

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
KYIV NATIONAL UNIVERSITY OF TECHNOLOGIES AND DESIGN

APPROVED BY ACADEMIC COUNCIL

Chairman of Academic Council

\_\_\_\_\_ Ivan GRYSHCENKO

(Minutes № 11, June 30 2021)

**EDUCATIONAL - PROFESSIONAL PROGRAM**

**Biotechnology**

|                           |  |
|---------------------------|--|
| Level of higher education | first bachelor's degree                      |
| Degree                    | Bachelor                                     |
| Subject area              | 16 Chemical Engineering and Bioengineering   |
| Specialty                 | 162 Biotechnology and Bioengineering         |
| Qualification             | Bachelor in Biotechnology and Bioengineering |

Kyiv 2021

LETTER OF APPROVAL  
EDUCATIONAL - PROFESSIONAL PROGRAM

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Vice-Rector for Scientific and Pedagogical Activity (Educational Activity)

\_\_\_\_\_ Oksana MORHULETS  
(date) (signature) (initials and the last name)

**Approved by the Academic Council of the Faculty of Chemical and Biopharmaceutical Technologies**

Minutes № 9 of « 19<sup>th</sup> » April 2021

Dean of the Faculty of Chemical and Biopharmaceutical Technologies

\_\_\_\_\_ Olha BAULA  
(date) (signature) (initials and the last name)

**Discussed and recommended at the meeting of the Department of Biotechnology, Leather and Fur**

Minutes № 12 of « 12<sup>th</sup> » April 2021

Head of the Department of Biotechnology, Leather and Fur

\_\_\_\_\_ Olena MOKROUSOVA  
(date) (signature) (initials and the last name)

Head of the project team \_\_\_\_\_ Ihor HRETSKIY

Enacted by order of the KNUTD from "02" July 2021 № 192

## INTRODUCTION

Developed by: Kyiv National University of Technologies and Design

### CONTENT BY:

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## 1. Profile of the educational - professional program **Biotechnology**

| <b>1 – General information</b>  |   |
|---|---|
| <b>Full name of a higher education institution and structural unit</b>  | Kyiv National University of Technologies and Design<br>Department of Biotechnology, Leather and Fur   |
| <b>Higher education and qualification in the original language</b>  | Higher Education Level - First (Bachelor)<br>Higher Education Degree - Bachelor<br>Subject area - 16 Chemical Engineering and Bioengineering<br>Specialty - 162 Biotechnology and Bioengineering  |
| <b>Type of diploma and scope of the educational program</b>   | Bachelor's Degree, single, 240 ECTS credits, duration of training - 3 years and 10 months<br>Bachelor's Degree, single, 180 ECTS credits, duration of training - 2 years and 10 months  |
| <b>Accreditation</b>  | Certificate UD № 11010111 dated 09.07.2019  |
| <b>Cycle/level</b>  | National Qualifications Framework of Ukraine: Bachelor - Sixth Level  |
| <b>Prerequisites</b>  | Complete general secondary education, professional higher education or junior bachelor's degree (junior specialist). In accordance with the Standard of Higher Education in the specialty based on the degree of junior bachelor (OQR junior specialist), the University recognizes and recalculates ECTS credits received within the previous educational program for junior bachelor (junior specialist)  |
| <b>Language (-s) of teaching</b>  | Ukrainian, English  |
| <b>Duration of the educational program</b>  | Until July 1 <sup>st</sup> , 2024   |
| <b>Website for a permanent description of the educational program</b>   | <a href="http://knutd.edu.ua/ekts/">http://knutd.edu.ua/ekts/</a>   |
| <b>2 – Purpose of the educational program</b>   |   |
| Formation and development of general and professional competencies in the field of biotechnology and bioengineering for the complex implementation of project-technological, industry-technological and scientific-research work related to the use of biological agents and their products to obtain biologically active substances and products through biosynthesis and/or biotransformation, aimed at acquiring by the student the knowledge, skills and abilities necessary for the designing and organization of biotechnological production and product quality assessment |   |
| <b>3 – Characteristics of the educational program</b>   |   |
| <b>Subject matter</b>   | The program is focused on the formation of applicants' competencies for the acquisition of deep knowledge, skills and abilities in the specialty. Compulsory educational components – 75%, of which: disciplines of general education – 33%, including learning a foreign language – 13 %; professional education – 67%, including practical training – 13% and Bachelor's thesis – 7%. Disciplines of free choice of students: 25% are selected from the university catalog in accordance with the approved procedure at the University. |
| <b>Orientation of the program</b>   | The bachelor's degree program focuses on training professionals who can use biological agents and their products at the professional level to obtain biologically active substances and products through biosynthesis and/or biotransformation, considering the bioethics and biosafety of society.   |
| <b>The main focus of the program and specialization</b>   | Emphasis is placed on the formation and development of professional competencies to solve applied problems in the field of biotechnology and bioengineering through research, development, creation, and  |

