

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Technical University of Ukraine
“Igor Sikorsky Kyiv Polytechnic Institute”

APPROVE
Scientific Council
Igor Sikorsky KPI
Protocol № 1
from 23/01/2023

BIOTECHNOLOGIES
EDUCATIONAL AND SCIENTIFIC PROGRAM
second (master's) level of higher education

specialty: 162 Biotechnologies and Bioengineering

areas of knowledge: 16 Chemical engineering and bioengineering
qualification: Master of biotechnologies and bioengineering

Effected by the Rector's Order
Igor Sikorsky KPI
from 2022-2023 ed. year
17/05/2023
№ NON/165/2023

Kyiv - 2023

DEVELOPED by the project team:

Project team leader:

Todosiichuk Tetiana Serhiivna, Doctor of Eng. Sciences, Professor, Dean of Faculty of Biotechnology and Biotechnics

Work group members:

Golub Nataliia Borysivna, Doctor of Technical Sciences, Associate Professor, Head of Department of Bioenergy, Bioinformatics and Environmental Biotechnology

Polishchuk Valentyna Yuriyvna, Ph.D of Technical Sciences, Acting Head of Department of Industrial Biotechnology and Biopharmacy, Associate Professor of Department of Industrial Biotechnology and Biopharmacy

Duhan Oleksiy Martemyanovych, Doctor of Biological Sciences, Professor, Professor of Department of Industrial Biotechnology and Biopharmacy

Gorobets Svitlana Vasylivna, Doctor of Technical Sciences, Professor, Professor of Department of Bioenergy, Bioinformatics and Environmental Biotechnology

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Klechak Inna Rishardivna, Ph.D of Technical Sciences, Associate Professor, Department of Industrial Biotechnology and Biopharmacy

VALIDATED:

Scientific and methodical commission of Igor Sikorsky Kyiv Polytechnic Institute in the specialty 162 Biotechnologies and Bioengineering

Head of SMC Nataliia Golub

(protocol № 2 from 22.12.2022)

Methodical commission of Igor Sikorsky Kyiv Polytechnic Institute

Head of Methodical commission Anatoliy MELNYCHENKO

(protocol № 4 from 19.01.2023)

**Professional examination was carried out by interested persons
(stakeholders):**

Grigoriieva M.A., Ph.D., leading specialist in the registration of medicinal products, LLC "MSD Ukraine"

Shvartau V. V., Doctor of Biological Sciences, Professor, Corresponding Member of the National Academy of Sciences of Ukraine, Head of the Plant Nutrition Physiology Department of the Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine

Kosterin S.O., professor, acting Director of the Institute of Biochemistry O.V. Paladin of the National Academy of Sciences of Ukraine

According to the results of the monitoring of the educational program, taking into account the suggestions of stakeholders (research and teaching staff, students of higher education, employers), an updated version of the educational program was developed.

The project group reviewed the balance, the rational allocation of credits, the ability of higher education applicants to effectively master its educational components.

The revision of the educational program was carried out in compliance with the order of the rector of Igor Sikorskyi KPI, No. HOH/282/2022 dated 04.10.2022 "On updating the educational programs of KPI named after Igor Sikorsky".

The educational and scientific program "Biotechnology" was discussed by scientific and pedagogical staff at meetings of the Department of Industrial Biotechnology and Biopharmacy (protocol No. 8 dated 18.01. 2023), Department of Bioenergy, Bioinformatics and Environmental Biotechnology (protocol No. 8 dated 18.01 2023), Department of Biotechnics and Engineering (protocol No. 9 dated 11.01. 2023).

Agreed by the Student Council of the Faculty of Biotechnology and Biotechnics, Igor Sikorsky KPI.

