Approved by the decision
of the MIPT Academic Council
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Federal State Autonomous Educational Institution of Higher Education "Moscow Institute of Physics and Technology (National Research University)"

THE MAIN EDUCATIONAL PROGRAM OF HIGHER EDUCATION

Level of higher education
BACHELOR

Domain of study
19.03.01 BIOTECHNOLOGY

Orientation (specialty)
BIOMEDICAL ENGINEERING/БИОМЕДИЦИНСКАЯ ИНЖЕНЕРИЯ

Starting year of the educational program
2025 y.

The main educational program of higher education in the field domain of study 19.03.01 Biotechnology, orientation (specialty) Biomedical Engineering/Биомедицинская инженерия, implemented at MIPT, is a set of basic characteristics of education (volume, content, planned results), organizational and pedagogical conditions, forms of certification, which is presented as a general characteristic of the educational program, curriculum, academic calendar schedule, work programs of disciplines (modules), training programs, evaluation and methodological materials. The main educational program of higher education has been created on the basis of the educational standard domain of study 19.03.01 Biotechnology, independently developed and approved by MIPT.

1. General characteristics of the educational program

Qualifications awarded to graduate: bachelor.

Form of education: full-time

Education period: 4 years.

The educational program consists o 240 credits and includes all types of student's classroom and independent work, training, time, allotted for quality control of the mastering of the educational program by the student.

The contact work of students with teachers consists of, at least, 4 542 hours.

Program implementation languag english.

Using a network form of educational program implementation: no.

Program goal:

This program is intended for students studying in the "Biotechnology" major in English. The program aims to provide students with the necessary knowledge in the field of Life sciences, as well as specialized knowledge in the fields of chemistry, biology, genetics, bioinformatics and biophysics. During the learning process, students choose the most interesting specialization for them for further in-depth study: bioinformatics, biophysics, molecular biology, genetics, etc. The goal of the program is to give the most complete picture of these areas for further specialization of students, as well as to provide the possibility of in-depth study of selected specialties.

2. Characteristics of the professional activity of graduates:

Fields of professional activity and areas of professional activity,

in which graduates, who have mastered the bachelor's program, can carry out professional activities:

40 Cross-cutting types of professional activities in industry (in the field of fundamental and applied research, innovation and development, as well as in the development and implementation of new technological processes for the production of advanced materials (including composites, nano- and metamaterials), optical products - micro- and nanoelectronics, development and application of electronic devices and complexes, as well as in the field of monitoring the parameters of materials, the state of complex technical and living systems and the state of the environment, including the development and use to solve assigned problems).

Graduates can carry out professional activities in other fields of professional activity and (or) areas of professional activity, provided that their level of education and acquired competencies meet the requirements of the employee's qualification.

Types of tasks of professional activity of graduates:

research.

Tasks of professional activity of graduates:

conducting scientific and analytical research on separate sections (stages, tasks) of the project within one's own subject area in accordance with approved plans and research methods;

participation in conducting observations and measurements, performing experiments and processing data using modern computer technologies;

collection and processing of scientific and analytical information using modern programs, tools and methods of computational mathematics, computer and information technologies;

participation in conducting theoretical research, building physics, mathematical and computer models of the processes and phenomena under study, in conducting analytical research in one's own subject area;

participation in the consolidation of the obtained data, conclusions formation, in the preparation of scientific and analytical reports, publications and presentations of the results of scientific and analytical research;

participation in the creation of new methods (genetic, cellular, biotechnological), technical means, algorithms and computer programs for research and applied purposes.

Objects of professional activity of graduates, mastered the program Bachelor's:

models, methods and means of fundamental and applied research and development in the field of mathematics, physics, biology, chemistry and other natural and socio-economic sciences in the profiles of subject activities in science, engineering, technology, as well as in the areas of high-tech production, management and business;

objects of engineering, technology and production;

natural and social phenomena and processes.

3. List of professional standard, corresponding to the professional activities of graduates:

40.011 Research and Development Specialist.

Code and name of the professional standard	Generalized labor functions			Labor functions		
	code	name	level of qualification	name	code	level of qualification
40.011 Professional standard "Research and Development Specialist"	A	Conducting R&D work on individual sections of the topic	5	Implementation of work on the processing and analysis of scientific and technical information and research results	A/01.5	5
				Implementation of experiments and registration of R&D work results	A/02.5	5

4. Requirements for the results of mastering the educational program

As a result of mastering the main educational program, the graduate should form universal, general professional and professional competencies.

