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

APPROVED
Head of the Phystech School of Aerospace Technology
S.S. Negodyaev

Practice program

course:	Personal Research Project/Научно-исследовательская работа
major:	Applied Mathematics and Physics
specialization:	Beam-Plasma Systems and Technologies/Пучково-плазменные системы и технологии
	Физтех-школа Аэрокосмических Технологий
	Chair of Logistics Systems and Technologies
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) - Grading test
4 (spring) - Grading test

Authors of the program:

M.N. Vasilev, doctor of technical sciences, full professor, professor
T.M. Vasileva, doctor of technical sciences, associate professor

The program was discussed at the Chair of Logistics Systems and Technologies 09.02.2022

Annotation

Internship - research work - is an integral part of the educational process; it is designed to provide a close link between scientific-theoretical and practical training, to give students experience in practical work in accordance with the profile of the programme.

The purpose of internship is to gain professional skills and experience of professional activities. Internship provides practical training of students and is aimed at the formation, consolidation and development of practical skills and competencies in the profile of the educational program.

1. General characteristics of practice

Purpose of the course

The purpose of practicum is to acquire professional skills and experience of professional activity in the area of plasma physics. Such Internship provides pactical training of students and aims at formation, consolidation and development of practical skills and competencies in the profile of educational program.

Purpose of practice

Objectives of practicum are:

- to develop professional research thinking of students, form of a clear perception of main professional problems and ways of their resolution;
- to form the ability to independently perform laboratory, computational research to resolve professional problems using modern methods of research, modern equipment and computers;
- to develop the ability to competently use modern technologies for data collection, processing and interpretation of experimental data.

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 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-4.2 Use the acquired skills to write, translate, and edit various academic texts (abstracts, essays, reviews, articles, etc.)
	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-1.3 Understand interdisciplinary relations in applied mathematics and computer science and apply them in professional settings
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 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	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

analyze scientific problems and obtain new scientific results	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 organisation of independent and collective research work;
- principles of organisation of experiments and tests;
- principles of registration of the results of scientific research work;
- be aware of the economic component of scientific research.

be able to:

- carry out search, processing, analysis and systematisation of scientific and technical information, choose methods and means of solving tasks set by the research programme;
- process and analyse experimental and test results;
- analyse and contribute to the solution of difficulties arising in the research activity;
- design solutions to a research problem based on the applicable legal regulations, available resources and constraints;
- document and present the results of research work

master:

- skills in formulating plans and programmes for research, technical development, assignments for implementers.

4. Practice content

4.1. Main stages of practice

№	Practice stage content	Labor intensity (hours), including independent work
1 semester		
1	Setting a task	855
Total AH in 1 semester		855
2 semester		
2	Gathering, processing, analysis and systematization of scientific and technical information on the topic of research	675
Total AH in 2 semester		675
3 semester		
3	Preparing and carrying out a scientific study	455
4	Interim report preparation	400
Total AH in 3 semester		855
4 semester		
5	Carrying out of scientific research and analysis of the result	465
6	Preparing the final report	300
Total AH in 4 semester		765
AH in total		3 150

4.2. Work content

Semester: 1 (Fall)

1. Setting a task

Carrying out safety briefing, familiarisation of the students with internal regulations. Setting the research task, drawing up the plan of practice, development of the research programme.

Semester: 2 (Spring)

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

Studying of scientific, periodic (including foreign) literature on the topic of research. Selection and justification of the accepted direction of research. Drafting of an analytical review. Formulation of aims and objectives of research. Planning of experimental research.

Semester: 3 (Fall)

3. Preparing and carrying out a scientific study

Preparing and carrying out an experimental and/or theoretical scientific study within the scope of the assigned tasks.

4. Interim report preparation

Preparation of an interim report for the semester on the results of the internship.

Semester: 4 (Spring)

5. Carrying out of scientific research and analysis of the result

Preparation and carrying out of scientific research (extension of the work begun in the previous semester), data processing and analysis of the results obtained.

6. Preparing the final report

Preparation of the report on the results of the practicum, presentation at a scientific seminar/meeting of the chair.

4.3. Practice supervision

The practicum is managed by the student's assigned supervisor whose responsibilities include:
- scientific and educational-methodical management of the research;
- development of individual assignments for students performed during internship;
- assistance to students in developing the plan of research work;
- conduct of consultations (research seminar, lectures) on carrying out research work;
- monitoring of the execution of the research plan;
- checking of the report documentation on the research work.

The plan and interim results of research are discussed at a meeting of the chair that trains the students, as well as at the scientific seminar of the chair and organisations with which cooperation is carried out and on the basis of which research can be conducted.

The results of the research must be presented in a report and submitted for review and approval to the scientific supervisor. A list (if available) of articles and abstracts published on the topic of research, as well as a list of reports and speeches of the student at scientific conferences and seminars shall be attached to the report. Lists of published works and speeches shall be accompanied by supporting documents (reprints of articles, photocopies of abstracts, as well as certificates of participation in conferences or the conference programme).

The supervisor gives the student a grade based on the results of the research.

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

The execution of practicum requires: a workplace in the educational or scientific subdivision which is a place of internship, a workplace for independent work containing a personal computer with access to the Internet and the MIPT electronic educational environment.
Place of internship: scientific laboratories of base and departmental chairs of the Phystech School Aerospace Technologies.