1. PROFILE OF THE EDUCATIONAL PROGRAM

by specialty 162 Biotechnologies and Bioengineering

1 – General information	
Complete IHE and institute / faculty	National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” Faculty of Biotechnology and Biotechnics
Higher education degree and title of qualification in the original language	Degree - Master Qualification - Master of biotechnologies and bioengineering
The official name of the educational program	Biotechnologies
Type of diploma and scope of educational program	Master’s diploma, single, educational component 120 credits. The term of study is 1 year 9 months
Availability of accreditation	Certificate of specialization accreditation, ND series No. 1192639, issued by the Ministry of Education and Science of Ukraine, valid until July 1, 2024.
Cycle/HE level	NQL Ukraine – 7 level QF-EHEA – second cycle EQF-LLL – level 7
Prerequisites	Bachelor's degree
Language (s) of teaching	Ukrainian, English
Term of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/ “educational programs” tab http://biotech.kpi.ua/index.php/uk/osvitni-prohramy
2 – Goal of educational program	
Training of highly qualified specialists capable of creating modern scientific knowledge and innovative biotechnologies, capable of organizing and conducting scientific research, project-technological, production-technological works related to the use of biological agents and products of their vital activities on the basis of the concept of sustainable development of society and securing a worthy place for Ukraine in the world community	
3 – Characteristics of the educational program	
Subject area	<p><i>Object:</i> biotechnological processes of obtaining biologically active substances and products by biosynthesis and/or biotransformation, as well as their engineering implementation</p> <p><i>Training goals:</i> training of engineers and scientists capable of organizing and carrying out research, design and production-technological works related to the use of biological agents and their products of vital activity.</p> <p><i>Theoretical content of the subject area.</i> Fundamental and applied scientific bases of industrial use of biosynthetic and/or biotransformational potential of living objects to obtain practically</p>

	valuable products. <i>Methods, techniques and technologies.</i> Chemical, physicochemical, biochemical, microbiological, molecular biological, genetic research methods, biotechnological production technologies, information and computer technologies. <i>Tools and equipment:</i> for the analysis of biological agents and their by-products, establishment for the cultivation of biological agents, isolation and purification of target products, means of automation and automated design systems of biotechnological productions.
Orientation of the educational program	Educational and scientific
The main focus of the educational program	Biotechnological processes and bioengineering in the areas of industrial biotechnology and biopharmaceutics, ecological biotechnology and bioenergy, molecular biotechnology. Keywords: industrial biotechnology, pharmacy. ecological biotechnology, bioenergy, molecular biotechnology, bioengineering
Features of the program	The unique theoretical-methodical and scientific-practical developments of the department's team allow students of higher education to gain knowledge about biotechnological processes and bioengineering. In the educational process, teachers use their own scientific developments, original methods, and modern educational technologies. Scientists and practitioners from industry institutions and enterprises of Ukraine and abroad are involved in teaching.
4 – Suitability of graduates for employment and further study	
Suitability for employment	Employment under DK 003: 2010: 2149.1: Junior researcher (bioengineering) 2149.2: Research engineer, standardization and quality engineer, technological engineer 2211.1 Junior researcher (biology) 2211.2: Biotechnologist 2310.2: Assistant 2310.2: Teacher at a higher education institution 2321: Teacher of a professional (vocational and technical) education institution 2419.3: State expert Professional certification is possible
Further training	Continuation of studies at the third educational and scientific level of higher education. Acquisition of additional qualifications in the postgraduate education system
5 – Teaching and assessment	
Teaching and learning	Problem-oriented learning in the form of lectures, practical and seminar classes, computer workshops, and laboratory works; course projects and works; the technology of mixed learning, practices, and excursions, the involvement of scientists and practitioners of industry institutions and enterprises in teaching; execution of a master's dissertation.
Evaluation	Current and semester control in the form of laboratory reports, tests, oral