Universal competencies of graduates and indicators of their achievement:

Code and name of competence	Code and name of the indicator of competence achievement
UC-1 Search and identify, critically assess, and synthesize information, apply a systematic approach to problem-solving	UC-1.1 Analyze problems, highlight the stages of their solution, plan the actions required to solve them UC-1.2 Find, critically assess, and select information required for the task in hand UC-1.3 Consider various options for solving a problem, assess the advantages and disadvantages of each option UC-1.4 Make competent judgments and estimates supported by logic and reasoning UC-1.5 Identify and evaluate practical consequences of possible solutions to a problem
UC-2 Determine the range of tasks for the set goal and choose the best way(s) to solve them, based on current legal regulations, available resources, and constraints	UC-2.1 Determine a set of interrelated tasks required to achieve the current objective, define the expected results of these tasks UC-2.2 Work out a solution to a specific task within a project, selecting the best way(s) to solve it, based on current legal regulations, available resources, and constraints
UC-3 Interact effectively with project team members and fulfill one's role properly	UC-3.1 Establish different types of communication (educational, scientific, business, informal, etc.) UC-3.2 Interact with other team members to fulfill the project objectives
UC-4 Conduct business communication in oral and written form in Russian and a foreign language	UC-4.1 Demonstrate the ability to exchange business information in oral and written form in Russian and at least one foreign language UC-4.2 Use modern information and communication tools to communicate
UC-5 Reflect on the cultural diversity of society from social-historical, ethical, and philosophical perspectives	UC-5.1 Demonstrate the knowledge of the basics of philosophy, history, the foundations of intercultural communication UC-5.2 Understand ethical and intellectual norms and values, their role in the history of society
UC-6 Use time-management skills, apply principles of self-development and lifelong learning	UC-6.1 Determine professional priorities and ways to improve professional performance through self-assessment UC-6.2 Plan independent activities in professional problem-solving; critically analyze the work performed; find creative ways to use relevant experience for self-development

UC-7 Maintain an adequate level of physical fitness to undertake social and professional activities	UC-7.1 Learn the basics of healthy living, health saving technologies, physical education UC-7.2 Understand the impact of physical education on health promotion and prevention of occupational diseases UC-7.3 Maintain one's physical fitness level; demonstrate general and professionally oriented physical agility; make various individual fitness plans
UC-8 Establish and maintain a safe living environment, including in the event of emergencies	UC-8.1 Learn the classification and causes of natural and human-made disasters; causes, signs, and consequences of hazards, safety procedures in case of emergency UC-8.2 Maintain a safe living environment; identify the signs, causes, and conditions of emergencies; assess the likelihood of potential hazards, and take measures to prevent them UC-8.3 Forecast dangerous or emergency situations and necessary safety measures in case of emergency
UC-9 Ability to make informed economic decisions in various areas of activity	UC-9.1 Understands the basic principles of the functioning of the economy and economic development. UC-9.2 Knows the main types and sources of economic and financial risks and how to reduce them. UC-9.3 Knows the basics of economic analysis for making informed economic decisions.
UC-10 Able to form an intolerant attitude towards manifestations of extremism, terrorism, corrupt behavior and counteract them in professional activity	UC-10.1 Understands the nature of the occurrence and danger of extremism, terrorism, corruption, the need to actively counter extremism, terrorism and corruption and the importance of forming a personal position in relation to extremism, terrorism and corrupt behavior UC-10.2 Knows the causes that generate extremism, terrorism and corruption, the possible forms of their manifestation, the principles (legal, administrative, organizational, etc.) of countering extremism, terrorism and corruption, the formation and implementation of policies to counter extremism, terrorism and corruption, as well as the basics of anti-corruption actions in various areas of life UC-10.3 Knows how to analyze the causes and prerequisites for the occurrence, the nature of manifestation and consequences of corrupt actions and is able to contribute to the implementation of the policy of countering extremism, terrorism, corruption and form a personal position on the main issues of a civil and ethical nature, demonstrating an intolerant attitude towards extremism, terrorism and corrupt behavior

