МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ УКРАЇНИ
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені Ігоря Сікорського»

ЗАТВЕРДЖЕНО
Вченою радою КПІ ім. Ігоря Сікорського
(протокол № 3 від «15» 03 2021 р.)
Голова Вченої ради
_____ Михайло ІЛЬЧЕНКО

М.П.

МЕДИЧНА ІНЖЕНЕРІЯ
MEDICAL ENGINEERING

ОСВІТНЬО-ПРОФЕСІЙНА ПРОГРАМА
другого (магістерського) рівня вищої освіти

за спеціальністю **163 Біомедична інженерія**

галузі знань **16 Хімічна та біоінженерія**

кваліфікація **магістр з біомедичної інженерії**

Введено в дію Наказом ректора
КПІ ім. Ігоря Сікорського
(наказ №1ОН/89/2021 від «19» 04 2021 р.)

Київ – 2021 р.

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

APPROVED
Academic Council of Igor Sikorsky Kyiv Polytechnic Institute
(protocol № ___ from «___» _____ 2021)
Chairman of the Academic Council
_____ Mykhailo ILCHENKO

P.S.

MEDICAL ENGINEERING

EDUCATIONAL PROFESSIONAL PROGRAM
second (master's) level of higher education

in specialty 163 Biomedical Engineering

fields of knowledge 16 Chemical and bioengineering

to qualify for a master's degree in biomedical engineering

Put into effect by the Rector's Order of
Igor Sikorsky Kyiv Polytechnic Institute
(order № НОН/89/2021 from « 19 » 04 2021)

Kyiv - 2021

PREAMBLE

DEVELOPED by the project team:

Project team leader:

Alkhimova Svitlana, PhD, Associate Professor of the Department of Biomedical Cybernetics

Project team members:

Maksymenko Vitaliy, Doctor of Medical Sciences, Professor, Dean of the Faculty of Biomedical Engineering

Shlykov Vladislav, Doctor of Technical Sciences, As. Professor, Acting Head of the Department of Biomedical Engineering

Tarasova Larysa, PhD, Associate Professor, Associate Professor of the Department of Biomedical Engineering

Delaware-Kasmai Mohammad, PhD, Senior Lecturer, Department of Biomedical Engineering

Vovyanko Svitlana, PhD, Associate Professor of the Department of Biomedical Engineering

Acting Head of the Department of Biomedical Engineering

Shlykov Vladislav, Doctor of Technical Sciences, Associate Professor

AGREED:

Scientific and methodical commission of Igor Sikorsky Kyiv Polytechnic Institute on specialty 163 Biomedical Engineering
Chairman of the commission _____ Vitaliy MAKSYMENKO
(protocol № 2 from " 19 " 02 2021)

Methodical council of
Igor Sikorsky Kyiv Polytechnic Institute
Chairman of the Methodical Council _____ Yuriy YAKYMENKO
(protocol № 6 from " 25 " 02 2021)

TAKEN INTO ACCOUNT:

Marynsky GS, Doctor of Technical Sciences, Senior Research Fellow, Head of the Department of Welding and Related Technologies in Medicine and Ecology of the Eugene Paton Institute of Electric Welding of the National Academy of Sciences of Ukraine;

Oshivalova O., MD, Associate Professor, Deputy Chief Physician for organizational and methodological work and quality of medical care of the State Scientific Institution "Scientific and Practical Center for Preventive and Clinical Medicine";

Korovin SI, Doctor of Medicine, Professor, Deputy Director for Research of the National Cancer Institute of the Ministry of Health of Ukraine;

Stychynsky OS, doctor of medical sciences, senior researcher, head of the department of electrophysiology and X-ray surgical methods of arrhythmias treatment of the National M.Amosov Institute of Cardiovascular Surgery affiliated to National Academy of Medical Sciences of Ukraine.

Based on the results of monitoring the educational program, the project group took into account proposals of stakeholders (employers), research and teaching staff, higher education seekers and developed an updated version of the educational program of the second (master's) level of higher education .