	and written exams, and the defense of the qualification work are evaluated in accordance with the defined criteria of the rating evaluation system.
6 – Program competencies	
Teaching and learning	The ability to solve complex tasks and problems of biotechnology and its bioengineering implementation, which involves conducting research and/or implementing innovative scientific and technical developments and is characterized by the uncertainty of conditions and requirements.
General competences (GC)	<ol style="list-style-type: none"> 1. The ability to conduct research at the appropriate level. 2. Ability to search, process and analyze information from various sources. 3. Ability to motivate people and move towards a common goal. 4. Ability to work in an international context. 5. Ability to show initiative and entrepreneurship. 6. The ability to act socially responsibly and consciously. 7. Ability to communicate with representatives of other scientific and professional groups of different levels 8. Ability to act on the basis of ethical considerations (motives)
Professional competences of the specialty (PC)	<ol style="list-style-type: none"> 1. The ability to protect intellectual property, in particular to patent inventions in biotechnology. 2. The ability to search for the necessary information in scientific and technical literature, databases and other sources 3. Ability to select and analyze relevant data, including using modern data analysis methods and specialized software. 4. The ability to develop and implement commercial and scientific and technical plans and projects in the field of biotechnology, taking into account all aspects of the solved problem, including technical, production, operational, commercial, legal, labor and environmental issues. 5. The ability to develop new biotechnological objects and technologies and to increase the efficiency of existing technologies based on experimental and/or theoretical research and/or computer modeling. 6. The ability to plan and carry out experimental work in the field of biotechnology using modern equipment and methods, to interpret the obtained data based on the totality of modern knowledge and ideas about the object and subject of research, to draw reasonable conclusions. 7. Ability to develop and improve complex biotechnologies based on understanding of modern scientific facts, concepts, theories, principles, and methods of bioengineering and natural sciences. 8. The ability to predict the direction of development of modern biotechnology in the context of the general development of science and technology. 9. Ability to apply modern methods of system analysis for research and creation of effective biotechnological processes. 10. Ability to apply problem-oriented methods of analysis and optimization of biotechnological processes, production management, to have skills in practical implementation of scientific developments.

	<p>11. The ability to find adequate ways to solve scientific problems in the field of biotechnology and bioengineering.</p> <p>12. Ability to present and discuss the results of scientific and applied research, prepare scientific publications, participate in scientific conferences and other events.</p> <p>13. Understanding methods, approaches, goals and objectives of scientific and pedagogical activities and the educational process.</p> <p>14. The ability to commercialize the results of scientific and applied research and innovations.</p> <p>15. The ability to use molecular genetic technologies to create new biological agents</p> <p>16. Ability to use modern biophysical technologies to create biotechnological processes (products)</p> <p>17. Ability to use molecular bioengineering methods to modify biological agents</p>
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7 – Program learning outcomes (PLO)

1. Be able to perform a patent search, find and process the necessary scientific and technical information; independently make an application for the invention.
2. Know national and international law in the field of copyright. Be able to protect own intellectual property and avoid infringements of other people's intellectual property.
3. Carry out technical and economic calculations of design decisions and analyze and evaluate their effectiveness, environmental and social consequences in the short and long period.
4. Be able to choose and apply the most suitable methods of mathematical modeling and optimization in the development of scientific and technical projects.
5. Know the molecular organization and regulation of gene expression, replication, recombination and repair, restriction and modification of genetic material in pro- and eukaryotes, the strategy of creating recombinant DNA for targeted construction of biological agents.
6. Know and evaluate the main methods of cultivation of eukaryotic cells of animal and plant origin, develop new technologies for their use in scientific purposes, medicine, agriculture, etc.
7. Have the skills of isolation, identification, storage, cultivation, immobilization of biological agents, optimize nutrient medium, choose the best methods of analysis, isolation and purification of the target product, using modern biotechnological methods and techniques for the particular area of biotechnology.
8. Plan and manage research, scientific and technical and / or production projects in the field of biotechnology, based on current trends in science, technology and society.
9. To be able to develop, substantiate and apply methods and means of protection of the human and environment from dangerous factors of a technogenic and biological origin.
10. Introduce the most effective biotechnological methods and techniques in practical production activities based on the evaluation of the effectiveness of advanced biotechnologies and considering the general trends in the development of new biotechnologies in leading countries.
11. To communicate freely orally and in writing by the state and foreign languages, to discuss with specialists and non-specialists the results of research, innovation and / or production management and biotechnology.
12. Find the necessary information in scientific and reference literature, electronic databases, other sources of information, evaluate its relevance and reliability.
13. Evaluate the relevance of the studied scientific problems, the suitability of known scientific

methods for their study based on the analysis of available data and publications in issue.

14. Carry out the content of optimization problems in the field of biotechnology and bioengineering, their formalization, choose appropriate methods for solving such problems and obtain their solutions with a given degree of accuracy.

