Appendix No 2 to Resolution No. 65/2026

THE PROGRAMME OF STUDY

The programme is effective from the academic year: 2026/2027

Field of study: BIOTECHNOLOGY

1. **ISCED Code: 0512**
2. **Forms of study: full-time programme**
3. **Number of semesters: 4**
4. **Professional title awarded to graduates: magister [master's degree]**
5. **Educational profile: general academic**
6. **Field of science: natural sciences**
7. **Discipline of science**:
   - **leading discipline: biological sciences - 72% (86 ECTS),**
   - **supplementary discipline: chemical sciences - 28% (34 ECTS).**
8. **Number of ECTS points necessary to complete studies: 120**
   1) the number of ECTS points that the student is obligated to obtain during classes conducted with the direct participation of academic teachers or other persons: **75 -** full-time programme of studies
   2) the number of ECTS points that the student is obligated to obtain as part of classes related to the conducted scientific activity in the discipline or disciplines to which the field of study is assigned in more than 50% of the total number of ECTS points): **63**
   3) the number of ECTS points that the student obtains by completing elective classes (at least 30% of the total number of ECTS points) (including elective general education courses (classes)): **53**
   4) the number of ECTS points that the student is obligated to obtain as part of classes in the field of humanities or social sciences, not less than 5 ECTS points - in the case of fields of study assigned to disciplines within fields other than humanities or social sciences, respectively: **5**
9. **Total number of hours of classes: 3090**
   - including the number of hours of classes conducted with the direct participation of academic teachers or other persons conducting classes: **1885**
   - number of class hours conducted using distance learning methods and techniques: **0**
10. **The concept and goal of education** (including the description of the graduate):

    The second-cycle programme of studies in the field of biotechnology at JKU (Jan Kochanowski University of Kielce) is conducted in accordance with the requirements of the Polish Qualifications Framework. After completing two-year second-cycle programme of studies, graduates of the field of biotechnology

obtain a master's degree. They have extensive knowledge in the field of genetic engineering, including the selection and modification of microorganisms and cells of animal and plant organisms. They have the ability to gather and critically evaluate information in the field of biotechnology, as well as planning and implementing biotechnological processes in the food industry, environmental protection, and medical diagnostics. They also have extensive ability to use modern methods in the field of genetic engineering, medical diagnostics, and instrumental analysis. They can create genetically modified organisms and analyse the natural environment, food products, and medical products. They have the abilities related to the control of analytical process, including quality assurance and quality control in a biotechnology laboratory. They acquire the mathematical and computer skills needed to analyse large data sets. Graduates of the second-cycle programme of studies in the field of biotechnology are prepared to implement red (medical) and white (industrial technology) biotechnology projects. Graduates are also prepared to continue their studies at doctoral schools and do doctoral theses in the field of biotechnology and biological and chemical sciences. They are predisposed to undertake skills improvement courses and postgraduate programmes of studies.

Graduates of the second-cycle programme of studies are prepared to:

- design and conduct processes to obtain products with desired characteristics,
- use the acquired knowledge and skills in the development and optimisation of biotechnological processes,
- design and conduct experiments and research work in the field of biotechnology,
- find employment in laboratories and industries using biotechnology.

11. LEARNING OUTCOMES

Symbol notation:

- BIOT – for marking the field of Biotechnology,
- 2A – for marking the cycle of study,
- symbol _ (underscore) – a separator,
- one of the letters W, U, K – for marking the category of outcomes (W-knowledge, U-abilities, K-social competence),
- outcome number within a given category, written in the form of two digits.

