

**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  
(2021, March 15, protocol No. 3)  
Head of Academic Council  
Mykhaylo ILCHENKO**

**“Regenerative and biopharmaceutical engineering”**

**EDUCATIONAL & PROFESSIONAL PROGRAM**

**The first (bachelor’s) level of higher education**

**Specialty: 163 Biomedical Engineering  
Field of knowledge: 16 Chemical & Bioengineering  
Qualification: Bachelor of Biomedical Engineering**

The program is implemented by  
the order of Rector of Igor Sikorsky  
Kyiv Polytechnic Institute  
order No. HOH/89/2021  
date 2021, April 19

## INTRODUCTION

### The Project team:

*The Head:*

*Alexander GALKIN*, D.Sc. (Biology), Full Prof., Head of Translational Medical Bioengineering Department

*The members:*

*Vitaliy MAKSYMENKO*, D.Sc. (Medicine), Full Prof., Dean of Biomedical Engineering Faculty;  
*Elena BESPALOVA*, Ph.D. (Biology), Associate Professor, Associate Professor of Translational Medical Bioengineering Department;

*Tatyana LUTSENKO*, Ph.D. (Engineering), Senior Lecturer, Translational Medical Bioengineering Department;

*Larysa TARASOVA*, Ph.D. (Engineering), Associate Professor, Associate Professor of Biomedical Engineering Department;

*Alexander BESARAB*, Ph.D. (Engineering), Senior Lecturer, Department of Translational Medical Bioengineering Department;

*Yurii GORSHUNOV*, Ph.D. (Engineering), General Director of LLC “DIXI-CENTER”;

*Nataliia Schotkina*, postgraduate student, Translational Medical Bioengineering Department.

Translational Medical Bioengineering Department is responsible for training students on the basis of this Program.

Approved by Student’s Council of Biomedical Engineering Faculty (protocol dated 2021, February 15)

Additions and modifications of this program are approved by the Scientific and Methodical Board of Igor Sikorsky KPI (2021, February 22, protocol No. 3)

Head of the Scientific and Methodical Board of Speciality *Vitaliy MAKSYMENKO*

The Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute (2021, February 25, protocol No. 6)

Head of the Methodological Council *Yurii YAKYMENKO*

**The program was subjected to peer review provided by the following stakeholders:**

- *Nadiia GORCHAKOVA*, D.Sc. (Medicine), Full Prof., Department of Pharmacology Bogomolets National Medical University, the member of Scientific and Expert Board of State Expert Centre;
- *Vira KAZMIRCHUK*, D.Sc. (Medicine), Full Prof., General Director, LLC “Institute of Immunology, Allergology and Rehabilitation”, Kyiv;
- *Serhii HULYY*, Ph.D. (Engineering), General Director, LLC “Nutrimed”, Kyiv;
- *Olena KLYUCHKO*, Ph.D. (Biology), Associate Professor, Associate Professor of Electronics, Robotics and Monitoring Technology and Internet of Things, National Aviation University, Kyiv.

The program has been updated considering stakeholders’ recommendations as well lecturers’ and students’ suggestions.

Some issues which describe focusing on biological and technological features of regenerative and biopharmaceutical engineering as well approaches to management of biopharmaceutical production on the basis of sustainable development concept have been defined more precisely.

The project team have revised a credit balance and function of credits, ability of students to mastering educational components of the program. In particular, the course “Information Technologies in Biomedical Engineering” has been included in the list of core courses, a quantity of credits within the biological educational component has been reallocated, the list of general core courses has been extended. For optimization of formation of an individual educational trajectory the approach to organizing electives according to student’s needs has been revised, namely the quantity of ECTS credits of the electives has been standardized pursuant the order #519 of Cabinet of Ministers of Ukraine, 25 June 2020 (The new edition of National Qualification Framework).