|  |   |  |
|--|---|--|
|  | production of biotechnological products for medicine, health, agriculture, ecology, energy, light industry and more.<br>Keywords: biological agents, biotechnology, immunobiotechnology, biomaterials, biosynthesis and biotransformation, bioethics, biosafety   |  |
| <b>Features of the program</b>                                       | The program provides in-depth theoretical and practical training, generalization of the results of project-technological and industry-technological solutions, scientific-research work, implementation, and defense of qualifying work. The program develops employment prospects in modern biotechnological enterprises. Provides opportunities for the implementation of international academic mobility of participants in the educational process.   |  |
| <b>4 – Suitability of graduates for employment and further study</b> |   |  |
| <b>Suitability for employment</b>                                    | The graduate is suitable for the employment at enterprises of any legal form (state, municipal, commercial, non-commercial), in organizations and institutions operating in the fields of biotechnology and bioengineering, in educational institutions, research and design institutes. He can hold the following positions: laboratory assistant/laboratory technician (chemical, biochemical, microbiological and physical research), technician (biotechnology), technician-laboratory assistant (biotechnology production), trainee researcher, technologist. Professional titles (according to DC 003: 2010): Biotechnology Specialist, Laboratory Assistant (biological research), Laboratory Technician, Laboratory Assistant (biotechnology) |  |
| <b>Further education</b>   | Opportunity to study according to the educational-professional and/or educational-scientific program of the second (Master's) level of higher education.  |  |
| <b>5 – Teaching and assessment</b>                                   |   |  |
| <b>Teaching and learning</b>   | Student-centered and problem-oriented learning, hands-on training and self-study are used. The system of teaching methods is based on the principles of purposefulness and binarity-active direct involvement of the teacher and the student. Teaching is carried out in the form of lectures, seminars, practical classes in small groups, laboratory practical training, independent work, consultations with teachers, development of professional projects.   |  |
| <b>Assessment</b>  | Exams, credits, tests, project work, presentations, reports.  |  |
| <b>6 – Program competencies</b>                                      |   |  |
| <b>Integral competency (IC)</b>                                      | The ability to solve complex specialized problems and practical problems, characterized by the complexity and uncertainty of the conditions in biotechnology and bioengineering, or in the process of learning, which involves the application of theories and methods of biotechnology and bioengineering.   |  |
| <b>General competencies (GC)</b>                                     | GC 1  | Ability to apply knowledge in practical situations.  |
|  | GC 2  | Proficiency in written and oral communication in Ukrainian (professional direction).   |
|  | GC 3  | Ability to communicate in a foreign language.  |
|  | GC 4  | Skills in using information and communication technology.  |
|  | GC 5  | Ability to learn and master a modern knowledge.  |
|  | GC 6  | Safe practice skills.  |
|  | GC 7  | The desire to preserve the environment.  |
|  | GC 8  | Ability to realize the rights and responsibilities as a member of society, realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, rights and freedoms of the man and citizen in Ukraine. |

