

Ministry of Science and Higher Education of the Russian Federation  
NATIONAL RESEARCH  
TOMSK STATE UNIVERSITY (NR TSU)

Institute of Applied Mathematics and Computer Science

APPROVE

Director of the Institute of Applied  
Mathematics and Computer Science

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Work program of the

**Research Work & Research Topics**

**(educational practice)**

in the major of training

**01.04.02 Applied mathematics and informatics**

Orientation (profile) of training:

**Big Data and Data Science**

Form of study

**full-time**

Year of admission

**2023**

Tomsk – 2023

## **1. Purpose of practice**

The purpose is familiarizing students with the theory and practice of research work. It is an integral part of the preparation of masters who have the skills of independent research work..

## **2. Practice objectives**

- developing master's students' interest in scientific creativity, teaching methods and methods for independently solving research problems, skills of working in scientific teams;
- organizing training for master's students in the theory and practice of scientific research;
- development of creative thinking and independence among undergraduates, deepening and consolidating theoretical and practical knowledge acquired during training;
- developing skills in working with fundamental and periodical literature, Internet sources;
- preparation of abstracts, conference reports or articles for publication;
- developing the skill of public presentation of research results – making a report at scientific seminars and conferences.

## **3. The place of practice in the structure of the educational program**

Educational practice “Research work (obtaining primary skills in research work)” refers to the mandatory part of Block 2. Practices, Educational practice.

## **4. Semester of mastering and form of intermediate certification in the practice**

Semesters 1 and 2, credit with assessment, course work.

## **5. Entrance requirements for mastering the practice**

In order to begin the practice, the student must have the following knowledge and skills: know the basics of computer technology; have solid knowledge of the main disciplines of the master's program; be able to design information systems; be able to build algorithms for solving assigned problems and develop computer programs.

## **6. Methods and forms of practice**

The practice is carried out on the basis of TSU. Methods of implementation: stationary.

## **7. Scope of practice**

The total labor intensity of the discipline is 6 credits, 216 hours.

Duration of practice:

1st semester: 10 weeks;

2nd semester: 12 weeks.

## **8. Planned results of the practice**

The results of the internship are the following indicators of achievement of competencies:

ICP - 2.1 Formulates the goal of the project, substantiates its significance and feasibility

IUC-2.2 Develops an action program to solve project problems, taking into account available resources and limitations

IUC-2.3 Ensures project implementation in accordance with established goals, deadlines and costs

IUC-4.1 Justifies the choice of current communication technologies (information technology, moderation, mediation, etc.) to ensure academic and professional interaction

IUC-4.2 Uses modern means of communication to improve the efficiency of academic and professional interaction, including in a foreign language

IUC-4.3 Evaluates the effectiveness of the use of modern communication technologies in academic and professional interactions

IUC-5.1 Identifies, compares, typologizes the uniqueness of cultures to develop a strategy for interaction with their carriers

IUC-5.2 Organizes and moderates intercultural interaction

IUC-6.1 Develops a strategy for personal and professional development based on correlating one's own goals and capabilities with the development of the chosen field of professional activity.

IUC-6.2 Implements and adjusts the strategy of personal and professional development taking into account the conditions and prospects for the development of the labor market

IUC-6.3 Evaluates the results of implementing the strategy of personal and professional development based on analysis (reflection) of one's activities and external judgments

IOPK-1.1 Analyzes problems in the field of fundamental and applied mathematics

IOPK-1.2 Formulates research objectives

IOPK-1.3 Solves current problems of fundamental and applied mathematics

IOPK-2.1 Uses the results of applied mathematics to master and adapt new methods for solving problems in the area of their professional interests

IOPK-2.2 Implements and improves new methods for solving applied problems in the field of professional activity

IOPK-2.3 Conducts qualitative and quantitative analysis of the resulting solution in order to construct the optimal option

IOPK-3.1 Develops mathematical models in the field of applied mathematics and computer science

IOPK-3.2 Analyzes mathematical models for solving applied problems of professional activity

IOPK-3.3 Develops and analyzes new mathematical models for solving applied problems of professional activity in the field of applied mathematics and computer science