The program has been revised pursuant to the order of Rector of Igor Sikorsky Kyiv Polytechnic Institute #NON/35/2020, 30 November 2020 (“On Development of Educational Programs for Bachelor’s degree”).

The program has been discussed and approved concerning all the comments and suggestions on the meeting of Translational Medical Bioengineering Department (protocol #9, 16 February 2021).

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# 1. PROFILE

<b>1 – General information</b>	
University and Faculty	National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”; Faculty of Biomedical Engineering
Degree and qualification (in Ukrainian)	Ступінь – бакалавр Кваліфікація – бакалавр з біомедичної інженерії
Cycle/Level of higher education	National Qualification Framework of Ukraine – 6 level; QF-EHEA (Europinian Higher Education Area Qualification Framework) – 1 <sup>st</sup> cycle; EQF-LLL (Europinian Qualification Framework for Lifelong Learning) – 6 level
Official title of the program	Regenerative and biopharmaceutical engineering
Diploma, credits and duration	Bachelor’s Diploma, single, 240 ECTS credits, duration – 3 years 10 months
Accreditation	Ministry of Education and Science of Ukraine. Accreditation Certificate pursuant to the official decision of State Accreditation Committee, 19 February 2019, protocol #9. Serial number ND №1192633, expiration date 1 July 2022; speciality – 163 “Biomedical engineering”.  <i>Accreditation of the program</i> National Agency for Higher Education Assurance of Ukraine is to accredit the program in 2022/2023 academic year.
Admission requirements	Complete secondary education
Languages	Ukrainian/English
Expiration date	Till the next accreditation
Permanent internet-address for the program location	<a href="https://osvita.kpi.ua/">https://osvita.kpi.ua/</a> (the Part “Educational programmes”) <a href="http://bi.fbmi.kpi.ua/uk/educational-program-ua/">http://bi.fbmi.kpi.ua/uk/educational-program-ua/</a> (the official web-site of Translational Medical Bioengineering Department)
<b>2 – Mission</b>	
On the basis of concepts of sustainable development, internationalization and globalization of education, cutting-edge innovative scientific activity, human development the mission is to train well qualified competitive biomedical engineers who are able to solve any professional problems relating to a life cycle of biomedical equipment and technological products within the field of regenerative and biopharmaceutical engineering.	
<b>3 – Description</b>	
Subject area	<i>Subjects:</i> design, development, production, testing, operation, service and maintenance, certification of medical equipment and products; processing of biomedical data; engineering support of medical technological products and systems.  <i>Goals:</i> to develop competences in the field of design, development, production, testing, operation, service and maintenance, certification of biomedical equipment and products; examination of compliance with technical regulations and safety standards for medical equipment, biomedical products, biomaterials and bioartificial organs as well as appropriate software and information

	<p>technologies.</p> <p><i>Theoretical content:</i> clinical engineering, medical equipment, microelectronics mechanical systems, medical radiology, medical biotechnologies, biomechanics, robotics, information technologies in biopharmaceutical engineering, problem-solving in medicine; signal receipt in biopharmaceutical engineering, processing and interpretation of signals and images of biological objects.</p> <p><i>Methodology:</i> engineering methods, biotechnologies and technologies within medical engineering, simulation, software and information technologies for data processing in biology, medicine and medical instrumentation engineering.</p> <p><i>Apparatuses and equipment:</i> apparatuses and equipment for biotechnology and medicine, biomedical products, biomaterials for medicine, artificial organs, computers.</p>
The type of the program	Educational & Professional Program
The main focus and specialization of the program	<p>Processes and equipment in the field of regenerative and biopharmaceutical engineering.</p> <p><i>Keywords:</i> regenerative engineering; cellular, tissue and genetic engineering; biopharmaceutical engineering, biomedical technologies, biomedical informatics.</p>
Special features	<p>The program has a strong bias towards special training in every aspects of technological basis for regenerative and biopharmaceutical engineering. Students master the courses being immersed in friendly academic environment that is supported by lecturers' scientific activity. They are focused on solving professional problems applying cutting-edge engineering experience on the basis of concepts of sustainable development.</p>
<b>4 – Employment and Access to further studies</b>	
Professional status	<p>Associate professional in biomedical engineering. Professional certification is allowed.</p>
Further studies	Access to second (master's) cycle of higher education.
<b>5 – Teaching and Assessment</b>	
Teaching	Lectures, practicals and seminars, computer workshops and lab work; course projects and works; blended learning, practice and field trips; implementation of the diploma project.
Assessment	Rating system of assessment, oral and written examinations, testing.
<b>6 – Competences</b>	
Integral competence	Ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty in the field of regenerative and biopharmaceutical engineering, or in a training process that involves the application of theories and methods of regenerative and biopharmaceutical engineering.

