

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
«IGOR SIKORSKY KYIV POLYTECHNICAL INSTITUTE»**

APPROVED BY

Dean of the FBME Faculty

_____ V.B. Maksymenko
(signature) (initials, last name)

« ____ » _____ 2020.

Stamp

**PROGRAM OF PROFESSIONAL EDUCATION
Medical Engineering
of the first (bachelor) level of high education**

Specialization 163 Biomedical Engineering
Knowledge branch 16 Chemical and Bioengineering
Qualification Bachelor in Biomedical Engineering

Approved by the Science Committee of the University
as of « ____ » _____ 2020, protocol № ____

KPI of Igor Sikorsky
Kyiv-2020

FOREWORD

Developed by the working group:

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Prof. Vitaliy Maksymenko, Doctor of Medical Science, Dean
Faculty of Biomedical Engineering _____

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Prof. Vladislav Shlykov, Doctor of Technical Science,
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Head of the Science-Methodological Sub-committee on Specialization
Prof. Vitaliy Maksymenko, Doctor of Medical Science, Dean
Faculty of Biomedical Engineering _____

The Educational Program has been approved by the Methodological Committee of the
University
(protocol № ____ as of « ____ » _____ 2020)

Head of the Methodological Committee
_____ Y.I. Yakimenko

Scientific Secretary of the Methodological Committee
_____ V.P. Golovenkin

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1. PROFILE OF THE EDUCATIONAL PROGRAM

On Specialization 163 *Biomedical Engineering*

1 – General Information	
Full title of the High Education Institution (HEI) and faculty name	National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnical Institute», Faculty of Biomedical Engineering
High Education level and Qualification title	Level – Bachelor’s Qualification – Bachelor in Biomedical Engineering
NRK Level	NRK Ukraine – level 7
Official title of the educational program	Biomedical Engineering
Diploma type and the volume of educational program	Bachelor’s Diploma, single, 240 credits, study term 3 years and 10 months
Accreditations	Ministry of Education and Science of Ukraine State Accreditation Commission Accreditation Certificate (HД, №1192633) on Speciality 163 Biomedical Engineering Expiration date of the Certificate – till 1 of July 2021
Prerequisites	Completed secondary education level or Diploma of EQL (OKP) «Junior Specialist» / «Junior Bachelor»
Study Languages	Ukrainian/English
Program validity term	Until the next Accreditation
Internet address of the permanent location of the educational program	http://bmi.fbmi.kpi.ua/department/educational-programs
2 – The Goal of the Educational Program	
Preparation of professionals capable of solving complex theoretical problems and practical issues in biomedical engineering field or in a learning process that involves application of certain theories and methods of chemical, biological and medical engineering.	
3 – Characteristics of the Educational Program	
Subject area	Knowledge Branch – 16 Chemical and Bioengineering Qualification – Bachelor in Biomedical Engineering
	Objects of study or/and activity: issues of development, production, testing, operation, service, repair and certification of medical equipment and biomedical products; processing of biomedical information; technical and informational support of medical technologies and systems.