|                                       |       |  |
|---------------------------------------|-------|--|
|                                       | GC 9  | Ability to store and multiply moral, cultural, scientific values and achievements of the society on the basis of understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, processes and technology, use different types and forms of motor activity for the active rest and healthy way life. |
| <b>Professional competencies (PC)</b> | PC 1  | Ability to use knowledge of math and physics to the extent necessary to reach other results of the educational program.  |
|                                       | PC 2  | Ability to use a thorough knowledge of chemistry and biology to the extent necessary to reach other results of the educational program.  |
|                                       | PC 3  | The ability to analyze regulatory documentation, necessary to provide engineering activities in the industry of biotechnology.   |
|                                       | PC 4  | Ability to work with biological agents, which are used in biotechnological processes (microorganisms, fungi, plants, animals, viruses, their individual components).   |
|                                       | PC 5  | Ability to conduct experimental studies connected with the improvement of biological agents, and cause changes in the structure of the hereditary apparatus and functional activity of biological agents.  |
|                                       | PC 6  | Ability to analyze raw materials, semi-finished products, target products of biotechnology production.   |
|                                       | PC 7  | Consideration of the commercial and economic context in the design of biotech productions of various applications (industrial, food, pharmaceutical, agricultural, etc.).  |
|                                       | PC 8  | Ability to use design techniques for the production of biotechnological products of various applications.  |
|                                       | PC 9  | Ability to use knowledge of math and physics to the extent necessary to reach other results of the educational program.  |
|                                       | PC 10 | Ability to draw up production flow charts of biotechnological products of various applications.  |
|                                       | PC 11 | Ability to draw up production hardware configurations of biotechnological products of various applications.  |
|                                       | PC 12 | Ability to put into practice methods and measures of computer-aided design for biotechnological productions of products of various applications.   |
|                                       | PC 13 | Ability to evaluate biotechnological efficiency of the process.  |
|                                       | PC 14 | The ability to use modern automated biotechnology production management systems of various purposes, their technical, algorithmic, information and software to solve professional tasks.   |
|                                       | PC 15 | Ability to comply with biosafety, biosecurity and bioethics.   |

### **7 – Program learning outcomes**

#### **Knowledge and understanding:**

|       |  |
|-------|--|
| PLO 1 | Be able to apply modern mathematical methods to solve practical problems related to research and design of biotechnological processes. Use knowledge of physics to analyze biotechnological processes  |
| PLO 2 | Be able to perform qualitative and quantitative analysis of substances of inorganic, organic and biological origin, using appropriate methods.   |
| PLO 3 | Be able to measure nutrient media composition, to determine points of their preparation and sterilization, to control the quality of raw materials and finished products based on knowledge of the physicochemical properties of organic and inorganic substances. |
| PLO 4 | Be able to apply the regulations about products certification, requirements for the organization of quality management systems in enterprises, rules for technical   |