General professional competencies of graduates and indicators of their achievement:

Code and name of competence	Code and name of the indicator of competence achievement
Gen.Pro.C-1 Apply knowledge of mathematical, physical, chemical, biological laws, patterns, and interrelation to study, analyze, and utilize biological objects and processes	Gen.Pro.C-1.1 Analyze the task in hand, outline the ways to complete it Gen.Pro.C-1.2 Build mathematical models, make quantitative measurements and estimates Gen.Pro.C-1.3 Determine the applicability limits of the obtained results
Gen.Pro.C-2 Use modern IT and software tools to perform professional tasks in compliance with information security requirements	Gen.Pro.C-2.1 Apply modern computing tools and Internet services in professional settings Gen.Pro.C-2.2 Apply numerical mathematical methods and use software applications for scientific problem-solving in professional settings Gen.Pro.C-2.3 Fulfill basic information security requirements

Gen.Pro.C-3 Write scientific and/or technical (technological, innovative) reports (publications, projects)	Gen.Pro.C-3.1 Adopt the general criteria for submission of manuscripts, scientific and technical documentation, using relevant software applications Gen.Pro.C-3.2 Employ practical methodologies for preparing scientific and technical reports (projects) Gen.Pro.C-3.3 Visually and graphically present scientific (scientific and technical, innovative technological) outcomes in the form of reports, scientific publications
Gen.Pro.C-4 Collect and process scientific and technical and/or technological data for fundamental and applied problem-solving	Gen.Pro.C-4.1 Apply scientific research and intellectual analysis methods for professional problem-solving Gen.Pro.C-4.2 Search for primary sources of scientific and technical and/or technological information in professional settings Gen.Pro.C-4.3 Prepare abstracts, reports, bibliographies, and reviews of information in professional settings Gen.Pro.C-4.4 Use computer and network skills to obtain, store, and process scientific (technical, technological) information
Gen.Pro.C-5 Participate in fundamental and applied research and development activities; independently develop new theoretical research methods (including mathematical research methods)	Gen.Pro.C-5.1 Perform tasks in the field of theoretical and experimental research and development activities Gen.Pro.C-5.2 Apply new knowledge through the study of literature, scientific articles, and other sources
Gen.Pro.C-6 Operate technological equipment, manage biotechnological processes, design technical and technological systems, technical facilities, biotechnological production processes by applying basic engineering and technological knowledge	Gen.Pro.C-6.1 Professionally operate modern experimental scientific research (measuring and analytical, technological) equipment in biotechnological research Gen.Pro.C-6.2 Evaluate, analyze, and interpret biotechnological data Gen.Pro.C-6.3 Possession of the skills to design new technological solutions for the scientific, technical, biotechnological task at hand

Professional competencies of graduates and indicators of their achievement:

Code and name of competence	Code and name of the indicator of competence achievement	Basis (professional standarts, analysis of other requirements for graduates)
type of professional activity tasks: research		

