

**Federal State Autonomous Educational Institution of Higher Education "Moscow
Institute of Physics and Technology
(National Research University)"**

APPROVED
**Head of Landau Phystech-School of
Physics & Research**
A.V. Rogachev

Practice program

course: Personal Research Project/Научно-исследовательская работа
major: Applied Mathematics and Physics
specialization: General and Applied Physics/Общая и прикладная физика
Физтех-школа физики и исследований им. Ландау
Chair of Biophysics
term: 1
qualification: Master
type of practice: industrial
practice method: mipt-based

Semesters, forms of interim assessment:

- 1 (fall) - Grading test
- 2 (spring) - Grading test
- 3 (fall) - Exam
- 4 (spring) - Grading test

Author of the program: I.V. Manukhov, doctor of biological sciences

The program was discussed at the Chair of Biophysics 01.04.2024

Annotation

Industrial practice - research work - is an integral part of the educational process, designed to ensure a close connection between scientific and theoretical and practical training, to give students practical experience in accordance with the profile of the program.

The purpose of the practice is to obtain professional skills and professional experience. The practice provides practical training for students and is aimed at the formation, consolidation, development of practical skills and competencies in the profile of the educational program.

The practice is carried out in the scientific laboratories of the Research Center for Molecular Mechanisms of Aging and Age-Related Diseases in MIPT.

1. General characteristics of practice

Purpose of the course

The purpose of the practice is to acquire professional skills and professional experience in the field of modern methods in biophysics, including cryo-electron microscopy, X-ray diffraction on protein crystals, bioinformatics, and computer modeling which are aiming to focus on the problems of aging, age-related diseases and living matter.

Purpose of practice

The objectives of the practice are:

- Development of professional research thinking of students, the formation of a clear idea of the main professional tasks and ways to solve them;
- formation of the ability to independently perform laboratory, computational research in solving professional problems using modern research methods, modern equipment and computing facilities;
- formation of the ability to competently use modern technologies for collecting information, processing and interpreting the obtained experimental data.

During the period of practice, the student must study:

- Information sources on the topic being developed for the purpose of their use in the performance of the final qualifying work;
 - Methods of analysis and processing of statistical data;
 - Information technologies used in scientific research, software products related to the professional sphere;
 - Requirements for the design of scientific and technical documentation;
- execute:
- Analysis, systematization and generalization of information on the topic of research, including bibliographic work on a given topic using modern information technologies;
 - Comparison of the research results of the object of development with domestic and foreign analogues;
 - Analysis of the scientific and practical significance of the research;
 - a report on the work done.

Forms of practice: dispersed

2. List of the planned results of the practice

Mastering the discipline is aimed at the formation of the following competencies:

| Code and the name of the competence | Competency indicators |
|--|---|
| UC-1 Use a systematic approach to critically analyze a problem, and develop an action plan | UC-1.1 Systematically analyze the problem situation, identify its components and the relations between them |
| | UC-1.2 Search for solutions by using available sources |
| | UC-1.3 Develop a step-by-step strategy for achieving a goal, foresee the result of each step, evaluate the overall impact on the planned activity and its participants |
| | UC-2.1 Set an objective within a defined scientific problem; formulate the agenda, relevance, significance (scientific, practical, methodological, or other depending on the project type), forecast the expected results and possible areas of their application |