Features of the educational program "Medical Engineering" are specified, which take into account the focus on biological and engineering features of biomedical and clinical engineering, as well as approaches to the organization of engineering and production activities based on the concept of sustainable development.

The project team reviewed the balance of EP, the appointment of credits, the ability of students to master the disciplines (educational components), the completeness of logistical, informational, personnel and other support of EP and the compliance of the educational program with the Licensing Conditions.

The project team took into account:

1. Possibilities of forming an individual educational trajectory, incl. through the individual choice of academic disciplines in the amount provided by the legislation of Ukraine on higher education;
2. Ensuring compliance with the Standard in Higher Education in the specialty 163 Biomedical Engineering for the second (master's) level of higher education, which is posted on the website of the Ministry of Education and Science of Ukraine: https://mon.gov.ua/storage/app/media/vishcha-osvita/zatverdzeni%20standarty/2019/04/25/163-biomedichna-inzheneriya-magistr.pdf
3. Comments and suggestions of employers and stakeholders based on the results of the public discussion:
   – scientific and pedagogical staff of the Department of Biomedical Engineering;
   – applicants for higher education who study in educational programs in the specialty 163 Biomedical Engineering;
   – employers and other external stakeholders

http://bmi.fbmi.kpi.ua/department/educational-programs/

OP was discussed and changed after receiving all the wishes and suggestions from employers and applicants for higher education of Igor Sikorsky Kyiv Polytechnic Institute, approved by the SMCU 163 Biomedical Engineering and approved at a meeting of the Department of Biomedical Engineering (protocol № 9 from "07" 02 2021).

Feedback reviews of stakeholders are attached.

CONTENT

1. PROFILE OF THE EDUCATIONAL PROGRAM

in specialty 163 Biomedical Engineering

1 - General information	
Full name of HEI and institute / faculty	National Technical University of Ukraine "Igor Sikorsky Kiev Polytechnic Institute", Faculty of Biomedical Engineering
Higher education degree and title of qualification in the original language	Degree – master Qualification – Master of Biomedical Engineering
The official name of the educational program	Medical engineering
Type of diploma and amount of educational program	Master's degree. The amount of the educational component is 90 ECTS credits, training period 1 year, 4 months.
Availability of accreditation	Ministry of Education and Science of Ukraine State Accreditation Commission Certificate of accreditation in the specialty 163 Biomedical Engineering (Series УД, №11001142). The certificate is valid until July 1, 2022. Re-accreditation is expected in 2022.
Prerequisites	Having a bachelor's degree
Language (s) of instruction	Ukrainian / English
Term of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	1. Department of Biomedical Engineering of Igor Sikorsky Kyiv Polytechnic Institute http://bmi.fbmi.kpi.ua/department/educational-programs 2. The educational process in Igor Sikorsky Kyiv Polytechnic Institute https://osvita.kpi.ua/op
2 - The purpose of the educational program	
The purpose of the educational program is to train qualified, competitive, integrated into the European and world scientific and educational space specialists with a master's degree in the field of Chemical and Bioengineering, specialty 163 Biomedical Engineering, capable of independent research, scientific-organizational, pedagogical-organizational and practical activities in the field of biomedical engineering and technology, which involves the implementation of intercultural interaction with representatives of the academic, scientific and technical communities in the following conditions: – scientific and technological progress in the field of Chemical and Bioengineering; – sustainable development of society and economic and environmental interests of society; – internationalization of education and integration of the international component into educational, research activities of higher educational institutions; – labor market transformation through interaction with stakeholders; – comprehensive professional, intellectual, social and creative development of the individual in the educational and scientific environment; – combination of engineering and biomedical knowledge about the means and methods of creating, improving and study of natural and artificial biological objects, materials and medical products, technologies and technical systems for diagnosis and treatment, information technologies in biology and medicine.	

