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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
01.03.02 APPLIED MATHEMATICS AND INFORMATICS**

**Orientation (specialty)
COMPUTER SCIENCE/ИНФОРМАТИКА**

**Starting year of the educational program
2022 y.**

The main educational program of higher education in the field domain of study 01.03.02 Applied Mathematics and Informatics, orientation (specialty) Computer Science/Информатика, 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 01.03.02 Applied Mathematics and Informatics, 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 of 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, 4 112 hours.

Program implementation language: english.

Using a network form of educational program implementation: no.

Program goal:

Training of highly qualified personnel who have deep knowledge not only in the field of modern computer technology, fundamental and applied mathematics, but are also able to conduct scientific research based on the latest advances in mathematics and information technology.

Students on this program receive training in the field of fundamental and applied mathematics, mastering the apparatus of probability theory and mathematical statistics, discrete mathematics, differential geometry and topology, group theory and computational complexity, optimization methods, as well as in the field of information science and programming, gaining advanced skills in such areas as algorithms and programming languages, system programming and distributed systems, machine learning, data storage and analysis.

Graduates of this program can participate in all stages of creating high-tech software products, from a science-intensive idea to putting an idea on the market with the help of a start-up company, both as a developer, and as a manager or analyst.

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:

01 Education and science (in the field of general, professional and additional professional education; in the field of scientific research);

06 Communication, information and communication technologies (in the field of design, development and testing of software; in the field of design, creation and support of information and communication systems and databases; in the field of creating information resources in the information and telecommunication network "Internet" (hereinafter referred to as the network "Internet")).

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:

study of new scientific results, scientific literature or research projects in accordance with the profile of the professional activity subject;

research and development of mathematical models, algorithms, methods, software, tools on the subject of ongoing research projects.

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

discrete mathematics;

optimization and optimal control;

probability theory and mathematical statistics;

high-performance computing and parallel programming technologies;

programming languages, algorithms, libraries and software packages, products of system and application software;

database.

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

06.001 Software developer.

| Code and name of the professional standard | Generalized labor functions | | | Labor functions | | |
|---|-----------------------------|--|------------------------|---|--------|------------------------|
| | code | name | level of qualification | name | code | level of qualification |
| 06.001 Professional standard "Software developer" | C | Integration of software modules and components and verification of software product releases | 5 | Development of procedures for integration of software modules | C/01.5 | 5 |
| | D | Requirements development and software design | 6 | Software design | D/03.6 | 6 |

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 evaluate 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, choosing 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 foreign language(s) | 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 the occurrence of 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 Ability to form an intolerant attitude towards corrupt behavior | UC-10.1 Understands the nature of the occurrence and danger of corruption, the need for active counteraction to corruption and the importance of forming a personal anti-corruption position. UC-10.2 Knows the causes of corruption, the possible forms of its manifestation, the principles (legal, administrative, organizational, etc.) of combating corruption, the formation and implementation of anti-corruption policy, as well as the basics of anti-corruption actions in various areas of activity. UC-10.3 Ability to analyze the causes and prerequisites for the occurrence, the nature of the manifestation and consequences of corrupt actions; ability to contribute to the implementation of anti-corruption policies and form a personal position on the main issues of a civil and ethical nature, demonstrating an intolerant attitude towards 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 fundamental knowledge of physics, mathematics, and/or natural sciences in professional settings | Gen.Pro.C-1.1 Analyze the task in hand, develop approaches 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 Meet 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 devise new theoretical research methods (including mathematical research methods) and work with cutting-edge scientific equipment (measuring, analytical, technological) | Gen.Pro.C-5.1 Perform tasks in the field of theoretical and experimental research and development activities Gen.Pro.C-5.2 Acquire new knowledge by studying literature, scientific articles, and other sources Gen.Pro.C-5.3 Use modern experimental scientific research (measuring and analytical, technological) equipment |

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 standards, analysis of other requirements for graduates) |
|---|--|---|
| type of professional activity tasks: research | | |
| Pro.C-1 Assign, formalize, and solve tasks, develop and research mathematical models of studied phenomena and processes, systematically analyze scientific problems, obtain new scientific outcomes | Pro.C-1.1 Locate, analyze, and summarize information on current research findings within the subject area Pro.C-1.2 Make hypotheses, build mathematical models of the studied phenomena and processes, evaluate the quality of the developed model PIK-1.3 Apply theoretical and/or experimental research methods to a specific scientific task and interpret the obtained results | Analysis of the requirements of employers, professional standard "Programmer" |
| Pro.C-2 Conduct scientific research and testing independently or as a member (leader) of a small research team | Pro.C-2.1 Apply the principles of scientific work, methods of collecting and analyzing obtained data and ways of argumentation Pro.C-2.2 Conduct scientific research independently or as a member (leader) of a small research team Pro.C-2.3 Present research results through scientific publications and participation in conferences | Analysis of the requirements of employers, professional standard "Programmer" |