| | |
|---|--|
| UC-2 Able to manage the project through all stages of implementation | UC-2.2 Forecast the project outcomes, plan necessary steps to achieve the outcomes, chart the project schedule and monitoring plan |
| | UC-2.3 Organize and coordinate the work of project stakeholders, provide the team with necessary resources |
| | UC-2.4 Publicly present the project results (or results of its stages) via reports, articles, presentations at scientific conferences, seminars, and similar events |
| UC-3 Organize and manage a team, and develop the team strategy to achieve the objectives | UC-3.1 Organize and coordinate the work of the project stakeholders and help resolve disputes and conflicts |
| | UC-3.2 Consider the interests, specific behavior, and diversity of opinions of team members/colleagues/counterparties |
| | UC-3.3 Foresee the results (consequences) of both individual and collective actions |
| | UC-3.4 Plan teamwork, distribute tasks to team members, hold discussions of different ideas and opinions |
| UC-4 Use modern communication tools in the academic and professional fields, including those in a foreign language | UC-4.1 Exchange business information in oral and written forms in Russian and at least one foreign language |
| | UC-4.3 Present the results of academic and professional activities at various academic events, including international conferences |
| | UC-4.4 Use modern ICT tools for academic and professional collaboration |
| UC-6 Determine priorities and ways to improve performance through self-assessment | UC-6.1 Achieve personal growth and professional development, determine priorities and ways to improve performance |
| | UC-6.2 Evaluate performance results in correlation with the set objectives and applied methods |
| Gen.Pro.C-1 Gain fundamental scientific knowledge in the field of physical and mathematical sciences | Gen.Pro.C-1.1 Apply fundamental scientific knowledge in the field of physical and mathematical sciences |
| | Gen.Pro.C-1.2 Consolidate and critically assess professional experience and research findings |
| Gen.Pro.C-2 Acquire an understanding of current scientific and technological challenges in professional settings, and scientifically formulate professional objectives | Gen.Pro.C-2.1 Assess the current state of mathematical research within professional settings |
| | Gen.Pro.C-2.2 Assess the relevance and practical importance of research in professional settings |
| | Gen.Pro.C-2.3 Understand professional terminology used in modern scientific and technical literature and present scientific results in oral and written form within professional communication |
| Gen.Pro.C-3 Select and/or develop approaches to professional problem-solving with consideration to the limitations and specifics of different solution methods | Gen.Pro.C-3.1 Analyze problems, plan research strategy to achieve solution(s), propose, and combine solution approaches |
| | Gen.Pro.C-3.2 Employ research methods to solve new problems and apply knowledge from various fields of science (technology) |
| | Gen.Pro.C-3.3 Gain knowledge of analytical and computational methods of problem-solving, understand the limitations of the implementation of the obtained solutions in practice |
| Gen.Pro.C-4 Successfully perform a task, analyze the results, and present conclusions, apply knowledge and skills in the field of physical and mathematical sciences and ICTs | Gen.Pro.C-4.1 Apply ICT knowledge and skills to find and study scientific literature and use software products |
| | Gen.Pro.C-4.2 Apply knowledge in the field of physical and mathematical sciences to solve problems, make conclusions, and evaluate the obtained results |
| | Gen.Pro.C-4.3 Justify the chosen method of scientific research |
| Gen.Pro.C-5 Undertake professional training, achieve professional growth, and become a team | Gen.Pro.C-5.1 Tolerate social, ethnic, religious, and cultural differences in teamwork |

| | |
|---|--|
| achieve professional growth, and become a team leader in a professional sphere, tolerant of social, ethnic, religious, and cultural differences | Gen.Pro.C-5.2 Manage a small professional team |
| | Gen.Pro.C-5.3 Apply new knowledge and achieve personal and professional growth |
| Pro.C-1 Assign, formalize, and solve tasks, develop and research mathematical models of the studied phenomena and processes, systematically analyze scientific problems and obtain new scientific results | 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 |
| | Pro.C-1.3 Apply theoretical and/or experimental research methods to a specific scientific task and interpret the obtained results |
| Pro.C-2 Organize and conduct scientific research and testing independently or as a member (leader) of a small research team | Pro.C-2.1 Plan and conduct scientific research independently or as part of a research team |
| | Pro.C-2.2 Test research results through scientific publications and participation in conferences |
| Pro.C-3 Use research and testing equipment (devices and installations, specialized software) in a selected subject field | Pro.C-3.1 Understand the operating principles of the equipment and specialized software |
| | Pro.C-3.2 Conduct an experiment (simulation) using research equipment (software) |
| | Pro.C-3.3 Evaluate the accuracy of the experimental (numerical) results |