<b>Generic Competencies (GC)</b>	
GC 1*	Ability to apply knowledge in practice.
GC 2*	Knowledge of the subject area and understanding of professional activity.
GC 3*	Ability to communicate in English/Ukrainian both orally and in writing.
GC 4*	Ability to use information and communication technologies.
GC 5*	Ability to conduct research.
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 decisions.
GC 9*	Ability to communicate with experts in other fields of knowledge and types of economic activity.
GC 10*	Ability to work safely.
GC 11*	Ability to evaluate and ensure the quality of work being performed.
GC 12*	The ability to exercise their own rights and responsibilities as a member of society, to realize the values of civil (free and democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms.
GC 13*	Ability to uphold moral, cultural, scientific values and improve social outcomes on the basis of understanding the history and patterns of development of the subject area, its place in the general system of knowledge about the nature and society and in the development of society, engineering and technology; employ different types of motor activity for active rest and leading a healthy lifestyle.
<b>Professional Competencies (PC)</b>	
PC 1*	Ability to apply software packages to research, analysis, processing and presentation of results of work, as well as for the automated design of biomedical technologies, products and systems.
PC 2*	Ability to conduct engineering analysis in the course of planning, development, evaluation and specification of biomedical technologies, products and systems.
PC 3*	Ability to independently study and apply new methods and tools to an analysis, simulation, design and optimization of biomedical technologies, products and systems.
PC 4*	Ability to provide the technical and functional characteristics of systems and other means used in medicine and biology (in prevention, diagnosis, treatment and rehabilitation).
PC 5*	Ability to apply physical, chemical, biological and mathematical methods to an analysis and simulation of functioning of living organisms and biotechnical systems.
PC 6*	Ability to effectively apply tools and methods to an analysis, design, calculation and testing in the course of developing biomedical products and services.
PC 7*	Ability to develop, design, install and operate medical systems, including biological origin; to plan and coordinate maintenance for medical systems used for prevention, diagnosis, treatment and rehabilitation in hospitals and research institutions.
PC 8*	Ability to conduct research and observations on the interaction of biological, natural and artificial systems and substances.
PC 9*	Ability to identify, formulate and solve engineering problems related to the interaction between living and non-living systems.
PC 10*	Ability to apply the principles of construction of modern automated control systems, their technical, algorithmic, information support and software to the production of medical devices and for solving professional problems.

\* Competences and Program Learning Outcomes according to National Standards for Higher Education; other Competences and Program Learning Outcomes are printed in italics.

