

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

APPROVED
**Head of the Phystech School of
Biological and Medical Physics**
D.V. Kuzmin

Practice program

course: Personal Research Project/Научно-исследовательская работа
major: Biotechnology
specialization: Biomedical Engineering/Биомедицинская инженерия
Физтех-школа Биологической и Медицинской Физики
Phystech School of Biological and Medical Physics
term: 4
qualification: Bachelor
type of practice: industrial
practice method:

Semesters, forms of interim assessment:

7 (fall) - Grading test

8 (spring) - Grading test

Authors of the program:

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The program was discussed at the Phystech School of Biological and Medical Physics 04.06.2022

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 acquire 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 basic and faculty departments of the Physics and Technology School.

1. General characteristics of practice

Purpose of the course

The purpose of the practice is to obtain professional skills and professional experience in the field of biotechnology and biological physics. 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.

Purpose of practice

The objectives of the practice are:

- development of professional research thinking of students, the formation of a clear understanding of the main professional tasks and ways to solve them;
- formation of the ability to independently perform laboratory, computational research with professional research using modern methods of researching the tasks of modern apparatus 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:

explore:

- 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 |
|---|---|
| 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 |

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|---|---|
| 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 |
| 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-1.2 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 |
| | Pro.C-1.10 Apply knowledge of leading scientific journals to select relevant publications in professional settings |

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| | 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-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 |
| 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 |
| 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 |

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

| № | Practice stage content | Labor intensity (hours), including independent work |
|------------|--|---|
| 7 semester | | |
| 1 | Formulation of the problem | 80 |
| 2 | Collection, processing, analysis and systematization of scientific and technical information on the research topic | 55 |

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|------------------------|--|-----|
| 3 | Preparation and conduct of scientific research | 105 |
| 4 | Preparation of interim report | 165 |
| Total AH in 7 semester | | 405 |
| 8 semester | | |
| 5 | Systematization of statistical and analytical material for writing a research report | 175 |
| 6 | Preparation of the final report | 230 |
| Total AH in 8 semester | | 405 |
| AH in total | | 810 |

4.2. Work content

Semester: 7 (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.

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.

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: 8 (Spring)

5. Systematization of statistical and analytical material for writing a research report

Preparation and implementation of scientific research (continuation of 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 available) is a list of articles and abstracts of the student's reports published on the research topic, as well as a list of reports and speeches of the student at 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, which is a place of practice, a workplace for independent work, containing a personal computer, with access to the Internet and the MIPT electronic educational environment.

Place of the practice: scientific laboratories of the basic and faculty departments of the Physics and Technology School.

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. 3. 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

Not used

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 in the implementation of the practice program is the development of methods, techniques, technologies for analyzing and systematizing scientific and technical information, developing plans and programs for conducting scientific research and acquiring practical skills for carrying out research activities, taking into account the interests and capabilities of the department or the base enterprise, where it is held. 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

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|------------------------|---|
| major: | Biotechnology |
| specialization: | Biomedical Engineering/Биомедицинская инженерия Физтех-школа Биологической и Медицинской Физики Phystech School of Biological and Medical Physics |
| term: | <u>4</u> |
| qualification: | Bachelor |

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Authors:

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1. Competencies formed during the process of studying the practice

| Code and the name of the competence | Competency indicators |
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| | Pro.C-1.5 Build mathematical models used to describe and research various processes and phenomena in relevant scientific fields |

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| | Pro.C-1.9 Use modern programming languages and software packages for scientific calculations |
| | Pro.C-1.10 Apply knowledge of leading scientific journals to select relevant publications in professional settings |
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| 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 |
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| | Pro.C-4.3 Provide evidence to support the cause-effect relationship of applied concepts and models |

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 offset.

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.

Форма отчета о прохождении практики

| ОТЧЕТ о прохождении производственной практики– научно-исследовательской работы _____ 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 руководителя за работу обучающегося | |

Обучающийся _____ дата _____ составления _____ отчета _____

Контактный телефон: 8-9__-__-__-__

Научный руководитель _____ / _____ /

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

Зав. кафедрой _____ / _____ /