3. List of the planned results of the practice

As a result of studying the course the student should:

know:

- Approaches to the organization of independent and collective research work;
- Principles of organizing experiments and tests;
- Principles of formalizing the results of research work;
- To have an idea of the economic component of scientific research.

be able to:

- to carry out search, processing, analysis and systematization of scientific and technical information, to select methods and means of solving problems set by the research program;
- Perform processing and analysis of the results of experiments and tests;
- Analyze the difficulties arising in research activities and contribute to their resolution;
- to design a solution to a research problem, based on current legal regulations and available resources and restrictions;
- To formalize and present the results of research work.

master:

- The skills of preparing plans and programs for conducting scientific research, technical developments, assignments for performers.

4. Practice content

4.1. Main stages of practice

| No | Practice stage content | Labor intensity (hours), including independent work |
|------------------------|--|---|
| 1 semester | | |
| 1 | Formulation of the problem | 720 |
| Total AH in 1 semester | | 720 |
| 2 semester | | |
| 2 | Collection, processing, analysis and systematization of scientific and technical information on the research topic | 630 |
| Total AH in 2 semester | | 630 |
| 3 semester | | |
| 3 | Preparation and conduct of scientific research | 1 305 |
| 4 | Preparation of interim report | 15 |

| | |
|--|-------|
| Total AH in 3 semester | 1 320 |
| 4 semester | |
| 5 Scientific research and analysis of the result | 1 065 |
| 6 Preparation of the final report | 15 |
| Total AH in 4 semester | 1 080 |
| AH in total | 3 750 |

4.2. Work content

Semester: 1 (Fall)

1. Formulation of the problem

Conducting a safety briefing, familiarizing students with the internal regulations. Setting a research task, drawing up a plan of practice, developing a research program.

Semester: 2 (Spring)

2. Collection, processing, analysis and systematization of scientific and technical information on the research topic

Study of scientific, periodical (including foreign) literature on the research topic. Selection and justification of the accepted direction of research. Preparation of an analytical review. Formulation of the goals and objectives of the study. Planning experimental research.

Semester: 3 (Fall)

3. Preparation and conduct of scientific research

Preparation and implementation of experimental and / or theoretical scientific research within the framework of the task.

4. Preparation of interim report

Preparation of an interim report on practice for a semester based on the results of mastering the practice.

Semester: 4 (Spring)

5. Scientific research and analysis of the result

Preparation and implementation of scientific research (continuation of the work begun in the previous semester), data processing and analysis of the results.

6. Preparation of the final report

Preparation of a report on practice based on the results obtained, presentation at a scientific seminar / meeting of the department.

4.3. Practice supervision

The practice is managed by the student's appointed scientific advisor, whose duties include:

- Scientific and educational-methodical management of research work;
- Development of individual tasks for students, performed during the practice period;
- Provision of assistance to students in the development of a plan for conducting research;
- Conducting consultations (research seminar, lectures) on conducting research;
- control over the implementation of the research plan;
- verification of the reporting documentation on the implementation of research work.

Discussion of the plan and intermediate results of research is carried out at the department that prepares students, as well as within the framework of the scientific seminar of the department and organizations with which cooperation is conducted and on the basis of which research can be carried out.

The results of research work should be drawn up in the form of a report and submitted for consideration and approval to the supervisor. Attached to the report (if any) is a list of articles and abstracts of the student's reports published on the topic of studies as well as list of reports on scientific conferences and seminars. Lists of published works and speeches are accompanied by supporting documents (reprints of articles, photocopies of abstracts, as well as certificates of participation in conferences or the conference program).

Based on the results of the research work, the supervisor gives the student an assessment.