	<p>Learning objectives: acquisition of competencies in the field of development, construction, production, operation, repair, maintenance, testing and certification of biological and biomedical devices and systems, assessment of compliance with technical regulations, standards of biosecurity and biosafety of biological and medical equipment, biomedical products and biomaterials as well as related software and information technology.</p> <p>Theoretical content of the subject area: clinical engineering, medical engineering, microelectromechanical biotechnical systems, medical radiology, medical biotechnology, biomechanics, medical robotics, biomedical informatics; receiving, processing, interpreting biological signals and images of biological objects.</p> <p>Methods, methodologies and technologies: engineering-design methods, biotechnical and medical technologies, modeling, software in medical instrumentation and information technologies for data processing and analysis in biology and medicine.</p> <p>Instruments and equipment: biological and medical equipment, biomedical and medical supplies, artificial organs, computer software and hardware.</p>
Direction of the Educational Program	Professional and educational
Main focus of the Educational Program	Special education on Specialization 163 Biomedical Engineering Keywords: biomedical engineering, biological and medical equipment, biomaterials for medical purposes, biomedical products, artificial organs and systems, diagnostic and therapeutic equipment.
Program specifications	Bachelor's Degree in Biomedical Engineering has been aligned with European educational programs as part of an international European program «TEMPUS: 543904-TEMPUS-1-2013-1-GR-TEMPUS-JPGR» in 2013-2016.
4 – Suitability of Graduates for Employment and Further Education	
Suitability for further employment	The specialist is able to perform the specialized professional work for DK 003:2010: 3439 – specialist 3115 – technician for equipment operation and repair, 3111 – specialist in medical physics, 3119 – technical documentation preparation technician, 3119 – equipment adjustment and testing technician, 3121 – specialist in information technology (biology and medicine)
Further education	The right to continue education at the second (Master's) level of higher education
5 – Teaching and Grading	
Teaching and studying	Lectures, practice classes and seminars, computer workshops and lab work; course projects and works; application of blended and distance learning technology, practice, field visits and performance of qualification work.
Grading	Rating Assessment System, oral and written examinations, testing, defense of course projects. Graduate certification of students, taught in Ukrainian - preparation and defense of qualification work. Graduate certification for students taught in English is a qualifying final exam.

6 – Program Competencies	
Integral competence	The ability to solve complex theoretical and practical problems in biomedical engineering or in a learning process that involves the application of certain theories and methods of chemical, biological and medical engineering, and is characterized by the complexity and uncertainty of learning conditions.
General Competencies (GC)	
GC 1	Ability to apply knowledge in practical situations.
GC 2	Knowledge and understanding of the subject area and understanding of professional activity.
GC 3	Ability to communicate in the national language both, verbally and in writing.
GC 4	Information and communication technology skills.
GC 5	Ability to conduct research at the appropriate level.
GC 6	Ability to search, process and analyze information from various sources.
GC 7	Ability to generate new ideas (creativity).
GC 8	Ability to make informed and conscious decisions.
GC 9	Ability to communicate with representatives of other professional groups of different levels (with experts in other fields of knowledge / types of economic activity).
GC 10	Practical safety skills.
GC 11	Ability to evaluate and ensure the quality of work performed.
GC 12	The ability to realize their rights and responsibilities as a members of society, to support the values of civil (democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of man and citizens.
GC 13	Ability to preserve and multiply moral, cultural, scientific values and achievements of the society on the basis of understanding of history and development patterns of the subject area, its place in the general system of knowledge about the nature and development of society, technology, using different types of activity for active rest and a healthy lifestyle.
Special Competencies of the Specialization (SC)	
SC 1	Ability to use software packages for research, analysis, processing and presentation of results of analysis, as well as for automated design of medical devices and systems.
SC 2	Ability to provide engineering expertise in the planning, development, evaluation and specification of medical equipment.
SC 3	Ability to learn and apply new methods and tools for analyzing, modeling, designing and optimizing medical devices and systems.
SC 4	Ability to provide the technical and functional characteristics of systems and tools used in medicine and biology (in prevention, diagnosis, treatment and rehabilitation).
SC 5	Ability to apply physical, chemical, biological and mathematical methods in the analysis, modeling of the functioning of living organisms and biotechnical systems.