IOPK-4.1 Analyzes problems of applied mathematics and computer science using information technology

IOPK-4.2 Takes into account the basic information security requirements

IOPK-4.3 Uses modern information and communication technologies to solve problems in the field of applied mathematics and computer science, taking into account information security requirements

IPC-1.1 Analyzes the tasks of research and design activities in order to select mathematical and algorithmic tools

IPK-1.2 Applies existing mathematical methods, algorithms and software to solve problems in the field of professional activity

IPK-1.3 Develops new methods, models, algorithms and software for solving problems in the field of professional activity

IPK-2.1 Analyzes research topics in order to clearly define research objectives and study the subject area

IPK-2.2 Decomposes the research development process into stages, is able to clearly define the goals and objectives of each stage

IPK-2.3 Able to obtain new scientific and applied results independently and as part of a scientific team

IPK-3.1 Can clearly and clearly describe the scientific results obtained, providing evidence, arguments, and examples of implementation

IPK-3.2 Able to draw up technical documentation, reports on research and development, in accordance with current standards for the preparation of technical documentation

IPK-3.3 Capable of writing articles, reviews, incl. in English

IPK-4.1 Provides an assessment of the behavior of society or its individual groups based on data analysis

IPK-4.2 Collects information from the Internet, incl. from social networks, and processes it

IPK-4.3 Analyzes the information received and finds hidden patterns

IPK-5.1 Uses modern information processing technologies and computer technology when solving problems of industrial data analysis

IPK-5.2 Able to collect industrial data, knows the specifics of such data

IPC-5.3 Draws up technical specifications for a task in a professional area

IPK-6.1 Monitors and evaluates big data processing performance

IPK-6.2 Uses methods and tools for receiving, storing, transmitting, and processing big data

IPK-6.3 Develops proposals to improve the performance of big data processing

## **9. Contents of practice**

During the internship, the student performs scientific research work (R&D). The organization and conduct of the educational practice “Research work (obtaining primary skills in scientific research work)” involves the head of the educational practice, the head of research work, the research consultant (if necessary), heads of departments, employees of the dean’s office of IPMKN and students.

### **9.1. Heads of departments:**

- coordinates the selection of topics and the distribution of students among research leaders (together with the dean’s office of IPMKN);
- organize the protection of reports based on the results of the practice (together with the head of the practice).

### **9.2. Head of research:**

- formulates a research task for the student;
- monitors the implementation of research work by students in accordance with the assignment;
- checks the text of the research work to ensure that the content of the work corresponds to the topic of the research work;
- checks the text of the research work for compliance with the design requirements (the supervisor does not have the right to accept research work from the student if it is not formatted according to the rules);
- confirms the readiness of the research work for defense with his signature on the title page of the course work;

- provides assistance in preparing research results for reports at scientific conferences and publication in scientific publications (if necessary).

### **9.3. Research consultant:**

- formulates the task to complete the relevant section of the research work in agreement with the head of the research work;
- determines the structure of the corresponding section of the research work;
- advises the student on work on the relevant section of research work according to the consultation schedule.
- checks the compliance of the volume and content of the corresponding section of the research work with the task;
- makes a decision on the readiness of the section, which is confirmed by the corresponding signatures on the title page of the course work.

### **9.4. Head of educational practice (responsible for safety):**

- brings to the attention of students the program of educational practice, methodological instructions for processing the results of research work and other reporting materials of students as part of the educational process at the National Research Tomsk State University (hereinafter referred to as methodological instructions);
- conducts instructions on safety and labor protection, compliance with fire safety rules, sanitary and epidemiological rules and hygienic standards at TSU;
- coordinates the practice schedule (together with the head of the research work) and systematically monitors the progress of the student’s work by marking it in the practice diary;
- provides consulting assistance in preparing practice reports and preparing trainees’ diaries;
- informs the student about the procedure for defending research work.