Learning outcomes symbols in the field	After the completion a graduate:	Relate learning outcomes to: universal characteristics for a given level of the Polish Qualifications Framework (Act on ZSK- Integrated Qualifications System)	Relate learning outcomes to: second-level characteristics of learning outcomes for the qualifications at levels 6-7 of the Polish Qualifications Framework (Regulation of the Ministry of Science and Higher Education)
in the scope of **KNOWLEDGE:**			
BIOT2A_W01	has extensive knowledge in the field of biology, chemistry, and biophysics, specialising in the field of biotechnology	P7U_W	P7S_WG
BIOT2A_W02	interprets complex natural phenomena in the context of biotechnological processes based on experimental data	P7U_W	PZS_WG
BIOT2A_W03	has extensive knowledge of selected facts, phenomena, and methods in the field of biotechnology, and also of theories explaining the relationships among them in the scope of the field studied	P7U_W	P7S_WG
BIOT2A_W04	has extensive knowledge in the field of research techniques used in biotechnology	P7U_W	P7S_WG
BIOT2A_W05	knows the potential applications of microorganisms in industry and medicine and the main development trends in biotechnology	P7U_W	P7S_WG
BIOT2A_W06	knows and understands extensively the principles of design and the course of various biotechnological processes and the potential risks resulting from their use	P7U_W	P7S_WG
BIOT2A_W07	knows advanced mathematical, statistical and bioinformatics methods used for modelling biotechnological processes	P7U_W	P7S_WG
BIOT2A_W08	knows the principles of ergonomic and safe organisation of work in biotechnology and related laboratories	P7U_W	P7S_WK
BIOT2A_W09	knows the principles related to legal conditions, including the procedures of intellectual property protection, and ethical conditions related to the scientific activity	P7U_W	P7S_WK
in the scope of **ABILITIES:**			
BIOT2A_U01	can plan and conduct research tasks with advanced techniques and tools used in biotechnology	P7U_U	P7S_UW

BIOT2A_U02	can conduct selected studies independently in the field of biotechnology under the supervision of a tutor	P7U_U	P7S_UW
BIOT2A_U03	can use advanced mathematical and statistical methods to analyse experimental data	P7U_U	P7S_UW
BIOT2A_U04	can work independently and cooperate with other persons, and take a leading role in teams as part of the research work undertaken in the field of biotechnology and related sciences	P7U_U	P7S_UO
BIOT2A_U05	can independently plan a path of professional and scientific development	P7U_U	P7S_UU
BIOT2A_U06	can critically evaluate the results of experiments, observations and theoretical calculations related to research work in the field of biotechnology	P7U_U	P7S_UW
BIOT2A_U07	can use a foreign language proficiently enough to read scientific literature and communicate at the B2+level	P7U_U	P7S_UK
BIOT2A_U08	can properly select and analyse information from a variety of sources and draw conclusions from it	P7U_U	P7S_UW
BIOT2A_U09	can present, in oral and written form, the goal, methodology and results of the study in Polish and in English	P7U_U	P7S_UW
BIOT2A_U010	can conduct biosynthesis and biotransformation processes, isolation and purification of bioproducts using modern biotechnological tools and techniques	P7U_U	P7S_UW

in the scope of **SOCIAL COMPETENCE:**

BIOT2A_K01	is aware of the importance of the acquired knowledge in solving cognitive and practical problems in the field of biotechnology and related sciences	P7U_K	P7S_KK
BIOT2A_K02	is ready to fulfil social obligations and share the expertise acquired in the field of biotechnology	P7U_K	P7S_KO
BIOT2A_K03	is ready to responsibly perform professional roles	P7U_K	P7S_KR
BIOT2A_K04	questions the knowledge gained and is aware of the need to improve it continuously.	P7U_K	P7S_KK

12. CLASSES WITH ASSIGNED ECTS POINTS, LEARNING OUTCOMES, AND STUDY PROGRAMME CONTENT:

Courses (classes)	Number of ECTS points	Study programme content	Reference to learning outcomes in the field of
GENERAL EDUCATION COURSES (CLASSES): (19 ECTS credits)			
1. Foreign lanuage	3	**Lexical content:** • Specialist vocabulary relevant to the field of study – discussions	BIOT2A_U07 BIOT2A_U09

			– interpretation of statistical data and graphs – presentations of, e.g., scientific articles, study results • Summaries of a diploma thesis, specialist articles or other written work relevant to the field of study • Elements of translation **Grammar content:** Revision and consolidation of the most important grammar issues (practically and professionally oriented). **Language functions:** Allowing students to communicate in a foreign language, express opinions, argue, produce summaries of specialist publications relevant to the field of study, make presentations.	
2.	Elective courses (classes) in the field of humanities	2	The world cultures / From Adam and Eve to 21st century marriage	BIOT2A_W09 BIOT2A_K02
3.	Elective courses (classes) in the field of humanities	3	Bioethics / Cultural texts in communication space	BIOT2A_W09 BIOT2A_K02
4.	An elective courses (classes) to support students in the learning process	1	Stress management methods / Self-presentation	BIOT2A_K03

GENERAL/MAJOR COURSES (CLASSES): (61 ECTS credits)