3 - Characteristics of the educational program	
Subject area (field of knowledge, specialty)	Field of knowledge - 16 Chemical and bioengineering. Specialty - 163 Biomedical Engineering . **Object of activity:** the means and methods of engineering and natural sciences to solve problems of biology and medicine: the development, production, testing, operation, maintenance, repair and inspection of medical equipment, biomaterials, bioengineering systems and processes, medical and biological products; processing of biomedical information, technical and information support of medical technologies and systems, improving health, duration and quality of life. **Learning objectives**: training of specialists capable of solving complex tasks and problems in the field of biomedical engineering or in the learning process, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements. **Theoretical content of the subject area:** fundamental and applied bases of analysis, modeling, design, development, production, testing, operation and examination, technical information support of medical equipment, medical devices and biomaterials, bioengineering systems and processes, processing and interpretation of biomedical information. **Methods, techniques and technologies:** engineering and design methods, biotechnical and medical-technical technologies, modeling, software and information technologies for data processing and analysis of biology, medicine and medical instrumentation. **Tools and equipment:** biological and medical equipment, biomedical products and materials for medical purposes, artificial organs, computers, tools and systems of automated design, construction, modeling in biology and medicine.
Orientation of the educational program	Educational professional
The main focus of the educational program	Medical physics and medical image processing technologies, medical microprocessor systems used in medical engineering and medical instrumentation. Acquisition of special education in the specialty 163 Biomedical Engineering and acquisition of the necessary professional competencies for further professional activity that is based on innovative ideas and results of modern scientific research. Key words: biomedical engineering, biological and medical equipment, biomaterials for medical purposes, biomedical products, artificial organs and systems, diagnostic and therapeutic equipment.
Features of the program	The master's program focuses on research in the field of medical engineering. In the context of the subject area it is provided in-depth study of methods of processing medical images and technical means based on medical microprocessor systems. The high level of educational and scientific part of the training is provided by the scientific school of biomedical engineering named after M.M. Amosov, by the presence of research and training laboratories, cooperation agreements with leading clinical, medical and research institutions of the Ministry of Health and the National Academy of Medical Sciences of Ukraine. The educational professional program was brought in line with the European educational programs within the framework of the international European program "TEMPUS" in 2013-2016.

4 - Suitability of graduates for employment and further study	
Suitability for employment	Employment under ДК 003:2010:: 2149.1 - Junior researcher (bioengineering); 2149.2 - Biomedical research engineer; 2149.2 - Biomedical engineer; 2149.2 - Debugging and testing engineer; 2149.2 - Engineer for the implementation of new equipment and technology; 2149.2 - Research Engineer; 2149.2 - Design engineer; 2149.2 - Research engineer, standardization and quality engineer, laboratory engineer, technological engineer, labor protection engineer; 2310.2 - Teacher of a higher educational institution; 2310.2 - Assistant; 2419.3 - State expert; 2320 - Teacher of vocational school
Further study	Graduates can continue their studies at the third educational scientific level of higher education. They have the right to receive additional qualifications in the system of postgraduate education.
5 - Teaching and assessment	
Teaching and learning	The general style of learning is creatively oriented, aimed at developing the skills of generating new ideas and gaining in-depth knowledge. The educational process is carried out on the basis of acmeological, axiological, systemic, competence, personality-oriented and innovation-informative approach, technology of blended and distance learning. A creative learning style is used, stimulating creativity in cognitive activity and initiative, learning through clinical practice. Teaching methods: communicative, problem-searching, research, explanatory-demonstration, partial-search, method of educational projects and startups. Implemented: 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 dissertation. Close scientific guidance and consulting of leading specialists of the department is provided. It is planned to write scientific articles, which are presented and discussed at university, national and international scientific-practical conferences.
Assessment	Current written and oral forms of knowledge control. Current attestations of study are carried out according to the individual study plan of the student (2 times a year). Introduction of research results into the educational process of the department. Publication of the results of own research in professional scientific publications (not less than one in a professional publication determined by the Ministry of Education and Science of Ukraine). Certification is carried out on the basis of public defense of the master's dissertation according to the approved procedure.