### **9.5. The student during the internship:**

- independently selects a research topic from those proposed by departments of the institute or formulates a research topic independently, guided by interest in the problem, the possibility of obtaining factual data, the availability of specialized literature, taking into account that the main requirement is the scientific and practical relevance and novelty of the topic;

- independently carries out research work in accordance with the requirements of the internship program and the internship schedule, in interaction with the head of the research work and the internship supervisor;
  - bears responsibility for the reliability of the data presented in the research work; when borrowing individual materials and results, refers to the authors and sources;
  - participates in the work of a scientific seminar of the department and/or institute (if seminars are provided) and reports on the intermediate results of his own research;
  - prepares reporting materials based on the results of practice in accordance with clause 11.
- 9.6. IPMKN Dean's Office staff:
- prepare an order on assigning supervisors and research topics to students;
  - preparing a draft order on sending students to practice.

A practice manager is appointed from each department of the institute to manage the practice of students performing research work at a given department. It is possible to appoint a research supervisor as a practice manager for each student.

Stages of practice	Types of work related to future professional activities	Hours(KRI/General)	
		1 semester	2 semester
1. Organizational	1. Holding a meeting to organize practice: – acquaintance with the goals, objectives, requirements for practice and reporting forms for practice (practice program); – familiarization with the internship schedule; – preparation of trainee diaries.	1/1	1/1
2. Introductory	1. Familiarity with the internal regulations and other local regulations of TSU. 2. Instruction on occupational safety and health, compliance with fire safety rules, sanitary and epidemiological rules and hygienic standards at TSU.	1/1	1/1
3. Analytical	1. Carry out work on processing and analysis of scientific and technical information and research results. 2. Analyzes scientific data, results of experiments and observations. 3. Develops plans and methodological programs for conducting research and development on a specific topic.	36,5/158	36,5/158
4. Final	1. Preparation of a report (course work/part of its sections) and preparation of materials necessary for its defense (presentation, methodological development, etc.). 2. Defense of the report based on the results of the internship.	2/20	2/20
<b>TOTAL:</b>		<b>40,5/180</b>	<b>40,5/180</b>

## 10. Practice reporting forms

The internship is considered completed if the student fulfills all the requirements of the internship program. Interim certification based on the results of practice in the first and second

semesters - test with assessment. Students are assessed based on the results of all types of activities in the presence of documentation on practice.

The student must provide, based on the results of the practice:

1. A practice diary containing a step-by-step work plan with progress marks, certified by the practice director.

2. A report on practice, drawn up in accordance with the rules for preparing reports on research work.

3. Report and presentation of the results of research work at the scientific and technical seminar of the department.

Current control - at least once a week, oral report from the practice manager. The practice manager checks the student's work and makes appropriate notes in the practice diary.

Interim certification based on the results of practice - drawing up a report on practice and its public defense at the department. The grade is given based on the results of defending the practice, taking into account the opinion of the supervisor.

## **11. Organization of intermediate certification of students**

### **11.1 Procedure and form of intermediate certification**

At the end of the 1st semester, intermediate certification is carried out in the form of a test with an assessment. The mark is given by the head of the practice, taking into account the opinion of the head of the research work.

At the end of the 2nd semester, intermediate certification is carried out in the form of a test through students' public defense of individual reports on their internship (coursework) before a commission appointed by the heads of departments, consisting of at least 2/3 of the department's research and teaching staff, including the head of practice from TSU.

### **11.2 Procedure for assessing learning outcomes**

The assessment of the development of learning outcomes is carried out by the commission at the end of the 2nd semester based on the analysis of the submitted reporting documents, the student's speech and his answers to questions, taking into account the opinion of the internship supervisor and the student's research supervisor.

### **11.3 Criteria for assessing learning outcomes**

The results of the internship are determined at the end of the 2nd semester by grades "excellent", "good", "satisfactory", "unsatisfactory".

#### **11.3.1 "Excellent" grade is given if:**

– Research work was carried out in accordance with the target setting, meets the requirements and is formatted in accordance with methodological instructions;

– the presentation at the defense is structured, the reasons for the choice and relevance of the topic, the purpose and objectives of the work, the subject, object and chronological framework of the study, the logic of drawing each of the most significant conclusions are revealed: the final part of the report shows the prospects and tasks for further research of this topic, issues of further application are highlighted and implementation of research results into practice;

– the duration of the speech complies with the regulations (5-7 minutes per report);

– the head of the research project rated the work as "excellent" or "good";

– the answers to the questions of the commission members are logical, reveal the essence of the issue, are supported by the provisions of monographic sources and regulations, conclusions and calculations from research work, show the independence and depth of study of the problem;

– wide use of information technologies, both in the research work itself and during the presentation.