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

Main literature

1. Alexander Fridman, Lawrence A. Kennedy, Plasma Physics and Engineering, CRC Press (2011).
2. Nonthermal Plasma Chemistry and Physics, Ed. Jurgen Meichsner, Martin Schmidt, Ralf Schneider, Hans-Erich Wagner, CRC Press (2013).
3. J. Leon Shohet, Encyclopedia of Plasma Technology - Two Volume Set, CRC Press (2016).
4. Plasma Medicine. Applications of Low-Temperature Gas Plasmas in Medicine and Biology. Editors: M. Laroussi, M. G. Kong, G. Morfill, May, 2012.

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)
2. 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)
3. Право интеллектуальной собственности. В 2 частях. Часть 2, учебник для вузов / И. А. Зенин. — Москва, Юрайт, 2020.— URL: https://urait.ru/bcode/451695 (дата обращения: 15.12.2020). - 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 патентоведения и широкому кругу исследователей. Основная патентная база FamPat содержит данные 95 патентных ведомств всех регионов мира; патенты объединены в семьи 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,

https://www.tandfonline.com/action/doSearch?AllField=research&startPage=&target=titleSearch&content=title

http://www.consultant.ru/

https://www.fips.ru/

https://patents.google.com/
https://www.wipo.int/portal/ru/

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

Databases:
- The Web of Science Core Collection abstract-bibliographic and scientific (bibliometric) database;
- Scopus abstract and science-based database (citation index).

Electronic Libraries:
- RFFI electronic library - https://www.rfbr.ru/rffi/ru/library;
- Scientific electronic library - https://elibrary.ru.

9. Guidelines for students to master the cource

The practicum's objective is defined by the scientific supervisor taking into account the specificity of scientific-research work of the chair or base enterprise. The core of the content of the student's independent work within the internship program is the mastering of methods, techniques, procedures of analysis and systematization of scientific and technical information, development of plans and programs of scientific research, and acquisition of practical skills of research activities, taking into account the interests and capabilities of the chair or base enterprise where it is carried out. When completing an individual assignment, the student must combine practical work on the subject of the assignment with theoretical study of the topic using recommended information resources. When working with literature sources it is recommended to compile a brief synopsis which should always include bibliographic data of the source. Research work is completed by writing a report.

SUPPLEMENT

Assessment funds for practice

major:	Applied Mathematics and Physics
specialization:	Beam-Plasma Systems and Technologies/Пучково-плазменные системы и технологии Физтех-школа Аэрокосмических Технологий Chair of Logistics Systems and Technologies
term:	1
qualification:	Master

Semesters, forms of interim assessment:

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

Authors:

M.N. Vasilev, doctor of technical sciences, full professor, professor
T.M. Vasileva, doctor of technical sciences, associate professor

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-4.2 Use the acquired skills to write, translate, and edit various academic texts (abstracts, essays, reviews, articles, etc.)
	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-1.3 Understand interdisciplinary relations in applied mathematics and computer science and apply them in professional settings
Gen.Pro.C-2 Acquire an understanding of current scientific and technological challenges in	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

professional settings, and scientifically formulate professional objectives	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 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 organisation of independent and collective research work;
- principles of organisation of experiments and tests;
- principles of registration of the results of scientific research work;
- be aware of the economic component of scientific research.

be able to:

- carry out search, processing, analysis and systematisation of scientific and technical information, choose methods and means of solving tasks set by the research programme;
- process and analyse experimental and test results;
- analyse and contribute to the solution of difficulties arising in the research activity;
- design solutions to a research problem based on the applicable legal regulations, available resources and constraints;
- document and present the results of research work

master:

- skills in formulating plans and programmes for research, technical development, assignments for implementers.

3. Student practice reporting

Intermediate attestation on practicums is carried out in the form of differential credit and examination.

During the internship period the student is obliged to:

- fully implement the plan of research work;
- follow instructions of scientific-research supervisor;
- be responsible for the work carried out and its results.

Grades for internship - research work - are awarded to the student by the supervisor according to the results of the defence of his/her work. The defence of research work is conducted in the form of a scientific seminar of the chair. Evaluation the research work takes the following into account:

- implementation of the plan of research work;
- presentation of the research work results;
- report on the research work in the prescribed form (Appendix 1).

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

The "good" grade (5-7 points) is awarded if the individual task is completed in full, but there are some shortcomings in the execution of the material presented.

The "satisfactory" grade (3-4 points) is awarded if the task is generally completed, but there are shortcomings in the execution of certain sections (parts) of the task during the internship, and there are comments on the presentation of the collected material.

The "unsatisfactory" grade (1-2 points) is awarded if the task is performed only partially, and there are numerous comments on the presentation of the collected material.

Examples of exam tests

Example 1:

1. What sources did you use when searching for scientific information on the topic of your research?

2. In which publications are the results of your work published?

3. What mathematical models did you use when processing the research results?

Example 2:

1. What is the novelty of your research results? How would you describe this novelty: a concept, an idea that enriches a well-known concept, or as a new technique that expands the boundaries of knowledge?

2. At which conferences were the results of your work presented?

3. Why did you choose this method for research?

Example 3:

1. What is the error of your chosen method of analysis? Show the confidence interval on the graph.

2. Describe your chosen research method.

3. How was the experimental data processed?