1.	Biostatistics	4	Linear and non-linear regression models. Simple regression. Multiple regression. Constructing a regression model: assumptions and model diagnostics. Non-linear regression. Logistic regression. Analysis of variance. Multiple comparison procedures. Survival analysis. Statistical evaluation of diagnostic test results. Operating characteristic curves. Meta-analyses. Data mining. Multivariate analysis and decision trees.	BIOT2A_W07 BIOT2A_U03 BIOT2A_K01
2.	Food chemistry	4	Chemical composition and breakdown of basic foods. Water activity and its influence on food reactions. Sugars in foods: structure, occurrence, and properties. Lipids: structure, properties, and role: fatty acids, triacylglycerols, and phospholipids. Proteins in foods: structure, metabolism. Amino acids and peptides. Occurrence, structure, and properties of polyphenols. Natural and synthetic colours in food. Flavour compounds in food. Mutagens, carcinogens and anticancerogens, food contaminants.	BIOT2A_W01 BIOT2A_U01 BIOT2A_U06 BIOT2A_K01
3.	Molecular biophysics	2	Biological properties of macromolecules. Thermodynamics and hydrodynamics of macromolecules. Methods of studying protein structure: optical spectroscopy, X-ray and neutron scattering methods. Structure and properties of biological membranes. Discussion of methods	BIOT2A_W01 BIOT2A_W02 BIOT2A_W03

			used in molecular biophysics, i.e. methods to study the structure of biomolecules, dynamics, and their functions. Introduction to physical phenomena used in molecular biophysics methods and interpretation of their results.	BIOT2A_U01 BIOT2A_U06 BIOT2A_K01
4.	Separation methods in biotechnology	5	Modern separation methods: chromatographic (gas chromatography with flame ionisation detection and mass spectrometry, liquid chromatography with UV-Vis detection) and electromigration (capillary electrophoresis with UV-Vis detection). Preparation and isolation of selected compounds from liquid and solid samples by liquid-solid methods: LLE, SPE, SPME, MEPS, MSPE. Membrane filtration. Pore transport and solubility-diffusion model. Processes: microfiltration (MF), reverse osmosis (RO), nanofiltration (NF). Permeation and pervaporation processes. Ion exchange membranes. Membrane bioreactors. Dialysis and electrodialysis. Membrane distillation (MD).	BIOT2A_W01 BIOT2A_W04 BIOT2A_W08 BIOT2A_U01 BIOT2A_U06 BIOT2A_K01 BIOT2A_K04
5.	Models of invertebrates in biotechnology	4	Fundamentals of the use of insect cells and baculoviruses. Examples of commercial insect cell line products. Use of hogweed larvae as a model for bacterial infection. Changes in the expression of selected bacterial pathogenicity factors following passage by hogweed larvae.	BIOT2A_W05 BIOT2A_W06 BIOT2A_U04 BIOT2A_U08 BIOT2A_K04 BIOT2A_K02
6.	Medical microbiology	6	Etiopathogenesis and epidemiology of infections (sources of infection, routes of transmission, susceptible population, risk factors). Microbiological diagnosis. Detailed microbiology (discussion of the most important clinical bacteria). Basic antimicrobial drug groups - mechanism of action, spectrum. Clinically important mechanisms of microbial resistance to antibiotics. Empirical and targeted antibiotic therapy. Disinfection, sterilisation and aseptic management. Prevention of infections. Structure of viruses. Virus multiplication. Selected viral diseases in humans. Other infectious particles. Vaccines.	BIOT2A_W03 BIOT2A_W06 BIOT2A_W05 BIOT2A_U06 BIOT2A_U04 BIOT2A_K01 BIOT2A_K02 BIOT2A_K04
7.	Methods for identifying compounds in biological systems	4	Practical application of UV-Vis and CD spectroscopy (interpretation of spectra) to study new compounds with biological properties (potential drugs) and their interactions with biomolecules in biological systems such as DNA, HSA/BSA, GSH (MS). Investigations of antioxidant properties (use of DPPH and ABTS radicals), NADH biocatalytic properties and lipophilicity of biological compounds by UV-Vis. Extension of knowledge in the application of nuclear magnetic resonance spectroscopy (1H, 13C, 15N), including 2D NMR correlation spectroscopy and mass spectrometry in the identification of compounds in biological systems or products formed in biotechnological processes. Molecular modelling of small ligands to study interactions with selected fragments of biological systems.	BIOT2A_W01 BIOT2A_W03 BIOT2A_W04 BIOT2A_W08 BIOT2A_U01 BIOT2A_U02 BIOT2A_U06 BIOT2A_K01