SC 6	Ability to effectively apply the tools and methods for analysis, design, calculation and testing when developing biomedical products and services.
SC 7	Ability to plan, design, develop, install, operate, maintain, maintain, control, and coordinate repair of devices, equipment, and systems for the prevention, diagnosis, treatment, and rehabilitation used in hospitals and research institutes.
SC 8	Ability to conduct research and observations on the interaction of biological, natural and artificial systems (prostheses, artificial organs, etc.).
SC 9	Ability to identify, formulate and solve engineering problems related to the interaction between living and non-living systems.
SC 10	The ability to apply the principles of construction of modern automated control systems for the production of medical devices, their technical, algorithmic, information and software for solving professional problems.
SC 11	Ability to understand the technical and functional characteristics of the systems, methods and procedures used in prevention, diagnosis and therapy.
SC 12	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.
SC 13	Ability to ensure and control adherence to safety and biomedical ethics when handling medical equipment.
SC 14	Ability to perform experiments using specified technical and medical technologies, perform computer processing, analysis and synthesis of obtained results.
7 – Program Learning Outcomes	
KNOWLEDGE (KN)	
KN 1	Knowledge of fundamentally applied, medical-physical and bioengineering fundamentals of technologies and equipment for the study of human body processes.
KN 2	Knowledge of methods of calculation and choice of classic and newest designs of materials, elements of devices and medical systems.
KN 3	Knowledge of design tools for devices, devices and systems of biomedical purposes.
KN 4	Knowledge of design methods for digital and microprocessor medical systems.
KN 5	Knowledge of research methods and methods used in the design of medical equipment.
KN 6	Knowledge of the methods of object research, analysis, and processing of experimental data.
KN 7	Knowledge of specialized conceptual principles acquired in the learning and / or professional activity at the level of recent achievements.
KN 8	Knowledge in the most advanced fields of study and professional activity and at the intersection of different industries.
KN 9	Knowledge about the latest developments in biomedical engineering.
KN 10	Knowledge of a foreign language to the extent sufficient for general and professional communication.

KN 11	Knowledge of the composition of automatic control systems and the properties of their elements.
KN 12	Knowledge of basic physical and physicochemical laws of biological objects functioning.
KN 13	Knowledge of basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems.
KN 14	Knowledge of the basics of proper operation and maintenance of medical equipment.
KN 15	Knowledge of methods of systematization and processing of experimental information.
KN 16	Knowledge of tools (medical devices, biomaterials) for conducting experiments.
KN 17	Knowledge of technical systems of automated design and peculiarities of their components.
KN 18	Knowledge of current programming technologies and tools that support their usage.
KN 19	Knowledge of general information about the human body and its functions from the standpoint of a systematic approach and their use in biomedical engineering.
KN 20	Knowledge of practical methods of organization and solving engineering problems of different levels of complexity.
KN 21	Knowledge of the technical documentation that regulates the order of commissioning, use and repair of medical equipment.
KN 22	Knowledge of methods of application of signal theory and methods of research of signals and images in the specialty of biomedical engineering.
KN 23	Knowledge of the basic methods and tools used to quantify the functioning of physiological systems.
KN 24	Knowledge of methods of statistical processing, modeling and simulation of processes and systems of physical and biological nature.
KN 25	Knowledge of the universal principles of construction of complex biological systems, including the human body.
SKILLS (SK) {on Speciality}	
SK 1	Apply knowledge of the basics of mathematics, natural sciences and engineering at the level necessary to solve the problems of biomedical engineering.
SK 2	Formulate logical conclusions and sound recommendations for the evaluation, operation and implementation of biotechnical, medical and bioengineering tools and methods.
SK 3	Manage complex actions or projects; be responsible for making innovative engineering decisions.
SK 4	Apply the provisions of the regulatory and technical documents governing the procedure for product certification and equipment certification.
SK 5	Be able to use databases, mathematical and statistical software for data processing and computer simulation of biotechnological systems.

SK 6	Be able to communicate with healthcare professionals in both national and foreign languages (English or one of the other EU official languages) and understand their requirements for biomedical products and services.
SK 7	To carry out engineering support, service and other maintenance during the operation of laboratory-testing equipment, medical diagnostic and therapeutic complexes and systems, as well as to compose standard documentation for the types of works in accordance with the Technical Regulations for Medical Devices.
SK 8	Understand theoretical and practical approaches to the creation and management of medical products and medical equipment.
SK 9	Understand theoretical and practical approaches to the creation and application of artificial biological and biotechnical objects and medical supplies.
SK 10	Be able to plan, organize, direct and control techno-medical and bioengineering systems and processes.
SK 11	Control the quality and operating conditions of medical equipment and medical supplies, artificial organs and dentures.
SK 12	Provide recommendations on the selection of equipment for diagnosis and treatment.
SK 13	Be able to analyze signals transmitted from organs to devices and to process diagnostic information.
SK 14	Be able to analyze the level of compliance with the current world standards, as well as evaluate solutions related to the development and use of medical equipment and biomaterials.
SK 15	To be able to make tasks for the development of automated control systems taking into account the possibilities of modern technical and software means of automation of medical equipment.
SK 16	Be able to choose and recommend appropriate medical equipment and biomaterials to equip medical facilities and to provide the basic stages of the diagnostic, prevention and treatment process.
SK 17	Be able to use computer aided design systems to develop technological and hardware schemes of medical devices and systems.
SK 18	To create, synthesize and apply artificial biotechnical and biological objects.
SK 19	Develop and implement modern diagnostic and therapeutic methods related to the use of biotechnology, computer science and nanotechnology.
SK 20	To use methods and means of quantitative assessment of functioning of physiological systems in practical engineering activity.
SK 21	Experimentally check the integrity and performance of biotechnology systems and determine their characteristics.
SK 22	Improve the technical elements of medical devices and systems and medical products in the course of professional activity.