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 60,83 percents 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 192 2/6 weeks, of which there are 117 3/6 weeks of theoretical and practical training, 36 weeks of the credit-examination period, 3 2/6weeks of the state final certification and 35 3/6 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;

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:

Preparation for and Taking State Examination in Mathematics/Подготовка к сдаче и сдача государственного экзамена по математике;

Preparation for and Taking State Examination in Informatics and Discrete Mathematics/Подготовка к сдаче и сдача государственного экзамена по информатике и дискретной математике;

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

The program of the state final certification (Appendix 6) includes program of state examination and 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

Work programs of disciplines (modules), trainings determine the material and technical, 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 learning sessions provided for by the educational program feature equipment and technical teaching aids, the composition of which is determined in the work programs of disciplines (modules) and trainings.

Premises for independent work of students are equipped with computers with Internet connection and are provided with access to the electronic information and educational environment of MIPT.

The MIPT electronic information and educational environment provides access to:

- Electronic library system (hereinafter – ELS):

Golden Fund of Scientific Classics ELS

University Online Library;

Book on Lime of University's Book House publishing house;

Doe publishing house ELS;

Urait publishing house ELS;

IBooks.ru publishing house ELS;

Information system "National Electronic Library" (NEL);

LLC Publishing House Fizmatkniga;

Znaniy ELS;

books.mipt.ru ELS;

Litsenziat ELS;

Knowledge Lab ELS;

- international scientific journals and electronic databases:

ELS Doe Database
SPIE journals;
The Cambridge Crystallographic Data Centre Database;
Elsevier database;
Web of Science database;
abstract and scientometric database (citation index) Scopus;
American Chemical Society journals;
American Institute of Physics journals;
Optical Society of America database;
The Royal Society of Chemistry journals;
Sage Publications journals;
Taylor & Francis Group journals;
WILEY journals;
American Physical Society journals;
Cambridge University Press publishing house journals;
Institute of Electrical and Electronics Engineers database;
Institute of Physics journals;
MathSciNet abstract database;
Oxford University Press journals;
American Association for the Advancement of Science — AAAS journal;
Springer Nature E-Books database;
Questel patents database;
Annual Reviews journals.

Logistics, literature and other methodological materials, when studying disciplines and passing all types of practices of the base department, are provided on the material and technical base of the organization of the base department of the educational program.

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 implementation of the main educational program is provided by executives and scientific and pedagogical workers who have a basic education corresponding to the profile of the discipline taught, and an academic degree or experience in the relevant professional field and systematically engaged in scientific and (or) scientific and methodological activities.

The educational program is implemented in cooperation with the Russian IT company Yandex, one of the leaders in software development.

General management of the scientific content of the program is carried out by Andrey Mikhailovich Raigorodsky, Doctor of Physical and Mathematical Sciences, Director of the Phystech School of Applied Mathematics and Informatics, Federal Professor of Mathematics, Chief Researcher - Head of the Laboratory of Advanced Combinatorics and Network Applications, Head of the Department of Discrete Mathematics. Andrei Mikhailovich carries out independent research projects and participates in the implementation of such projects in the field of study, has annual publications on the results of this research activity in leading domestic and foreign peer-reviewed scientific journals and publications, and also carries out annual approbation of the results of this research activity at national and international conferences

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 percents.

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 percents.

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 percents.

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

Chair of Discrete Mathematics: head of Chair, Doctor of Physics and Mathematical Sciences, Associate Professor, Raygorodskiy Andrey Mikhailovich, chief Researcher - Head of the Laboratory. Modern discrete mathematics is an exceptionally beautiful and multifaceted discipline, rich in non-trivial "fundamental" problems and various high-tech applications. The department has a team of like-minded people who want to deal with both pure mathematics and its practical applications. Our employees are young and active specialists in the field of discrete (combinatorial) mathematics, theory of algorithms and computational complexity, mathematical logic, probability theory and mathematical statistics, combinatorial (algebraic) topology, combinatorial algebra and combinatorial geometry. Many of us teach at the Bachelor's degree in the basic department of "Data Analysis" of Yandex, because, in web technologies, in the analysis of the structure of the Internet, etc. in particular, those ideas and methods that are so rich in discrete mathematics find applications. Moreover, many of us work directly at Yandex - in the Department of Theoretical and Applied Research.