PC 11	<i>Ability to analyze biological objects of different forms of organization (acaryotes, prokaryotes, eukaryotes: cells and tissues of humans and animals) and their individual parts (proteins, nucleic acids, etc.) applying biological, chemical, physical and mathematical methods.</i>
PC 12	<i>Ability to develop and organize production processes involving biological objects of various forms of organization (biological agents) to produce products of biosynthesis or biotransformation for health, prophylactic or therapeutic (biopharmaceutical) purposes or to develop biomedical technologies.</i>
PC 13	<i>Ability to integrate practical applications of engineering and biological methods for the development, design, implementation of regenerative and biopharmaceutical technologies as well as engineering foundations of translational medicine.</i>
<b>7 – Program Learning Outcomes</b>	
PLO 1	<i>Recognize principles of organization and functioning of biological objects and their parts <b>in vivo</b> and <b>in vitro</b> as well as various methods (biological, chemical, physical, mathematical) of their study.</i>
PLO 2*	Recognize theoretical and practical approaches to development and operation of medical equipment.
PLO 3*	Recognize theoretical and practical approaches to development and practical applications of artificial biological and biotechnical objects and medical materials.
PLO 4*	Apply knowledge of mathematics, natural sciences and engineering to solve the problems of regenerative and biopharmaceutical engineering.
PLO 5*	Make specific recommendations for evaluation, operation and installation of biotechnical, medical, biotechnological, bioengineering means and methods.
PLO 6*	Manage complex activities or projects; be responsible for making engineering decisions in unforeseen circumstances; examine projects for compliance with technical regulations and safety standards.
PLO 7*	Apply statutory regulations governing certification of products and production.
PLO 8*	Use databases, mathematical and software for data processing and a computer simulation of biological and biotechnical systems.
PLO 9*	Communicate with healthcare professionals in Ukrainian, English, or other EU official languages and realize their requirements for biomedical products and services considering the historical context and healthy lifestyle concept.
PLO 10*	Provide a range of engineering services in the course of operation of medical equipment and systems performing a variety of functions (laboratory, diagnostic, therapeutic etc.); maintain proper records according to statutory regulations.
PLO 11*	Plan, develop and supervise medical and bioengineering systems and processes.
PLO 12*	Monitor the quality of medical materials of different origin and operation conditions for medical equipment and systems performing a variety of functions (including artificial organs, prosthesis etc.).
PLO 13*	Make recommendations for selection of medical devices for diagnosis and treatment.
PLO 14*	Analyze signals transmitted from organs to devices and process diagnostic information.
PLO 15*	Evaluate engineering solutions and draw up technical specifications for automated control systems on the basis of resources of modern engineering and software means by modern word standards.
PLO 16*	Draw up technical specifications for automated control systems on the basis of resources of modern engineering and software means.
PLO 17*	Select and recommend appropriate medical products and biomaterials to equip medical institutions and to provide the main stages of technological process of diagnostics, prevention and treatment.
PLO 18*	Apply computer-assisted design systems to developing technological and hardware diagrams of medical devices and systems.