|   |   |
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|   | documentation and technological process, based on knowledge gained during practical training.   |
| PLO 5   | Be able to analyze normative documents (state and industry standards, technical guidelines, etc.), compile separate sections of technological and analytical documentation for biotechnological products for various purposes; analyze technological situations, choose rational technological solutions.   |
| <b>Application of knowledge and understanding (skills):</b> |   |
| PLO 6   | Be able to determine and analyze the basic physicochemical properties of organic compounds that are part of biological agents (proteins, nucleic acids, carbohydrates, lipids).   |
| PLO 7   | Be able to apply knowledge of the composition and structure of different cell types in order to determine the optimal conditions for cultivation and the potential of the cells in biotechnology.   |
| PLO 8   | Be able to isolate and identify microorganisms of different systematic groups from natural ecosystems. Determine the morphological, cultural, physiological, biochemical properties of various biological agents.   |
| PLO 9   | Be able to prepare the basic nutrient media for the cultivation of various biological agents. Evaluate the growth of biological agents in media of different composition.   |
| PLO 10  | Be able to do experimental research to determine the impact of physicochemical and biological factors of the environment on the viability of cells of living organisms.   |
| PLO 11  | Be able to perform basic genetic and cytological studies to improve and enhance the biosynthetic capacity of biological agents, taking into account the principles of biosafety, biosecurity and bioethics (induced mutagenesis using physical and chemical mutagenic factors, selection and accumulation of auxotrophic mutants, etc.).  |
| PLO 12  | Using microbiological, chemical, physical, physicochemical and biochemical methods, be able to perform chemical control (determination of the concentration of disinfectant solutions, titrants, concentration of nutrient components, etc.), technological control (concentration of carbon and nitrogen sources in the culture fluid during the process; target product); microbiological control of nutrient media after sterilization, microbiological purity of biological agent, etc.), microbiological purity and sterility of biotechnological products for various purposes. |
| PLO 13  | Be able to carry out a feasibility study for the production of biotechnological products for various purposes (determination if there is a need in target product and calculation of production capacity).  |
| PLO 14  | Be able to justify the choice of biological agent, the composition of the nutrient medium and method of cultivation, the necessary additional work and the main stages of the technological process.  |
| <b>Making judgments:</b>                                    |   |
| PLO 15  | Based on knowledge about the laws of mechanical, hydromechanical, heat and mass transfer processes and basic design characteristics, be able to choose the appropriate equipment in the process of designing the production of biotechnological products for various purposes to ensure their maximum efficiency.   |
| PLO 16  | Based on the knowledge gained during the internship at enterprises and institutions, be able to carry out product calculation and calculation of technological equipment.   |
| PLO 17  | Be able to compile a material balance for one cycle of the production process, equipment specifications and a map of step-by-step control with the indication of production control points.   |
| PLO 18  | Be able to substantiate and select the appropriate technological equipment and graphically depict technological process according to the requirements of regulatory documents using the knowledge gained during practical training.   |
| PLO 19  | Be able to use computational design systems to develop technological and hardware schemes of biotechnological productions.  |

|  |   |
|--|---|
| PLO 20   | Be able to calculate the main criteria for effectiveness estimation of the biotechnological process (growth parameters of biological agents, the rate of synthesis of the target product, the synthesizing capacity of biological agents, economic coefficient, yield of the target product from the substrate, productivity, nutrient value, etc.).  |
| PLO 21   | Be able to formulate tasks for development of automation systems for production of biotechnological products for various purposes.  |
| PLO 22   | Be able to apply social, environmental, ethical, economic aspects, the requirements of labor protection, industrial sanitation and fire safety in the formation of technical solutions. Be able to use different types and forms of physical activity for active recreation and healthy lifestyle.  |
| PLO 23   | Be able to use in product and social activities fundamental concepts and categories of state formation to substantiate their own views and political beliefs with understanding of Ukraine social and political history, legal principles and ethical norms.  |
| PLO 24   | Be able to communicate with specialists and non-specialists about ideas, problems, solutions and personal experience in the field of biotechnology and bioengineering in state (official) or one of the main European languages.  |
| <b>8 – Resource support for program implementation</b>   |   |
| <b>Staffing</b>  | All scientific and pedagogical workers who carry out the educational and professional program correspond to the profile and direction of the disciplines taught by qualification; they have the necessary experience of pedagogical and practical work. Specialists with experience in scientific, managerial, innovative, creative and professional work, foreign teachers are involved in the organization of the educational process.  |
| <b>Material and technical support</b>                    | Logistics fully allows ensuring the educational process throughout the cycle of training in the specialty.<br>Laboratory equipment includes: complex equipment for the development, production, and characterization of biotechnological products of various origins in structure and function; orbital thermal shaker incubator, natural convection microbiological incubator, electrophoresis chamber, PCR analyzer and PCR box, enzyme-linked immunosorbent assay equipment, microscopes with video cameras for photo and video studies of microbiological objects, spectrophotometers for quantitative and qualitative analysis, microdispensers, centrifuges, including necessary technical support, complete with computer and multimedia equipment.<br>The condition of the premises is certified by sanitary passports that comply with applicable regulations. |
| <b>Information and methodological support</b>            | The program is fully equipped with an educational and methodological complex of all components of the educational program, the availability of which is presented in the modular environment of the educational process of the University.  |
| <b>9 – Academic mobility</b>                             |   |
| <b>National credit mobility</b>                          | Provides for the possibility of academic mobility in some components of the educational program, providing the acquisition of general and / or professional competencies.   |
| <b>International credit mobility</b>                     | The program opens up prospects for participation and internships in research projects and academic mobility programs abroad; conducted in an active research environment.   |
| <b>Education for foreign higher education applicants</b> | Training of foreign applicants for higher education is carried out according to accredited educational programs.  |