15. Have the skills to plan and perform experimental research both personally and in a team, critical analysis of the results; figuration of research results in the form of a report, scientific publication, presentation at scientific and other events.

16. Understand the goals, objectives and methods of educational activities in higher education, be able to conduct basic types of training.

17. Have the skills to develop and implement innovative projects and commercialize the results of research and development in the field of biotechnology and bioengineering.

18. Have the skills to use molecular genetic technologies to create new biological agents.

19. Be able to create and use specialized software for analysis and management of biotechnological objects (processes)

20. Be able to use molecular bioengineering methods to create new biological agents.

21. Understand the principles and methods and have the skills to develop and manage scientific and scientific and technical projects, including international ones.

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 Resolution of the Cabinet of Ministers of Ukraine No. 1187 dated 30.12.2015 as amended by Resolution of the Cabinet of Ministers of Ukraine No. 365 dated 24.03.2021, the involvement of scientists in teaching and practitioners of industry institutions and enterprises
Logistics	In accordance with the technological requirements for the 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 as amended by Resolution of the Cabinet of Ministers of Ukraine No. 365 dated 24.03.2021, as well as specialized biotechnological laboratory equipment
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the corresponding level of HE, approved by Resolution of the Cabinet of Ministers of Ukraine No. 1187 dated 30.12.2015 as amended by Resolution of the Cabinet of Ministers of Ukraine No. 365 dated 24.03.2021.

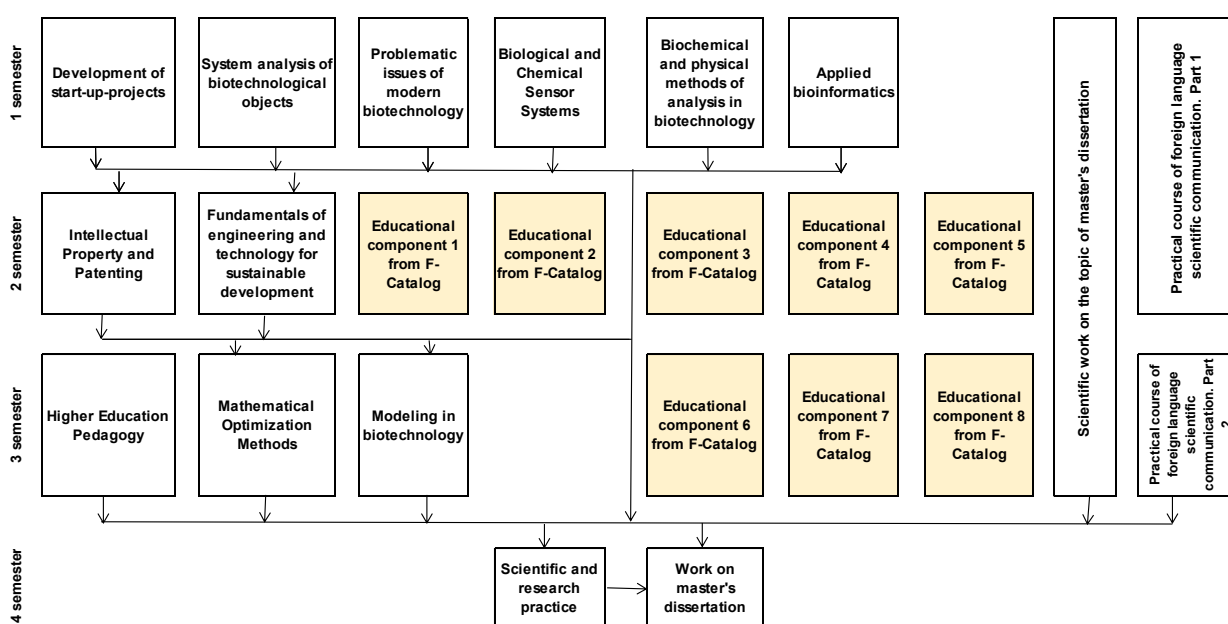
9 – Academic mobility

National credit mobility	The possibility of studying agreements on academic mobility and on double graduation
International credit mobility	Possibility of concluding agreements on international academic mobility (Erasmus + K1), on double graduation, on long-term international projects that include inclusive student education
Training of foreign applicants for higher education	In common academic groups in the Ukrainian language, or in separate groups in a foreign language.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PART OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