Pro.C-1 Plan and conduct scientific experiments (in a selected subject area) and/or theoretical (analytical and simulation) research	Pro.C-1.1 Understand the fundamental concepts, laws, and theories of modern physics and biology Pro.C-1.10 Apply knowledge of leading scientific journals to select relevant publications in professional settings Pro.C-1.11 Conducts experimental research with cells and cell cultures, conduct physical and chemical study of macromolecules, analyze and study life systems, apply mathematical methods to process biological research outcomes, understand and apply the basic concepts of bioengineering Pro.C-1.2 Gain in-depth knowledge and understanding of mathematical disciplines Pro.C-1.3 Proficiency in methods of observation, description, identifIcation and scientific classification of biological objects Pro.C-1.4 Set scientific objectives and build models of biotechnological objects and systems Pro.C-1.5 Build mathematical models used to describe and research various processes and phenomena in relevant scientific fields Pro.C-1.6 Safely use modern scientific tools and other experimental equipment Pro.C-1.7 Follow the basic rules of conduct in a modern scientific laboratory Pro.C-1.8 Estimate the time and resources required to conduct a scientific experiment Pro.C-1.9 Use modern programming languages and software packages for scientific calculations	Cross-cutting types of professional activities in industry
Pro.C-2 Analyze research data and make scientific conclusions	Pro.C-2.1 Adopt methods of statistical process and scientific data analysis Pro.C-2.2 Define key parameters of the studied phenomenon and make relevant numerical estimates Pro.C-2.3 Make scientific claims with supporting evidence for a professional audience in verbal and written form, state scientific problems and propose solutions	Cross-cutting types of professional activities in industry
Pro.C-3 Select the necessary devices, tools, and research methods for problem-solving in a selected subject area	Pro.C-3.1 Apply functional principles and operating ranges of scientific equipment Pro.C-3.2 Apply theory to evaluate the accuracy of analytical calculations Pro.C-3.3 Estimate the accuracy of numerical methods used on a computer, learn the computational complexity of the applied algorithms and the number of required computing resources	Cross-cutting types of professional activities in industry
Pro.C-4 Critically assess the applicability of applied methods and techniques	Pro.C-4.1 Apply the numerical order of values in respective professional settings Pro.C-4.2 Understand the causes of measurement errors and inaccuracies, estimate them, verify the validity of experimental results Pro.C-4.3 Provide evidence to support the cause-effect relationship of applied concepts and models	Cross-cutting types of professional activities in industry

5. Curriculum

The curriculum (Appendix 1) determines the list, labor input, sequence and distribution by periods of study of academic disciplines (modules), trainings, other types of educational activities, forms of intermediate and final certification of students. The labor input of the educational program is set in credit units.

The volume of compulsory part, excluding the volume of the state final attestation, is 47,92 persents percent of the total volume of the program.

The matrix of compliance of competencies with the disciplines of the curriculum is given in Appendix 2.

6. Academic calendar schedule

Academic calendar schedule (Appendix 3) shows the distribution of types of educational activities, periods of attestation of students and vacations by year of study (courses) and within each academic year. The academic calendar schedule of the educational program of higher education includes 196 3/6 weeks, of which there are 118 weeks of theoretical and practical training, 41 3/6 weeks of the credit-examination period, 1 2/6weeks of the state final certification and 35 4/6 weeks of holidays.

7. Work programs of disciplines (modules)

Work programs of disciplines (modules), including evaluation materials for ongoing monitoring of progress and intermediate certification, are presented in Appendix 4.

8. Practice programs

The educational program provides for the following trainings:

Research Practice/Научно-исследовательская практика (Учебная): academic practice;

Project Session/Проектная сессия: academic practice;

Laboratory Safety and Biological Workshop/Лабораторная безопасность и биологический практикум: academic practice;

Personal Research Project/Научно-исследовательская работа: practical training.

Work programs of trainings, including assessment materials for ongoing monitoring of progress and intermediate certification are presented in Appendix 5.

9. Program of the state final certification

As part of the state final certification, the following are provided:

Performance of and Defence of Graduation Thesis/Выполнение и защита выпускной квалификационной работы.

The program of the state final certification (Appendix 6) includes requirements for final qualifying works (volume, structure, design, presentation), the procedure for their implementation, the procedure for defending the final qualifying work, criteria for evaluating the results.

10. Material and technical, educational and methodological support of the educational program

The work programs of disciplines (modules), practices determine the material and technical and educational and methodological support of the educational program, including a list of licensed and freely distributed software, a list of electronic educational publications and (or) printed publications, electronic educational resources, a list and composition of modern professional databases and information reference systems.

Classrooms for conducting training sessions provided for by the educational program are equipped with equipment and technical means of training, the composition of which is determined in the work programs of disciplines (modules) and practices.

The premises for independent work of students are equipped with computer equipment with the ability to connect to the Internet and are provided with access to the electronic information and educational environment of MIPT.

MIPT's electronic information and educational environment provides access to:
– to EBS:
EBS "University Library online": section «Golden fund of scientific classics».