6 - Program competencies	
Integral competence	Ability to solve complex tasks and problems in biomedical engineering or in the learning process, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.
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, formulate and solve problems.
GC 4	Ability to work in a team.
GC 5	Ability to work in an international context.
Professional competencies (PC)	
PC 1	Ability to solve complex problems of biomedical engineering using the methods of mathematics, natural and engineering sciences.
PC 2	Ability to develop a working hypothesis, plan and set experiments to test the hypothesis and achieve the engineering goal using appropriate technologies, technical means and tools.
PC 3	Ability to analyze complex medical engineering and bioengineering problems and formalize them to find quantitative solutions using modern mathematical methods and information technology.
PC 4	Ability to create and improve tools, methods and technologies of biomedical engineering for research and development of bioengineering facilities and systems for medical and technical purposes.
PC 5	Ability to develop terms of reference for creation, as well as to model, evaluate, design and construct complex bioengineering and medical engineering systems and technologies.
PC 6	Ability to study 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	Ability to develop models and perform experiments aimed at solving problems related to human health, according to the specific needs of scientific research, to analyze, explain the results and evaluate the cost of research.
PC 9	Ability to create tools and methodologies of scientific activity, evaluation and implementation of 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 measuring equipment.
PC 11	Ability to develop, plan and apply mathematical methods in the analysis, modeling of the functioning of living organisms, systems and processes in biology and medicine.
FC 12	Ability to perform research and observations on the 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	Understanding of fundamental-applied, medical-physical and bioengineering bases of technologies and equipment for research of physiological and pathological processes of the person.
PLO 2	Understanding the principles of action of modern diagnostic equipment and display systems of biomedical information, the basis of appropriate software.
PLO 3	Possession of modern methods of scientific research software, construction of adequate theoretical models and methods of their substantiation.
PLO 4	Application of calculation methods and selection of classical and new designs of biomaterials, elements of devices and systems of medical appointment.
PLO 5	Application of methods and tools for designing computer network.
PLO 6	Possession of methods of designing digital microprocessor and biotechnical systems for medical purposes.
PLO 7	Possession methods research, design and construction of objects of biomedical engineering, analysis and processing of experimental data.
PLO 8	Knowledge of general requirements for the conditions of engineering, technological and scientific projects.
PLO 9	Knowledge of the principles of development and modern problems of creating biocompatible materials in medical practice.
PLO 10	Knowledge in the most advanced fields of education and professional activity and at the junction of different fields.
PLO 11	Understanding the latest achieving in Biomedical Engineering.
PLO 12	Understanding of ethical, environmental and commercial constraints in engineering practice.
PLO 13	Knowledge of a foreign language to an extent sufficient for general and professional communication.
PLO 14	Possession of the basic provisions of the concept of sustainable development, the principles of building a secure existence of mankind, taking into account economic, social and environmental aspects.
PLO 15	Understanding of specialized conceptual principles acquired in the process of learning and/or professional activity at the level of the latest achievements, which are the basis for original thinking and innovation, in particular in the context of research work.
PLO 1 6	Knowledge of methods of design, construction, improvement and application of medical-technical and bioengineering products, devices and systems in compliance with technical requirements, as well as to support their operation.
PLO 17	Analysis and solution of complex medical-engineering and bioengineering problems with the use of mathematical methods and information technologies.
PLO 18	Creation and improvement of means, methods and technologies of biomedical engineering for comprehensive research and development of bioengineering objects and systems of medical and technical purpose.
PLO 19	Development, planning, use and substantiation of innovative projects of bioengineering facilities and systems for medical-technical purposes, taking into account engineering, medical, legal, economic, environmental and social aspects, the implementation of their information and methodological support.
PLO 20	Evaluation of biological and technical aspects and consequences of interaction of engineering and bioengineering objects with biological systems, anticipation of their mutual influence, legal, deontological and moral and ethical consequences of use.
PLO 21	Solving in practice the tasks of biomedical engineering with awareness of their own ethical and social responsibility in personal activities and / or in a team.

