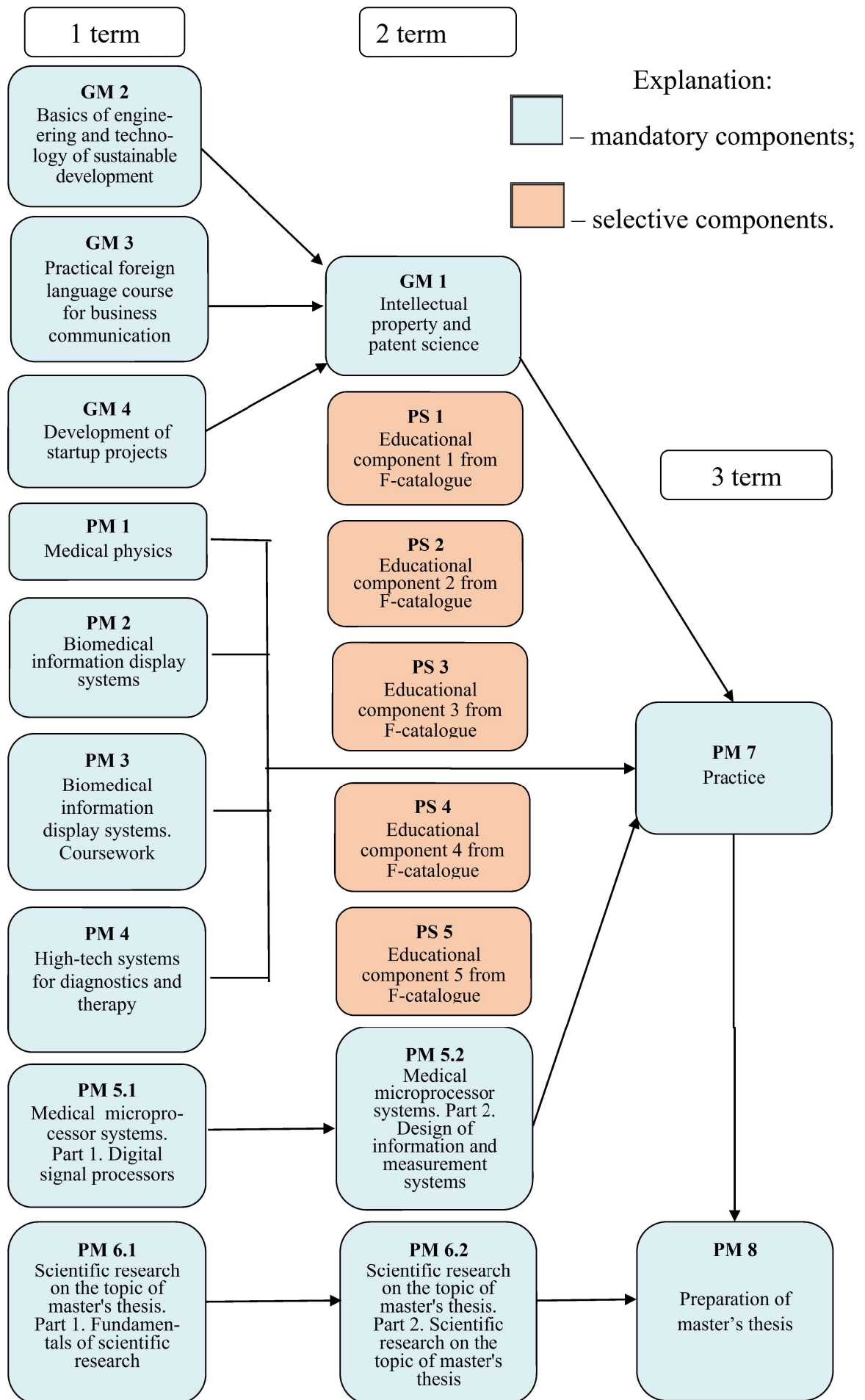
PLO 11	Proficiency in the basic provisions of the concept of sustainable development, the principles of building a safe existence of mankind, taking into account economic, social and ecological aspects.
PLO 12	To design, construct, improve and apply medical and technical and bioengineering products, devices, and systems in compliance with technical requirements, as well as to accompany their operation
PLO 13	Analyze and solve complex medical engineering and bioengineering problems using mathematical methods and information technologies
PLO 14	Create and improve means, methods and technologies of biomedical engineering for comprehensive research and development of bioengineering objects and systems for medical and technical purposes
PLO 15	Develop, plan, implement and justify innovative projects of bioengineering objects and systems for medical and technical purposes, taking into account engineering, medical, legal, economic, ecological and social aspects, provide their informational and methodical support
PLO 16	Assess the biological and technical aspects and consequences of the interaction of engineering and bioengineering objects with biological systems, predict their mutual influence, legal, deontological and moral and ethical consequences of use
PLO 17	Solve biomedical engineering tasks in practical activities with an awareness of one's own ethical and social responsibility in personal activity and/or in a team
PLO 18	Present the results of research and development in national and foreign languages in the form of applications for inventions, scientific publications, reports at scientific and technical events
PLO 19	Providing methodological and practical assistance during the implementation of projects and programs, plans and contracts.
8 – Resource support for program implementation	
Staff support	In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 in the current version
Material and technical support	In accordance with the technological requirements for material and technical support of educational activities of the corresponding level of HE, approved by Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 (in force) in version by No. 347 dated 23.05.2018.
Informational, educational and methodological support	In accordance with the technological requirements for educational, methodological and informational support of educational activities of the corresponding level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 (current) in version by No. 347 dated 23.05.2018. Use by the Scientific and Technical Library of Igor Sikorsky Kyiv Polytechnic Institute.
9 – Academic mobility	
National credit mobility	The possibility of academic mobility based on bilateral agreements between the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" and other higher education institutions of Ukraine.