"Book on Lime" by the publishing house "University Book House";
EBS of "Lan" publishing house;
EBS of "Yurait" publishing house;
EBS of "IBooks.ru" publishing house;
EBS ZNANIUM.COM;
access to the source books.mipt.ru;
access to the collections of the National Electronic Library.
– scientific foreign and Russian journals and electronic databases:
database “Uspekhi Fizicheskikh Nauk” (Autonomous non-profit organization Editorial Office of the journal “Uspekhi Fizicheskikh Nauk”);
journals of the RAN (Russian Academy of Sciences);
journals of the Steklov Mathematical Institute of the Russian Academy of Sciences: Mathematical journals (mathnet.ru): Izvestia of the Russian Academy of Sciences. Series mathematical, Mathematical Collection, Uspekhi matematicheskikh nauk;
electronic version of the journal "Quantum Electronics" (Lebedev Physical Institute of the Russian Academy of Science);
Russian journals on the East View platform of IVIS;
database full-text collection of journals Bentham Journal Collection (Bentham Science Publishers);
EDP Sciences database
EBSCO eBooks database (EBSCO Information Services GmbH);
Wiley Journal Database;
archival journal collection Wiley Journal Backfiles (2005-2013);
archival collection of journals Wiley Journal Backfiles (2014 -2022);
World Scientific Complete eJournal Collection database (World Scientific Publishing Co Pte Ltd.).

Classrooms for conducting training sessions provided for by the educational program are equipped with equipment and technical teaching aids, the composition of which is determined in the work programs of disciplines (modules) and practices.
The premises for independent work of students are equipped with computer devices with the ability to connect to the Internet and are provided with access to the electronic information and educational environment of MIPT.

11.Features of the educational program implementation for the disabled and persons with special needs

If there are persons with disabilities or persons with special needs among students, the educational program is adapted taking into account the special educational needs of such students.
When teaching according to an individual curriculum for people with disabilities, the period for mastering the educational program can be extended at their request by no more than one year compared to the period for obtaining education for the corresponding form of education.

12. Staff conditions for the implementation of the educational program

The teaching staff who provide training in the core disciplines of the educational program are highly qualified specialists in the field of biomedical engineering.

The share of scientific and pedagogical staff (in teaching loads reduced to integer values) with an education corresponding to the profile of the discipline (module) being taught, in the total number of scientific and pedagogical staff implementing the Bachelor's program is more than 70 persents.

The share of scientific and pedagogical staff (in teaching loads reduced to integer values) who have an academic degree (including an academic degree awarded abroad and recognized in the Russian Federation) and (or) an academic title (including an academic title obtained abroad and recognized in the Russian Federation), in the total number of scientific and pedagogical staff implementing the Bachelor's program, is more than 60 persents.

The share of scientific and pedagogical staff (in teaching loads reduced to integer values) from the number of managers and employees whose activities are related to the orientation (specialty) of the ongoing Bachelor's program (having work experience in this professional field for more than 3 years) in the total number of employees implementing the master's program is more than 5 persents.

13. Information about the departments involved in the implementation of the educational program

Center for educational programs in bioinformatics: director – Candidate of Biological Sciences Kuzmin Denis Vladimirovich, director. The Center for Educational Programs has incorporated a combination of various programs and areas, teachers have various competencies, disciplines are taught by practicing specialists in various fields, and student enrollment increases every year. Students learn to process and analyze large volumes of information about biological objects, both currently available and that which will become available in the near future, taking into account the trend towards exponential growth of this data. They will also study how molecular diagnostic methods are developed and new drug targets are selected.

Basic organisations:

Федеральное государственное бюджетное научное учреждение "Всероссийский научно-исследовательский институт сельскохозяйственной биотехнологии" The main objective of the Institute is to conduct fundamental and applied research aimed at developing new biotechnologies in order to create initial promising forms of agricultural plants and animals with improved characteristics. Currently, VNIISB is working in the following areas: development of fundamental principles of genetic engineering technologies for creating transgenic plants and animals with specified properties; development of methods of cellular and genetic engineering for creating new promising forms of basic agricultural plants; development of new methods for marking genes and traits of agricultural plants using DNA technologies; study of physiological, biochemical and molecular mechanisms of action of biosynthetic plant growth regulators; development of methods for creating immunochemical test systems for diagnosing plant and animal pathogens; creation of new generation genetically engineered vaccines to protect animals from infection. The Institute trains scientific personnel, has postgraduate and doctoral programs. The Institute's employees maintain international relations with foreign research institutions.