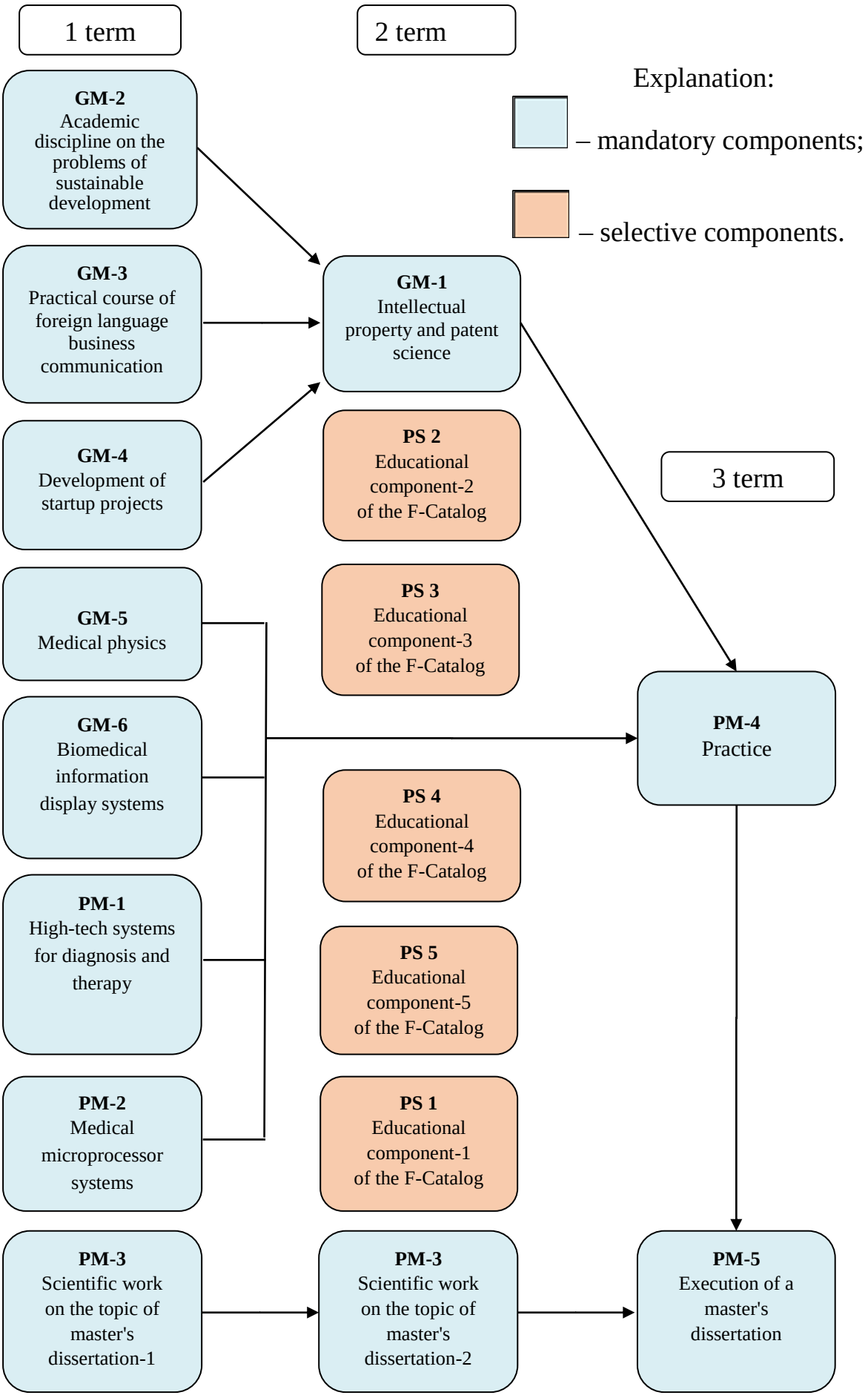
PLO 22	Presentation of research and development results in the state and foreign languages in the form of applications for inventions, scientific publications, reports at scientific and technical events.
PLO 23	Providing methodological and practical assistance in the implementation of projects and programs, plans and agreements.
PLO 24	Mastery of adaptation skills and action in situations related to work in the specialty, the ability to generate new ideas in the field of biomedical engineering.
PLO 25	Implementation of achievements of domestic and foreign science and technology, use of creative initiative, rationalization, invention and best practices that ensure the effective operation of the medical enterprise.