## 2. List of components of the educational-professional program "Biotechnology" and their logical sequence

### 2.1 List of components of the educational-professional program

| Code of the course                                     | Components of the educational program (educational subjects, course papers, practical training, qualification work) | Number of credits | Form of final control |
|--|---|-------------------|-----------------------|
| <b>Compulsory components CC</b>                        |   |                   |                       |
| <b>General courses cycle</b>                           |   |                   |                       |
| CC 1   | Ukrainian and foreign culture   | 3                 | credit                |
| CC 2   | Foreign language  | 12                | exam                  |
| CC 3   | Business Ukrainian language   | 3                 | credit                |
| CC 4   | Philosophy, political science and sociology   | 6                 | exam                  |
| CC 5   | Foreign language for specific purposes  | 12                | exam                  |
| CC 6   | Safety and civil protection   | 3                 | exam                  |
| CC 7   | General and Inorganic Chemistry   | 9                 | exam                  |
| CC 8   | Higher mathematics  | 6                 | exam                  |
| CC 9   | Physics   | 3                 | exam                  |
| CC 10  | Physical training   | 3/9*              | credit                |
| <b>Total from the cycle</b>                            |   | <b>60</b>         |                       |
| <b>Professional courses cycle</b>                      |   |                   |                       |
| CC 11  | Biotechnology fundamentals  | 3                 | credit                |
| CC 12  | Information systems and technologies  | 3                 | exam                  |
| CC 13  | Qualitative and quantitative analysis   | 6                 | exam                  |
| CC 14  | Organic chemistry   | 6                 | exam                  |
| CC 15  | Physical and Colloid Chemistry  | 3                 | exam                  |
| CC 16  | Biologically active compounds   | 6                 | credit                |
| CC 17  | Cell Biology  | 3                 | exam                  |
| CC 18  | Biological Chemistry  | 6                 | exam                  |
| CC 19  | Genetics  | 3                 | credit                |
| CC 20  | Professional communications   | 3                 | credit                |
| CC 21  | General microbiology and virology   | 6                 | exam                  |
| CC 22  | Immunology and immunobiotechnology  | 3                 | exam                  |
| CC 23  | Hygiene and sanitation  | 3                 | credit                |
| CC 24  | Processes and apparatuses of biotechnological manufactures  | 3                 | exam                  |
| CC 25  | General biotechnology   | 6                 | exam                  |
| CC 26  | Automated design of biotechnological systems  | 3                 | exam                  |
| CC 27  | Economic efficiency of enterprises  | 3                 | credit                |
| CC 28  | Equipment and tools for biotechnological manufacturing  | 3                 | exam                  |
| CC 29  | Methods and tools of diagnostics in biotechnology   | 3                 | exam                  |
| CC 30  | Design of biotechnological productions  | 3                 | exam                  |
| CC 31  | Fundamentals of bioethics and biosafety   | 3                 | credit                |
| CC 32  | Regulatory support of biotechnological industries   | 3                 | credit                |
| CC 33  | Industrial practice   | 6                 | credit                |
| CC 34  | Educational practice  | 12                | credit                |
| CC 35  | Pre-diploma practice  | 6                 | credit                |
| CC 36  | Bachelor's thesis   | 12                | attestation           |
| <b>Total from the cycle</b>                            |   | <b>120</b>        |                       |
| <b>The total amount of required components</b>         |   | <b>180</b>        |                       |
| <b>Selective components of the educational program</b> |   |                   |                       |
| SCEP   | Disciplines of free choice of the student   | 60                | credit                |
| <b>The total amount of sample components</b>           |   | <b>60</b>         |                       |
| <b>TOTAL CRDITS</b>                                    |   | <b>240</b>        |                       |

\* Physical training (in addition to credits)

## 2.2. Structural-logical scheme of the educational-professional program for Bachelor's study in specialty 162 Biotechnology and Bioengineering