8 – Resource provisions for Program implementation	
Human Resource provisions	According to the personnel requirements for the provision of educational activities at the appropriate level of HE (Annex 2 to the License Conditions), Approved by the Resolution of the Cabinet of Ministers of Ukraine as of 30.12.2015, № 1187.
Material and Technical provisions	In accordance with the technological requirements for logistical support of educational activities of the relevant level of HE (Annex 4 to the License Conditions), Approved by the Resolution of the Cabinet of Ministers of Ukraine as of 30.12.2015, № 1187.
Informational and Educational-Methodological provisions	In accordance with technological requirements for educational and methodological and informational support of educational activities of the relevant level of HE (Annex 5 to the License Conditions), Approved by the Resolution of the Cabinet of Ministers of Ukraine as of 30.12.2015, № 1187.
9 – Academic Mobility	
National grades mobility	Possibility to conclude cooperation agreements between the universities of Ukraine.
International grades mobility	Erasmus + International Academic Mobility Program between the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" and foreign higher education institutions providing professional training in the specialty "Biomedical Engineering"
Study of foreign students on HE programs	English language teaching.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

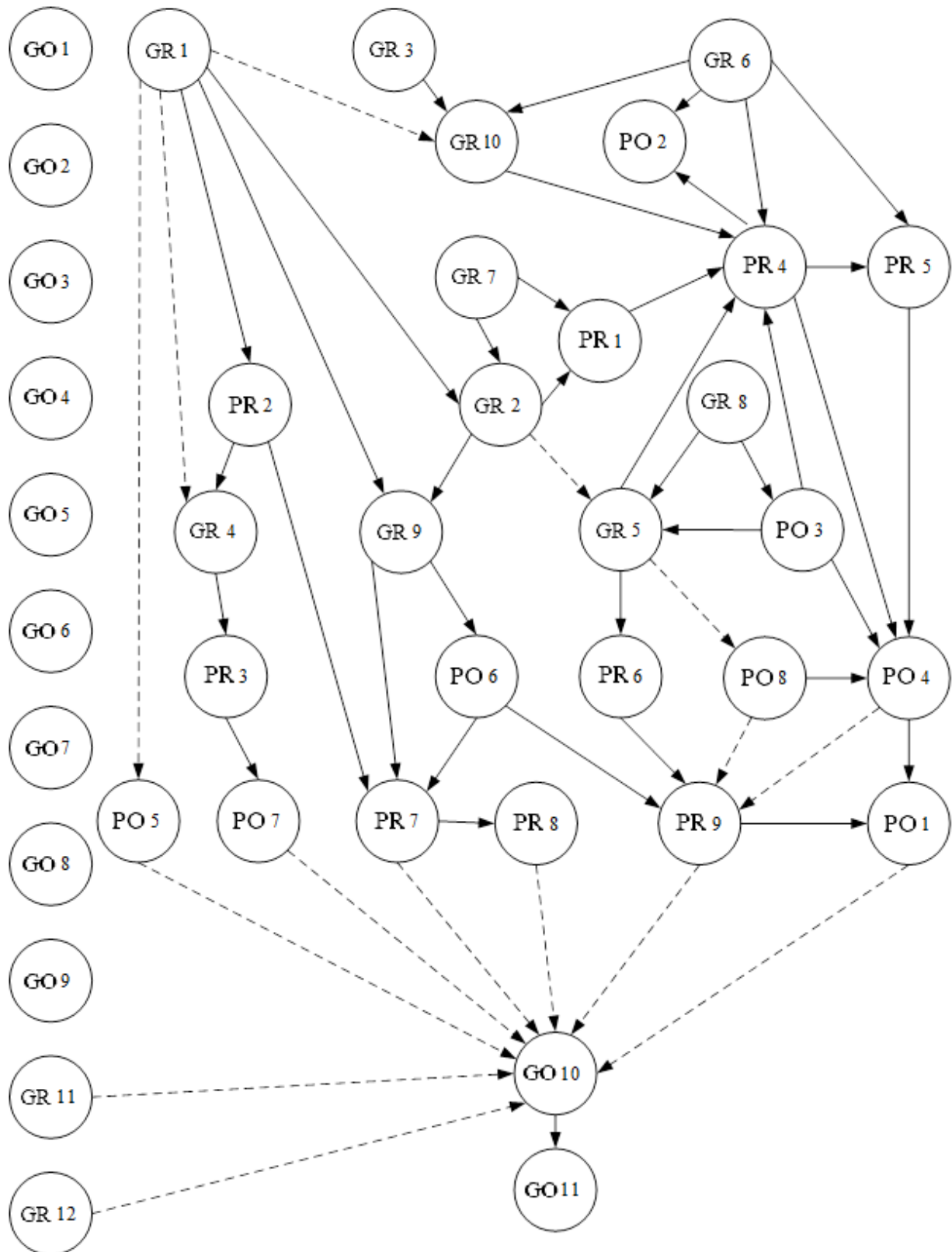
Course Code	Components of the educational program (courses, course projects / course theses, internships, qualifications)	Number of Credits	Form of final Assessment
1	2	3	4
1. General Learning Cycle			
Required Components (GR) of the EP			
GR 1	Higher Mathematics Вища математика	20,5	exam
GR 2	Physics Фізика	11	exam
GR 3	Biochemistry Біохімія	7,5	test
GR 4	Fundamentals of Informatics Основи інформатики	5,5	test
GR 5	Biophysics Біофізика	4,5	test