5. Description of the material and technical facilities that are necessary for the implementation of the educational process of the course (training module)

To carry out the practice, you need: a workplace in an educational or scientific unit that is a place of practice, a workplace for independent work, containing a personal computer with access to the Internet and the electronic educational environment of the MIPT.

Place of practice: scientific laboratories of the Research Center for Molecular Mechanisms of Aging and Age-Related Diseases of MIPT.

6. List of the main and additional literature, that is necessary for the course (training module) mastering

Main literature

1. Подготовка и защита бакалаврской работы, магистерской диссертации, дипломного проекта [Электронный ресурс], учеб. пособие / Ю. Н. Новиков. — СПб., Лань, 2019.— URL: <https://e.lanbook.com/book/122187> (дата обращения: 29.01.2021). - Полный текст (Режим доступа : из сети МФТИ / Удаленный доступ)

Additional literature

1. Искусство писать научные статьи, научно-практическое руководство / Е. З. Мейлихов. — Долгопрудный, Интеллект, 2020.— URL: <http://books.mipt.ru/book/301312> (дата обращения: 18.12.2020). - Полный текст (Режим доступа : из сети МФТИ / Удаленный доступ)

7. List of curricular resources for independent work on practice

1. Questel Orbit <https://www.orbit.com/> – объединяет около 100 баз данных, предназначенных специалистам в области патентования и широкому кругу исследователей. Основная патентная база FamPat содержит данные 95 патентных ведомств всех регионов мира; патенты объединены в семь по тематическому признаку.

2. Inspec Analytics – аналитический модуль базы данных Inspec <https://inspec-analytics-app.theiet.org/>. Inspec Analytics позволяет визуализировать результаты поиска, сравнивать полученные результаты на уровне учреждений, авторов, тематик по количеству публикаций.

3. Sage journals – более 100 журналов доступно в полнотекстовом режиме в области естественных наук, техники и медицины.

<https://journals.sagepub.com/action/doSearch?filterOption=allJournal&AllField=research&content=journalTitle&target=titleSearch&pageSize=100&startPage=0>

4. Taylor&Francis journals – более 2000 журналов по всем областям знаний. Журналы разделены по коллекциям в области STM наук (Science, Technology & Medicine) и HSS (Humanities & Social Sciences), а также по более узким, конкретным областям знаний,

5. <https://cmm-mipt.ru/education.html>

8. List of web resources that are necessary for the practice mastering

Database:

–Referential-bibliographic and scientometric (bibliometric) database Web of Science Core Collection;

–Abstract and scientometric database (citation index) Scopus.

Electronic libraries:

- RFBR electronic library - <https://www.rfbr.ru/rffi/ru/library>;
- Scientific electronic library - <https://elibrary.ru>.

9. Guidelines for students to master the course

The assignment for practice is determined by the supervisor, taking into account the specifics of the research work of the department or the base enterprise. The basis of the content of the student's independent work during the implementation of the practice program is the development of methods, приемов, technologies for analyzing and systematizing scientific and technical information, developing plans and programs for conducting scientific research and acquiring practical skills in carrying out research activities, taking into account the interests and capabilities of the department или базового предприятия, где it is being carried out. When completing an individual assignment, the student must combine practical work on the subject of the assignment with a theoretical study of the issue using the recommended information resources. When working with literary sources, it is recommended to draw up a short synopsis with the obligatory fixation of the bibliographic data of the source. Research work ends with writing a report.