#### **11.3.2 "Good" grade is given if:**

– The research work was carried out in accordance with the target setting, meets the requirements and is formalized in accordance with the requirements for it;

- the presentation at the defense of research work is structured, one or two inaccuracies are allowed when disclosing the reasons for the choice and relevance of the topic, the goals and objectives of the work, the subject, object and chronological framework of the research, an error is allowed in the logic of deriving one of the most significant conclusions, which is eliminated during additional clarification questions;

- the final part of the report does not sufficiently reflect the prospects and objectives of further research on this topic, issues of further application and implementation of research results into practice;

- the duration of the speech complies with the regulations (5-7 minutes per report);

- the head of the research project rated the work as “good” or “excellent”;

- there was a violation of logic in the answers to the questions of the commission members, but, in general, the essence of the question is revealed, the speaker’s theses are supported by the provisions of regulatory legal acts, conclusions and calculations from research work, they show the independence and depth of study of the problem by the student;

- limited use of information technology by the student, both in the research work itself and during the presentation.

11.3.3 A “Satisfactory” grade is given if:

- Research work was carried out in accordance with the target setting, but does not fully meet the requirements, incl. by design in accordance with the standard;

- the presentation at the defense of the research work is structured, but inaccuracies are allowed in disclosing the reasons for the choice and relevance of the topic, the goals and objectives of the work, the subject, object and chronological framework of the research, there was a gross error in the logic of drawing one of the most significant conclusions, which, when pointed out, is eliminated with difficulties;

- the final part of the report does not sufficiently reflect the prospects and objectives of further research on this topic, issues of further application and implementation of research results into practice;

- the duration of the speech exceeds the regulations (more than 7 minutes per report);

- the head of the research project rated the work as “satisfactory” or “good”;

- answers to questions from commission members do not fully reveal the essence of the issue, are poorly supported by the provisions of monographic sources and regulations, conclusions and calculations from research work, and show insufficient independence and depth of study of the problem by the student;

- insufficient use of information technologies, both in the research work itself and during the presentation;

- in the process of defending the research work, the student demonstrated an understanding of the content of the mistakes he made during its implementation.

11.3.4 An “Unsatisfactory” grade is given if:

- The research work was carried out in violation of the target setting, does not meet the requirements, and there are deviations from the standard in the design; the student’s presentation at the defense is not structured, the reasons for the choice and relevance of the topic, the goals and objectives of the work, the subject, object and chronological framework of the study are not sufficiently disclosed, gross errors are allowed in the logic of drawing several of the most significant conclusions, which, when pointed out, are not eliminated;

- the final part of the report does not reflect the prospects and objectives of further research on this topic, issues of further application and implementation of research results into practice;

- the duration of the speech significantly exceeds the regulations;

- the head of the research project rated the work “unsatisfactory”;

- answers to questions from commission members do not reveal the essence of the issue, are not supported by the provisions of regulatory legal acts, conclusions and calculations from



the final qualifying work, and show the lack of independence and depth of study of the problem by the student;

- information technologies are not used in research work, as well as in the report;
- in the process of defending research work, the student demonstrates a lack of understanding of the content of the mistakes he made during its implementation.

## **12. List of educational literature and Internet resources**

a) basic literature:

1. Documented procedure for DP QMS NU TSU 10/05/06/2010. “The process of preparation, development, writing and execution of final qualifying works (GQR).” Introduced by order of the TSU rector No. 397 dated September 30, 2010. <http://vital.lib.tsu.ru/vital/access/manager/Repository/vtls:000506706>

2. GOST 7.1 – 2003 System of standards for information, library and publishing business. Bibliographical record. Bibliographic description. General requirements and rules for drawing up:. Introduced 05/29/2003. – M.: Standards Publishing House, 2003. – 12 p. <http://www.lib.tsu.ru/win/metod/gost/gost7.1-2003.pdf>;