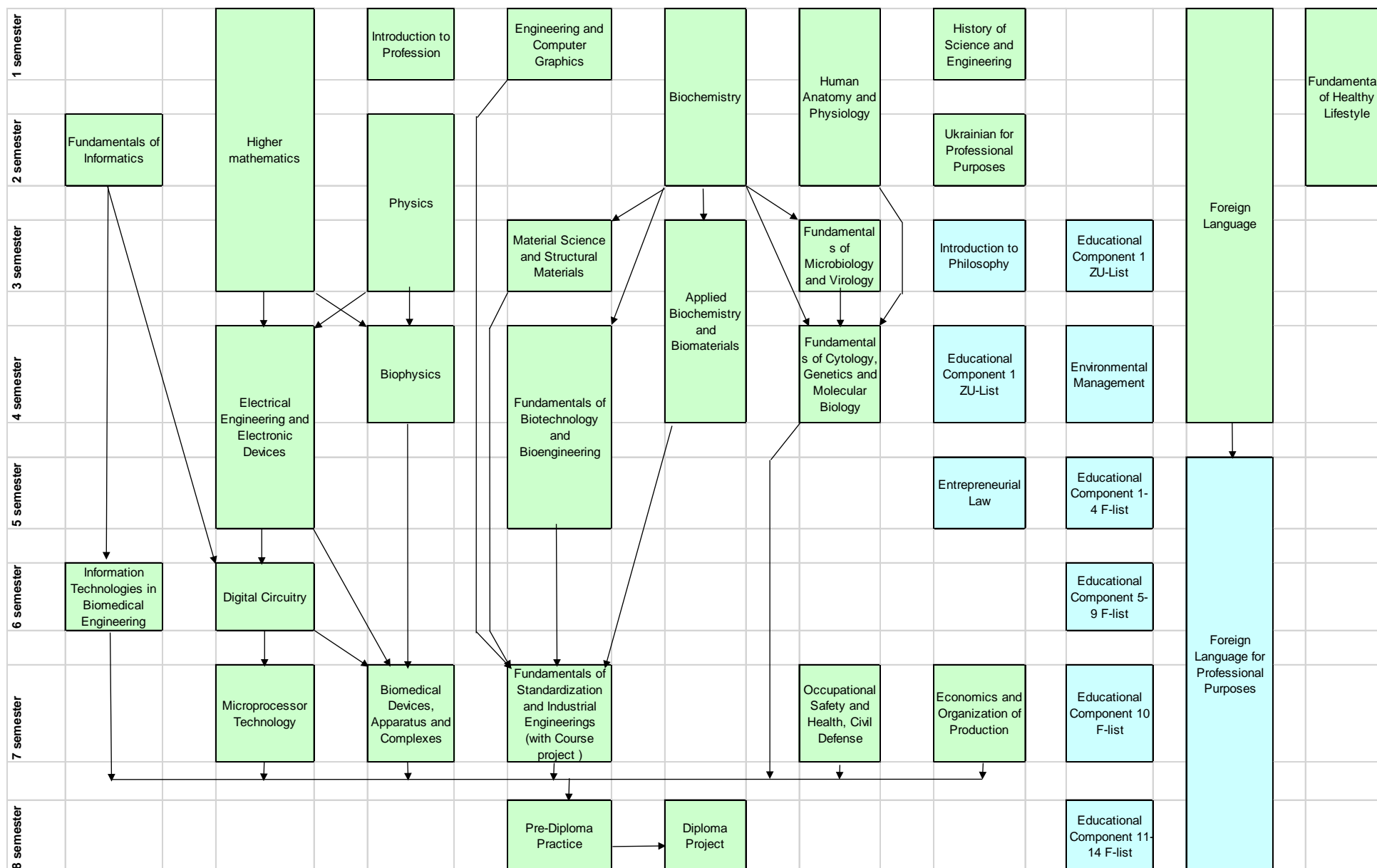


PLO 19*	Apply knowledge of chemistry and bioengineering to formation, synthesis and practical applications of artificial biotechnical and biological objects.
PLO 20	<i>Organize bioengineering processes according to properties of an initial biological object and/or final product.</i>
<b>8 – Resources</b>	
Academic staffing	In accordance with the HR requirements for the educational process (License conditions approved by the Cabinet of Ministers of Ukraine Decree No. 1187 of December 30, 2015).
Logistical support	In accordance with the technological requirements for logistical support of the educational process (License conditions approved by the Cabinet of Ministers of Ukraine Decree No. 1187 of December 30, 2015).
Methodological and information support	In accordance with the technological requirements for methodological and information support of the educational process (License conditions approved by the Cabinet of Ministers of Ukraine Decree No. 1187 of December 30, 2015). Students are allowed to use KPI Library without any additional fees.
<b>9 – Academic Mobility</b>	
National academic mobility	Participation in credit mobility and double diploma projects.
International academic mobility	Participation in credit mobility and double diploma projects (Erasmus + K1).
Teaching services for foreign students	The courses within the program are taught in English on demand.