Code	Components of the educational program (academic disciplines, practices, qualification work))	Credit	Form of final control
1	2	3	4
1. NORMATIVE educational components			
1.1. General training cycle			
GN1	Intellectual Property and Patenting	3	Test
GN2	Fundamentals of engineering and technology for sustainable development	2	Test
GN3	Practical course of foreign language scientific communication. Part 1	3	Test
GN4	Practical course of foreign language scientific communication. Part 2	1,5	Test
GN5	Development of start-up-projects	3	Test
GN6	Higher Education Pedagogy	2	Test
GN7	Mathematical Optimization Methods	4	Test
GN8	Modeling in biotechnology	4	Test
1.2. Vocational training cycle			
PT1	System analysis of biotechnological objects	5	Exam
PT2	Problematic issues of modern biotechnology	5	Exam
PT3	Biological and Chemical Sensor Systems	5	Exam
PT4	Biochemical and physical methods of analysis in biotechnology	4	Test
PT5	Applied bioinformatics	4	Test
PT6	Scientific work on the topic of master's dissertation	11	Test
PT7	Scientific and research practice	9	Test
PT8	Work on master's dissertation	17	Dissertation defense
2. ELECTIVE educational components			
Vocational training cycle			
FC1	Educational component 1 from F-Catalog	4	Test
FC2	Educational component 2 from F-Catalog	4	Test
FC3	Educational component 3 from F-Catalog	5	Exam
FC4	Educational component 4 from F-Catalog	5	Exam
FC5	Educational component 5 from F-Catalog	5	Exam
FC6	Educational component 6 from F-Catalog	5	Exam
FC7	Educational component 7 from F-Catalog	5	Exam
FC8	Educational component 8 from F-Catalog	4,5	Test
The total amount of mandatory components:		82,5	
Total amount of elective components:		37,5	
The total amount of educational components that ensure the acquisition of competencies defined by the Standard		82,5	
TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM		120	

3. STRUCTURAL-LOGICAL SCHEME



4. FORM OF CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Attestation of students of higher education in the educational and professional program Biotechnology, specialty 162 Biotechnologies and bioengineering is carried out in the form of a public 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 biotechnology and bioengineering. The qualifying work is checked for plagiarism and after protection is placed in the NTB repository of the University for free access. The dissertation, which contains materials or results that are the common property of industrial enterprises or scientific institutions on the basis of which the work was performed, is placed in public access only with their consent or in the form of extended annotations.

Attestation is carried out openly and publicly.

5. MATRIX OF SUITABILITY OF SOFTWARE COMPETENCIES OF THE COMPONENTS OF THE EDUCATIONAL PROGRAM

The matrix of correspondence of program competencies to the components of the educational program is given in Appendix A.

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

The matrix of the provision of program learning outcomes by the relevant components of the educational program is given in the Appendix B.

Appendix A

**MATRIX OF SUITABILITY OF SOFTWARE COMPETENCIES OF THE
COMPONENTS OF THE EDUCATIONAL PROGRAM**

	GN1	GN2	GN3	GN4	GN5	GN6	GN7	GN8	PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8
GC 1							+	+				+		+		
GC 2	+		+	+										+		+
GC 3		+			+	+										
GC 4	+		+	+												
GC 5	+				+											
GC 6	+	+				+										
GC 7			+	+		+										
GC 8	+	+														
PC 1										+				+		
PC 2													+	+		
PC 3									+				+			
PC 4										+					+	
PC 5									+			+	+			+
PC 6											+			+		
PC 7									+	+		+				
PC 8									+	+						
PC 9									+			+				
PC 10										+		+			+	
PC 11										+						+
PC 12															+	+
PC 13														+	+	
PC 14															+	+
PC 15									+				+			
PC 16												+		+		
PC 17											+					

Appendix B**MATRIX OF PROVIDING PROGRAM LEARNING OUTCOMES BY
RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM**

	GN1	GN2	GN3	GN4	GN5	GN6	GN7	GN8	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 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							+						+	+		
PLO 20								+	+				+			
PLO 21			+	+	+								+		+	