Assessment funds for practice

major: Applied Mathematics and Physics
specialization: General and Applied Physics/Общая и прикладная физика
Физтех-школа физики и исследований им. Ландау
Chair of Biophysics
term: 1
qualification: Master

Semesters, forms of interim assessment:

- 1 (fall) - Grading test
- 2 (spring) - Grading test
- 3 (fall) - Exam
- 4 (spring) - Grading test

Author: I.V. Manukhov, doctor of biological sciences

1. Competencies formed during the process of studying the practice

| Code and the name of the competence | Competency indicators |
|--|---|
| UC-1 Use a systematic approach to critically analyze a problem, and develop an action plan | UC-1.1 Systematically analyze the problem situation, identify its components and the relations between them |
| | UC-1.2 Search for solutions by using available sources |
| | UC-1.3 Develop a step-by-step strategy for achieving a goal, foresee the result of each step, evaluate the overall impact on the planned activity and its participants |
| UC-2 Able to manage the project through all stages of implementation | UC-2.1 Set an objective within a defined scientific problem; formulate the agenda, relevance, significance (scientific, practical, methodological, or other depending on the project type), forecast the expected results and possible areas of their application |
| | UC-2.2 Forecast the project outcomes, plan necessary steps to achieve the outcomes, chart the project schedule and monitoring plan |
| | UC-2.3 Organize and coordinate the work of project stakeholders, provide the team with necessary resources |
| | UC-2.4 Publicly present the project results (or results of its stages) via reports, articles, presentations at scientific conferences, seminars, and similar events |
| UC-3 Organize and manage a team, and develop the team strategy to achieve the objectives | UC-3.1 Organize and coordinate the work of the project stakeholders and help resolve disputes and conflicts |
| | UC-3.2 Consider the interests, specific behavior, and diversity of opinions of team members/colleagues/counterparties |
| | UC-3.3 Foresee the results (consequences) of both individual and collective actions |
| | UC-3.4 Plan teamwork, distribute tasks to team members, hold discussions of different ideas and opinions |
| UC-4 Use modern communication tools in the academic and professional fields, including those in a foreign language | UC-4.1 Exchange business information in oral and written forms in Russian and at least one foreign language |
| | UC-4.3 Present the results of academic and professional activities at various academic events, including international conferences |
| | UC-4.4 Use modern ICT tools for academic and professional collaboration |
| UC-6 Determine priorities and ways to improve performance through self-assessment | UC-6.1 Achieve personal growth and professional development, determine priorities and ways to improve performance |
| | UC-6.2 Evaluate performance results in correlation with the set objectives and applied methods |
| Gen.Pro.C-1 Gain fundamental scientific knowledge in the field of physical and mathematical sciences | Gen.Pro.C-1.1 Apply fundamental scientific knowledge in the field of physical and mathematical sciences |
| | Gen.Pro.C-1.2 Consolidate and critically assess professional experience and research findings |
| Gen.Pro.C-2 Acquire an understanding of current scientific and technological challenges in professional settings, and scientifically formulate professional objectives | Gen.Pro.C-2.1 Assess the current state of mathematical research within professional settings |
| | Gen.Pro.C-2.2 Assess the relevance and practical importance of research in professional settings |
| | Gen.Pro.C-2.3 Understand professional terminology used in modern scientific and technical literature and present scientific results in oral and written form within professional communication |
| | Gen.Pro.C-3.1 Analyze problems, plan research strategy to achieve solution(s), propose, and combine solution approaches |