8.	Quality control in a biotechnology laboratory	3	Methods of quality assurance and quality control of biotechnology laboratory work. Standards applicable to research laboratories. Measurement procedures – their characteristics and requirements. Validation process. Measurement errors and measurement uncertainty. Methods of evaluating procedures used in biotechnology laboratories.	BIOT2A_W07 BIOT2A_W08 BIOT2A_U03 BIOT2A_U06 BIOT2A_K01
9.	Food biotechnology	4	Procedures for testing microbiological contamination of food. Factors affecting microbiological contamination of food. Characteristics of pathogenic bacteria in food. Selected fermentation processes in food production.	BIOT2A_W02 BIOT2A_W05 BIOT2A_U01 BIOT2A_U02 BIOT2A_K02 BIOT2A_K03
10.	Fundamentals of genetic diseases and molecular markers	4	Mechanisms of neoplastic transformation. Effects of environmental factors on the genome. Selected genetic diseases caused by gene or chromosome mutations. Types of inheritance of genetic diseases and determination of the level of risk of a disease. Molecular basis of inborn errors of metabolism. Molecular biology and cytogenetic methods in the diagnosis of genetic diseases. Characterisation of selected molecular markers of genetic diseases in diagnosis.	BIOT2A_W03 BIOT2A_W04 BIOT2A_U01 BIOT2A_U08 BIOT2A_K01 BIOT2A_K03
11.	Methodology of scientific work	2	Types of scientific papers and their structure. Principles of designing scientific experiments. Description of the research paper; presentation of results: tables, graphs, diagrams. Interpretation of results and their discussion. Graphic presentation of a scientific paper (e.g., a scientific poster, a graphic abstract, an infographic). Copyright and protection of intellectual property rights. Legal and ethical considerations of the conducted experiments.	BIOT2A_W06 BIOT2A_W09 BIOT2A_U05 BIOT2A_U06 BIOT2A_U07 BIOT2A_U08 BIOT2A_U09 BIOT2A_K02 BIOT2A_K04
12.	Genetic engineering	8	Genetic engineering tools - restriction enzymes, vectors, polymerases, ligases, nucleases, DNA modifying enzymes. Prokaryotic and eukaryotic gene expression systems. Stages of genetic modification of an organism. Methods of introducing recombinant DNA into cells. Real-time PCR technique. Nucleic acid isolation techniques. Electrophoretic techniques. Molecular cloning procedures. Transformation and typing of bacterial strains. Production and purification of recombinant proteins. Applications of DNA cloning: biopharmaceutics, gene therapy, gene analysis. Applications of genetic engineering in medicine, industry, and agriculture. Analysis of gene expression at the level of RNA and protein.	BIOT2A_W02 BIOT2A_W03 BIOT2A_W06 BIOT2A_U01 BIOT2A_U02 BIOT2A_K01 BIOT2A_K02

13.	Clinical immunology	4	Structure and functions of the immune system. Immune reactions at the level of mucous membranes and skin. Immunological aspects of diseases of the digestive, respiratory, circulatory, and nervous systems. Immune deficiencies. Anaphylaxis and allergy. Autoimmune diseases. Proliferative diseases of the lymphatic system. Immunotherapy. Issues in transplantology. Immunological aspects of pregnancy and reproduction. Evaluation of cellular immunophenotype, tests assessing humoral response. Determination of in vitro antibody production in response to mitogen and cytokine stimulation. Blastic transformation assay. Assessment of T and NK lymphocytes. Cellular cytotoxicity. Expression of adhesion molecules. Assessment of phagocytosis. Tests to assess complement component deficiencies. Total haemolytic complement activity. Serological typing of HLA antigens.	BIOT2A_W01 BIOT2A_W03 BIOT2A_W04 BIOT2A_U01 BIOT2A_U02 BIOT2A_K01 BIOT2A_K02
14.	Fundamentals of metabolomics	3	Metabolomics versus functional genetics. Qualitative and quantitative analysis of metabolites present in cells, biological fluids, and tissues. Systems biology tools. GC-MS method. Interpretation of complex interactions occurring in a specific biological system. Application of metabolomics in microbiology and biomedicine. Methods for the analysis of biological and biochemical relations in living organisms.	BIOT2A_W01 BIOT2A_W03 BIOT2A_W04 BIOT2A_U01 BIOT2A_U04 BIOT2A_K01 BIOT2A_K04
15.	Biotechnology of bacterial polysaccharides	4	Characterisation of metabolic processes of microbial polysaccharide biosynthesis. Selected examples of polysaccharide production - xanthans, dextrans alginates. Oligosaccharides as components of vaccines.	BIOT2A_W05 BIOT2A_W06 BIOT2A_W09 BIOT2A_U04 BIOT2A_U06 BIOT2A_U08 BIOT2A_U10 BIOT2A_K02 BIOT2A_K04