3. GOST R 7.0.5 – 2008. System of standards for information, library and publishing. Bibliographic link. General requirements and rules for drafting/ Introduced on 04/28/2008. – M.: Standards Publishing House, 2008. – 22 p. <http://www.lib.tsu.ru/win/metod/gost/gostR7.0.5-2008.pdf>

4. GOST 7.9-95. System of standards on information, librarianship and publishing. Abstract and annotation. – Instead of GOST 7.9-77; Introduced 07/01/97. – Minsk: Standards Publishing House, 1996. – 7 p.

5. Recommendations. Bibliographic description of the document. <http://www.lib.tsu.ru/win/produkcija/metodichka/1.html>

6. GOST 19.001-77. Unified system of program documentation. General provisions. Introduced 01/01/80. – M.: Standards Publishing House, 1977. – 3 p.

7. GOST 19.701–90 Unified system of program documentation. Schemes of algorithms, data programs and systems. Conventions and execution rules

8. GOST 19.101-77. Unified system of program documentation. Types of programs and program documents. Introduced 01/01/80. – M.: Publishing house of standards, 1977. – 4 p.

9. Template of required documents

<http://csi.tsu.ru/ru/content/%D0%B3%D1%80%D0%B0%D1%84%D0%B8%D0%BA%D0%B8-%D0%B8-%D1%88%D0%B0%D0%B1%D0%BB%D0%BE%D0%BD%D1%8B-%D0%B4%D0%BE%D0%BA%D1%83%D0%BC%D0%B5%D0%BD%D1%82%D0%BE%D0%B2>.

b) additional literature:

1. Guidelines for preparing reports on coursework, diploma work and industrial (pre-graduation) practice at the Faculty of Informatics of TSU. Methodological recommendations / Compiled by: Yu.L. Kostyuk. – Tomsk, 2003. – 19 p.

c) Internet resources:

1. <http://www.lib.tsu.ru/> – TSU Scientific Library

2. <http://www.diss.rsl.ru/> – Electronic library of dissertations of the RSL

3. <http://elibrary.ru/> – Scientific electronic library

4. <http://www.consultant.ru> – All-Russian Network ConsultantPlus Legal reference system.

## **13. List of information technologies**

a) licensed and freely distributed software::

– Microsoft Office: MS Word, MS Excel, MS PowerPoint;

– publicly available cloud technologies (GoogleDocs, Yandex Disk, etc.).

b) information reference systems:

- Electronic library (repository) of TSU –  
<http://vital.lib.tsu.ru/vital/access/manager/Index>  
– EBS Lan – <http://e.lanbook.com/>  
– EBS Student Consultant – <http://www.studentlibrary.ru/>  
– Educational platform Urayt – <https://urait.ru/>  
– EBS ZNANIUM.com – <https://znanium.com/>  
– EBSIPRbooks – <http://www.iprbookshop.ru/>  
c) professional databases:  
– University Information System RUSSIA – <https://uisrussia.msu.ru/>

#### **14. Material and technical base for practical training**

The lecture hall (for conducting a scientific and technical seminar of the department) must be equipped with projection equipment: a computer and a projector, as well as software for their operation.

Computer class (for independent student work), computers must be connected to a local network with Internet access.

The scientific library on the basis of the National Research Tomsk State University (SL TSU) provides the necessary educational, methodological and information support for student learning: SL TSU fund - 4 million copies, including electronic Russian and foreign network resources - scientific electronic library eLIBRARY.ru, EAST VIEW , Scopus, WoS, the electronic library of the Grebennikov Publishing House, the electronic library system of the Lan Publishing House and many others. The National Library of TSU provides students with the main educational and educational publications necessary for organizing the educational process in accordance with the requirements for basic educational program. The contents of the publications are presented on the website of the National Library of TSU <http://www.lib.tsu.ru/>, in the “Electronic Resources” section - <http://www.lib.tsu.ru/ru/elektronnye-resursy>. Students are provided with individual unlimited access to electronic resources from any computer at the National Library of TSU.

#### **15. Authors information**

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