| | |
|---|---|
| Gen.Pro.C-3 Select and/or develop approaches to professional problem-solving with consideration to the limitations and specifics of different solution methods | Gen.Pro.C-3.2 Employ research methods to solve new problems and apply knowledge from various fields of science (technology) |
| | Gen.Pro.C-3.3 Gain knowledge of analytical and computational methods of problem-solving, understand the limitations of the implementation of the obtained solutions in practice |
| Gen.Pro.C-4 Successfully perform a task, analyze the results, and present conclusions, apply knowledge and skills in the field of physical and mathematical sciences and ICTs | Gen.Pro.C-4.1 Apply ICT knowledge and skills to find and study scientific literature and use software products |
| | Gen.Pro.C-4.2 Apply knowledge in the field of physical and mathematical sciences to solve problems, make conclusions, and evaluate the obtained results |
| | Gen.Pro.C-4.3 Justify the chosen method of scientific research |
| Gen.Pro.C-5 Undertake professional training, achieve professional growth, and become a team leader in a professional sphere, tolerant of social, ethnic, religious, and cultural differences | Gen.Pro.C-5.1 Tolerate social, ethnic, religious, and cultural differences in teamwork |
| | Gen.Pro.C-5.2 Manage a small professional team |
| | Gen.Pro.C-5.3 Apply new knowledge and achieve personal and professional growth |
| Pro.C-1 Assign, formalize, and solve tasks, develop and research mathematical models of the studied phenomena and processes, systematically analyze scientific problems and obtain new scientific results | 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 |
| | Pro.C-1.3 Apply theoretical and/or experimental research methods to a specific scientific task and interpret the obtained results |
| Pro.C-2 Organize and conduct scientific research and testing independently or as a member (leader) of a small research team | Pro.C-2.1 Plan and conduct scientific research independently or as part of a research team |
| | Pro.C-2.2 Test research results through scientific publications and participation in conferences |
| Pro.C-3 Use research and testing equipment (devices and installations, specialized software) in a selected subject field | Pro.C-3.1 Understand the operating principles of the equipment and specialized software |
| | Pro.C-3.2 Conduct an experiment (simulation) using research equipment (software) |
| | Pro.C-3.3 Evaluate the accuracy of the experimental (numerical) results |

2. Competency assessment indicators

As a result of studying the course the student should:

know:

- Approaches to the organization of independent and collective research work;
- Principles of organizing experiments and tests;
- Principles of formalizing the results of research work;
- To have an idea of the economic component of scientific research.

be able to:

- to carry out search, processing, analysis and systematization of scientific and technical information, to select methods and means of solving problems set by the research program;
- Perform processing and analysis of the results of experiments and tests;
- Analyze the difficulties arising in research activities and contribute to their resolution;
- to design a solution to a research problem, based on current legal regulations and available resources and restrictions;
- To formalize and present the results of research work.

master:

- The skills of preparing plans and programs for conducting scientific research, technical developments, assignments for performers.

3. Student practice reporting

Interim certification in practice is carried out in the form of a differentiated test and an exam.

During the period of practice, the student is obliged:

- Completely fulfill the research plan;
- follow the instructions of the head of research work;
- be responsible for the work performed and its results.

Assessment for industrial practice - research work - is given to the student by the scientific supervisor based on the results of the defense of his work. The defense of research work is carried out in the form of a scientific seminar of the department. When evaluating research work, the following is taken into account:

- implementation of the research plan;
- presentation of research results;
- R&D report of the established form (Appendix 1).

The mark "excellent" (8-10 points) is given if the individual task is completed in full, the student has shown a high level of independence and a creative approach to its implementation.

The mark "good" (5-7 points) is given if the individual task is completed in full, there are some shortcomings in the design of the presented material.

The mark "satisfactory" (3-4 points) is given if the task as a whole is completed, but there are shortcomings in the implementation of individual sections (parts) of the task during practice, there are comments on the design of the collected material.

The mark "unsatisfactory" (1-2 points) is given if the task is completed only partially, there are numerous comments on the design of the collected material.

| ОТЧЕТ о прохождении производственной практики <u>научно-исследовательская работа</u> <small>наименование практики</small> ____ семестр, ____ / ____ учебный год | |
|--|--|
| ФИО обучающегося | |
| Физтех-школа, группа | |
| Место прохождения практики | |
| Задание на практику | |
| Отчет (проделанная работа и полученные результаты) | |
| Отзыв руководителя о работе обучающегося | |
| Оценка за работу обучающегося, рекомендуемая руководителем | |

Обучающийся _____ дата составления отчета _____

Контактный телефон: 8-9__-__-__-__

Руководитель практики _____ / _____ /

Контактный телефон: 8-9__-__-__-__ e-mail:

Зав. кафедрой _____ / _____ /