COURSES (CLASSES) TO BE SELECTED: (47 ECTS credits)

1.	Courses (classes) within the scope of preparation and for submission of a master's thesis	29	**Master seminar classes in the field of red, white, gray, and gold biotechnology, including respectively:** Papers of selected articles in the field of work issue. Searching for information. Translations of fragments of articles from a foreign language. Presentation of selected elements of master's theses. Discussing the main theses of master's theses. Discussing the results of experimental works. Substantive and technical tips. The use of physicochemical and statistical methods in a thesis. Substantive and editorial elements considered by reviewers. Presentation of	BIOT2A_W02 BIOT2A_W04 BIOT2A_W06 BIOT2A_U02 BIOT2A_U04 BIOT2A_U05

			the literature and experimental parts of master's theses in PowerPoint. Discussion and correcting errors. Specifics and the course of the master's exam. Discussion of the elements subject to the assessment. **Master workshop in the field of red, white, gray, and gold biotechnology, including respectively:** collecting materials, conducting an experiment, development of results and writing a thesis.	BIOT2A_U06 BIOT2A_U07 BIOT2A_U08 BIOT2A_U09 BIOT2A_K01 BIOT2A_K04
2.	Courses (classes) expanding the student's interests	18 from 26	Pharmaceutical biotechnology (4 ECTS) Complex compounds in medical therapy and medical diagnostics (4 ECTS) Biotechnology in National Security and Bioterrorism (4 ECTS) Microbiomes of healthy and sick persons (4 ECTS) Epigenetics (2 ECTS) Nanobiotechnology (2 ECTS) Chromatographic and electromigration methods in biotechnology (4 ECTS) X-ray crystallography methods for single crystals (2 ECTS)	BIOT2A_W01 BIOT2A_W03 BIOT2A_W04 BIOT2A_W05 BIOT2A_W06 BIOT2A_W08 BIOT2A_U01 BIOT2A_U02 BIOT2A_U04 BIOT2A_U06 BIOT2A_U08 BIOT2A_K01 BIOT2A_K02 BIOT2A_K04

INTERNSHIPS: (4 ECTS credits)

INTERNSHIPS: 75 hours of student internship (3 weeks). Internships are held after the first year of studies	3	As part of the internships, the student should familiarise himself/herself with the functioning of the research laboratory in the workplace. The internship takes place in accordance with the individual internship plan agreed with the workplace. The internship is completed based on the internship student book.	BIOT2A_U01 BIOT2A_U04 BIOT2A_K01 BIOT2A_K02 BIOT2A_K03

total	**120**

Students are required to undergo a 4-hour training on safe and hygienic conditions of education (semester 1, ending with a pass).

Students are required to attend a 4-hour first aid course (semester 2, ending with a pass).

Students are required to undergo a 2-hour library training (semester 1, ending with a pass).

No ECTS credits are assigned to the classes mentioned above.

13. **METHODS OF VERIFICATION AND ASSESSMENT OF THE LEARNING OUTCOMES ACHIEVED BY THE STUDENT DURING THE ENTIRE EDUCATIONAL CYCLE:**

- **phased works:** tests, reports on practical (laboratory) exercises, presentations, projects;
- written and oral **exams, credits;**
- **diploma process** (verification of the assumed learning outcomes) – the master's thesis (experimental work) is assessed by the supervisor and the reviewer;
- **student internships** (completion of the concept of education and verification of effects in accordance with the regulations of internships);
- **tracing the graduates' careers** (information on the graduate's usefulness on the labour market);
- **survey of employers' opinions.**

The forms and methods of conducting classes as well as the assessment criteria and its components are specified in the detailed course description.
All forms of verification of the student's achievements obtained during classes in a given semester are recorded in the student`s periodic progress report.