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 HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 (current) in the wording dated 23.05.2018 № 347.
Logistics	In accordance with the technological requirements for material and technical support of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 (current) in the wording dated 23.05.2018 № 347.
Information and educational methodical support	In accordance with the technological requirements for educational methodological and informational support of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 (current) as amended on 23.05.2018 № 347. Use of Scientific and Technical Library of Igor Sikorsky Kyiv Polytechnic Institute
9 - Academic mobility	
National credit mobility	Possibility of academic mobility on the basis of bilateral agreements between the Igor Sikorsky Kyiv Polytechnic Institute and other institutions of higher education in Ukraine.
International credit mobility	Based on bilateral agreements between the Igor Sikorsky 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
Training of foreign applicants for higher education	Possibility of teaching in Ukrainian in general training groups or in English with the provision of learning Ukrainian as a foreign language.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code a/d	Components of the educational program (academic disciplines, course projects / course works, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
Mandatory (regulatory) components of the EP			
General training			
GM 1	Intellectual property and patent science	3	test
GM 2	Fundamentals of engineering and sustainable development technologies	2	test
GM 3	Practical course of foreign language business communication	3	test
GM 4	Development of startup projects	3	test
GM 5	Medical physics	6	exam
GM 6	Biomedical information display systems	6	exam, CW
Professional training			
PM 1	High-tech systems for diagnosis and therapy	5	exam
PM 2	Medical microprocessor systems	9	test
Research (scientific) component			
PM 3	Scientific work on the topic of master's dissertation	4	test
PM 4	Practice	14	test
PM 5	Execution of a master's dissertation	12	defense
Selective components of EP			
PS 1	Educational component-1 of the F-Catalog	4	test
PS 2	Educational component-2 of the F-Catalog	4	test
PS 3	Educational component-3 of the F-Catalog	5	exam
PS 4	Educational component – 4 of the F-Catalog	5	exam
PS 5	Educational component – 5 of the F-Catalog	5	exam
The total amount of **mandatory components** :		67	
The total amount of **selective components** :		23	
The amount of educational components, **that ensure 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 FINAL CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Graduation certification of applicants for higher education in the educational-professional program "Medical Engineering" in specialty 163 – Biomedical Engineering is performed in the form of defense of a master's dissertation and ends with the issuance of a standard document on awarding a master's degree with a master's qualification in biomedical engineering according to the educational-professional program "Medical Engineering".

The final qualifying work of the applicant should not contain academic plagiarism, falsification, fabrication.

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

Graduation certification is carried out openly and publicly.

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

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

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

	GM1	GM 2	GM 3	GM 4	GM 5	GM 6	PM 1	PM 2	PM 3	PM 4	PM 5
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 1 6				+				+	+	+	+
PRN 1 7				+				+	+	+	+
PRN 1 8				+					+	+	+
PLO 1 9				+					+	+	+
PLO 20				+			+		+		
PRN 21			+	+			+			+	+
PLO 22	+		+	+		+			+	+	+
PLO 23	+		+	+							
PLO 24	+		+	+		+				+	+
PLO 25	+		+	+		+				+	+