International credit mobility	On the basis of bilateral agreements between the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute" and educational institutions of partner countries, agreements on international academic mobility (Erasmus+ K1) concluded with leading universities in Europe and the world: http://bmi.fbmi.kpi.ua/internationally/academic-mobility
Education of foreign students of higher education	In English or Ukrainian language

LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

E/D code	Components of the educational program (disciplines, course projects/coursework, practices, qualification work)	Number of credits	Final control form
1	2	3	4
Mandatory (normative) components of EP			
General training cycle			
GM 1	Intellectual property and patent science	3	test
GM 2	Basics of engineering and technology of sustainable development	2	test
GM 3	Practical foreign language course for business communication. Ukrainian as a foreign language	3	test
GM 4	Development of startup projects	3	test
Cycle of professional training			
PM 1	Medical physics	6	exam
PM 2	Biomedical information display systems	5	exam
PM 3	Biomedical information display systems. Coursework.	1	test
PM 4	High-tech systems for diagnostics and therapy	5	exam
PM 5.1	Medical microprocessor systems. Part 1. Digital signal processors	4.5	test
PM 5.2	Medical microprocessor systems. Part 2. Design of information and measurement systems	4.5	test
PM 6.1	Scientific research on the topic of master's thesis. Part 1. Fundamentals of scientific research	2	test
PM 6.2	Scientific research on the topic of master's thesis. Part 2. Scientific research on the topic of master's thesis	2	test
PM 7	Practice	14	test
PM 8	Preparation of master's thesis	12	defence
Selective components of EP			
PS 1	Educational component 1 from F-catalogue	4	test
PS 2	Educational component 2 from F-catalogue	4	test
PS 3	Educational component 3 from F-catalogue	5	exam
PS 4	Educational component 4 from F-catalogue	5	exam
PS 5	Educational component 5 from F-catalogue	5	exam
The total amount of normative educational components :			67
The total amount of selective educational components :			23
The amount of educational components that support the acquisition of competencies defined by the SHE:			53
TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM			90

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF ATTESTATION OF HIGHER EDUCATION APPLICANTS

Attestation of higher education applicants of a master's degree in the educational and professional program "Medical engineering" in specialty 163 Biomedical engineering is carried out in the form of a defense of the qualification work and ends with the issuance of a document of the established model on awarding him a master's degree with the qualification: master in biomedical engineering in the educational-professional program "Medical Engineering".

The candidate's qualifying work must not contain academic plagiarism, falsification, or fabrication.

The qualification work of the applicant is posted on the website of the higher education institution (Igor Sikorsky Kyiv Polytechnic Institute), as well as in the repository of STL of Igor Sikorsky Kyiv Polytechnic Institute for free access.

Attestation of applicants is carried out openly and publicly.

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

	GM 1	GM 2	GM 3	GM 4	PM 1	PM 2	PM 3	PM 4	PM 5	PM 6	PM 7	PM 8
GC 1	+	+		+	+	+	+	+	+	+	+	+
GC 2	+	+	+		+	+	+	+	+	+	+	+
GC 3	+	+	+	+	+	+	+	+	+	+	+	+
GC 4			+	+	+	+	+				+	
GC 5	+	+	+	+	+	+	+	+	+	+	+	+
PC 1	+	+			+	+	+	+	+	+	+	+
PC 2					+	+	+	+		+	+	+
PC 3					+	+	+			+	+	+
PC 4									+	+	+	+
PC 5	+	+			+	+	+		+	+	+	+
PC 6	+				+	+	+		+	+	+	+
PC 7				+		+	+			+	+	
PC 8					+				+			
PC 9								+	+		+	+
PC 10								+				+
PC 11					+	+	+					
PC 12					+	+	+				+	+

6. MATRIX OF PROVISION OF PROGRAM LEARNING OUTCOMES BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GM 1	GM 2	GM 3	GM 4	PM 1	PM 2	PM 3	PM 4	PM 5	PM 6	PM 7	PM 8
PLO 1	+		+	+	+	+	+	+	+	+	+	+
PLO 2	+			+	+	+	+	+	+	+	+	+
PLO 3	+			+		+	+		+			
PLO 4						+	+		+		+	+
PLO 5					+	+	+				+	+
PLO 6					+	+	+		+	+	+	+
PLO 7					+	+	+				+	+
PLO 8	+		+	+		+	+			+	+	+
PLO 9	+									+		+
PLO 10	+		+		+	+	+	+	+	+	+	+
PLO 11		+									+	
PLO 12				+					+	+	+	+
PLO 13				+					+	+	+	+
PLO 14				+						+	+	+
PLO 15				+						+	+	+
PLO 16				+				+		+		
PLO 17			+	+				+			+	+
PLO 18	+		+	+		+	+			+	+	+
PLO 19	+		+	+								