GR 6	Introduction to Specialization Вступ до фаху	5	test
GR 7	Engineering and Computer Graphics Інженерна та комп'ютерна графіка	4	exam
GR 8	Human Anatomy and Physiology Анатомія та фізіологія людини	8,5	exam

1	2	3	4
GR 9	Electrical Engineering and Electronic Devices Електротехніка та електронні прилади	9,5	exam
GR 10	Material Science and Structural Materials Матеріалознавство та конструкційні матеріали	5,5	test
GR 11	Labor Protection and Civil Protection Охорона праці та цивільний захист	4	test
GR 12	Economics And Organization Of Production Економіка та організація виробництва	4	test
Optional Components (GO) of the EP			
GO 1	Environmental Н/Д Екологічні Н/Д	2	test
GO 2	Historical Courses (block 1) Історичні Н/Д (блок 1)	2	test
GO 3	Ukrainian Language Courses (block 2) Україномовні Н/Д (блок 2)	2	test
GO 4	Philosophical Courses (block 3) Філософські Н/Д (блок 3)	2	test
GO 5	Psychological Courses (block 4) Психологічні Н/Д (блок 4)	2	test
GO 6	Law (current legislation) Courses (block 5) Правові Н/Д (блок 5)	2	test
GO 7	Foreign Language Іноземна мова	6	test
GO 8	Foreign Language Professional Applications Іноземна мова професійного спрямування	4	test
GO 9	Physical education or the basics of a healthy lifestyle Фізичне виховання або основи здорового способу життя	5	test
GO 10	Pre-Diploma practice Переддипломна практика	7,5	test
	Technological practice (teaching in English) Технологічна практика (викладання англійською мовою)		
GO 11	Graduate Diploma Thesis Дипломне проектування	6	defense
	Preparation for the qualification exam (teaching in English) Підготовка до кваліфікаційного іспиту (викладання англійською мовою)		exam
2. Professional Learning Cycle			
Required Components (PR) of the EP			
PR 1	Mechanics Механіка	6	exam
PR 2	Fundamentals of Discrete Mathematics Основи дискретної математики	4	test
PR 3	Object-Oriented Programming Об'єктно-орієнтоване програмування	4,5	test
PR 4	Fundamentals of Biomedical Engineering Основи біомедичної інженерії	13,5	test