## 2. LIST OF THE EDUCATIONAL COMPONENTS

Code	Components of the educational program (courses, practices, projects)	ECTS Credits	Testing
<b>1. Core courses</b>			
<b>1.1. General Training Cycle</b>			
CO 1	Higher mathematics	20,5	Exam
CO 2	Physics	11	Exam
CO 3	Engineering and Computer Graphics	4	Exam
CO 4	Fundamentals of Informatics	5,5	Test
CO 5	Ukrainian for Professional Purposes	2	Test
CO 6	History of Science and Engineering	2	Test
CO 7	Fundamentals of Healthy Lifestyle	3	Test
CO 8	Foreign Language	6	Test
CO 9	Economics and Organization of Production	4	Test
CO 10	Occupational Safety and Health, Civil Defense	4	Test
CO 11	Foreign Language for Professional Purposes	6	Exam, Test
CO 12	Environmental Management	2	Test
CO 13	Introduction to Philosophy	2	Test
CO 14	Entrepreneurial Law	2	Test
<b>1.2. Professional Training Cycle</b>			
PO 1	Introduction to Profession	4,0	Test
PO 2	Biochemistry	8,0	Test
PO 3	Biophysics	4,5	Test
PO 4	Human Anatomy and Physiology	8,5	Exam
PO 5	Electrical Engineering and Electronic Devices	9,5	Exam
PO 6	Material Science and Structural Materials	4,5	Test
PO 7	Digital Circuitry	4,5	Test
PO 8	Microprocessor Technology	4,0	Test
PO 9	Biomedical Devices, Apparatus and Complexes	5,0	Test
PO 10	Pre-Diploma Practice	6,0	Test
PO 11	Diploma Project	6,0	Defence
PO 12	Applied Biochemistry and Biomaterials	8,0	Exam, Test
PO 13	Fundamentals of Cytology, Genetics and Molecular Biology	5,0	Exam
PO 14	Fundamentals of Biotechnology and Bioengineering	12,5	Exam
PO 15	Fundamentals of Standardization and Industrial Engineerings	6,5	Exam
PO 16	Course project in Basics of Standardization and Industrial Engineering	1,5	Test
PO 17	Fundamentals of Microbiology and Virology	4,0	Test
PO 18	Information Technologies in Biomedical Engineering	4,0	Exam
<b>2. Electives</b>			
<b>2.1. General Training Cycle</b>			
CS 1	Educational Component 1 ZU-List (Course in multi-field studying and institutional development)	2	Test
CS 2	Educational Component 1 ZU-List (Course in employee potential development)	2	Test
<b>2.2. Professional Training Cycle</b>			
PS 1-14	Educational Component 1-14 F-list	56 (14×4)	Test
Total of Core Courses			180
Total of Electives			60
Total of educational components to ensure competences according to National Standards for Higher Education			180
<b>TOTAL</b>			<b>240</b>

### 3. STRUCTURAL & LOGICAL SCHEME



## **4. CERTIFICATION**

Certification of students is provided in the form of defence of a diploma project or passing a qualification exam.

The defence of the diploma project is to be provided in public.

The diploma project that contains plagiarism or any other form of academic misconduct is not allowed to defence.

The diploma project is to be put on official on-line resources with free access (web-sites of the department and resources of KPI Library).

## 5. MATRIX OF CORRESPONDENCE BETWEEN COMPETENCES AND EDUCATIONAL COMPONENTS

000	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10	CO 11	CO 12	CO 13	CO 14	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PO 17	PO 18			
GC 1																								+											
GC 2															+										+	+									
GC 3					+																				+	+							+		
GC 4				+																					+	+							+		
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GC 11																									+	+							+		
GC 12						+						+	+	+																					
GC 13						+	+	+			+	+	+		+												+								
PC 1			+	+														+		+	+	+	+	+	+	+							+		
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PC 3				+														+	+	+	+	+	+	+	+	+	+		+	+	+			+	
PC 4																		+		+	+	+	+	+	+	+		+					+		
PC 5	+	+		+												+	+	+							+	+	+	+					+	+	
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PC 12			+							+															+	+			+	+	+				
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