1	2	3	4
PR 5	Biothermodynamics and Mass Transfer Біотермодинаміка та масоперенос	4	test
PR 6	Fundamentals of Clinical Engineering and Radiology Основи клінічної інженерії та радіології	11,5	test
PR 7	Digital Imaging Technology Цифрова схемотехніка	6,5	exam
PR 8	Microprocessor Technology Мікропроцесорна техніка	5	exam
PR 9	Biomedical Devices, Apparatus and Complexes Біомедичні прилади, апарати і комплекси	9	exam
Optional Components (PO) of the EP			
PO 1	Medical Therapeutic Equipment Лікувальна медична техніка	4	test
	Development and Operation of Medical Devices Розробка та експлуатація медичних приладів		
PO 2	Theory of Inventive Problems Solving Теорія рішення винахідницьких задач	4	test
	Algorithms for Solving Practical Problems of Science and Technology Алгоритми розв'язання практичних задач науки і техніки		
PO 3	Quantitative Physiology Кількісна фізіологія	6,5	exam
	System Physiology Системна фізіологія		
PO 4	Diagnostic Methods and Methodologies Методи та засоби діагностики	7,5	test
	Instrumental Methods for Diagnosing Human Health Інструментальні методи діагностики здоров'я людини		
PO 5	Biomedical Statistics Медико-біологічна статистика	8	test
	Modeling of Biomedical Processes and Systems Моделювання біомедичних процесів і систем		
PO 6	Automation Control Theory Теорія автоматичного керування	6	exam, CW
	Design of Automatic and Control Systems Проектування систем автоматичного контролю і керування		
PO 7	Technology of Creating Software Products Технологія створення програмних продуктів	4,5	test
	Software Design, Tools and Standards Проектування, засоби і стандарти розробки програмного забезпечення		
PO 8	Theory of Biomedical Signals Теорія біомедичних сигналів	5,5	exam, CW
	Registration and Processing of Biosignals and Medical Images Реєстрація і обробка біосигналів і медичних зображень		

1	2	3	4
	Total amount of the General Learning Cycle:		130,0
	Total amount of the Professional Learning Cycle:		110,0
	Total amount of the Required Components:		153,5
	Total amount of the Optional Components:		86,5
	Including those, by the choice of students:		86,5
	TOTAL AMOUNT OF CREDITS IN EDUCATIONAL PROGRAM		240

3. STRUCTURAL-LOGICAL SCHEME OF THE EDUCATION PROGRAM



4. FORM OF GRADUATE PROFESSIONAL CERTIFICATION IN HIGH EDUCATION

Graduate Certification for higher education level students in the Professional Education Program "Medical Engineering" is held in the form of defense of qualification work or passing the qualification exam (for teaching in English). The Graduate Certification ends with the issuance of the document of the established standard for awarding of a Bachelor's Degree of Engineering in the Professional Education Program "Medical Engineering".

Graduate certification process shall be open to public.

6. MATRIX OF PROVISION OF THE PROGRAM RESULTS BY THE RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GR 1	GR 2	GR 3	GR 4	GR 5	GR 6	GR 7	GR 8	GR 9	GR 10	GR 11	GR 12	GO 1	GO 2	GO 3	GO 4	GO 5	GO 6	GO 7	GO 8	GO 9	GO 10	GO 11	PR 1	PR 2	PR 3	PR 4	PR 5	PR 6	PR 7	PR 8	PR 9	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8			
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SK 1	+	+	+	+	+	+	+	+	+	+	+	+										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
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SK 18			+		+					+													+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
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SK 20					+			+															+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
SK 21																							+	+					+	+	+	+	+	+	+	+	+	+	+	+	+	+
SK 22																							+	+					+	+	+	+	+	+	+	+	+	+	+	+	+	+