

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
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higher education
NORTH CAUCASIAN FEDERAL UNIVERSITY

I APPROVE

Dean Faculty of Mathematics and
Computer Science named after Professor
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Professor

_____ T.A. Grobova

**REQUIREMENTS FOR FINAL QUALIFICATION WORKS AND THE PROCEDURE
FOR THEIR IMPLEMENTATION**

Direction of training	02.04.01 Mathematics and Computer Science
Directionality (profile)	Training Program for Electronic Information
Graduate qualifications	Master's degree
Form of study	Full-time
Year of commencement of studies	2026

DEVELOPED BY:

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Computational Mathematics and
Cybernetics

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«___» _____ 2026

Stavropol, 2026

1. Introduction

According to the program's educational program, master's degree students complete their final qualifying work in the form of a thesis, which is an independent and logically complete final qualifying work related to solving problems related to the type(s) of activity for which the master's degree student is preparing. It must be up-to-date with the current state of scientific development, and its topic must be relevant.

A graduate thesis is a theoretical or applied research project aimed at acquiring and applying new knowledge. The logical completeness of a graduate thesis implies the integrity and internal unity of the work, the interconnectedness of the goal, objectives, methodology, structure, completeness, and results of the research.

2. The purpose and objectives of the final qualifying work

The purpose of the final qualifying work: to establish the compliance of the level of professional training of graduates with the requirements of the educational standard, to demonstrate the ability to use the acquired theoretical knowledge in collecting, analyzing and summarizing factual material on the selected topic, and to demonstrate practical skills in its application.

Tasks:

- deepening, systematization and integration of theoretical knowledge and practical skills in the direction of master's training and programs;
- development of skills to generalize theoretical positions, use modern methods and approaches when solving problems in the area under study;
- development of skills in planning and conducting scientific research, processing and analyzing scientific information; formulating the results of the research;
- strengthening the skills of presentation, public discussion and defense of scientific results, developed proposals and recommendations.

In the process of completing the final qualifying work, the master's student must:

- demonstrate the ability to independently conduct scientific research;
- set and solve professional problems;
- select research methods that are adequate to the tasks set;
- professionally present specialized information, scientifically argue and defend your point of view, relying on the developed competencies;
- process the obtained results; present the research results.

3. List of competencies, the level of development of which must be checked during the defense of the final qualifying work

Code competencies	Formulation
UK – (No.)	Universal competencies
UK-2	Capable of managing a project at all stages of its life cycle
UK-3	Able to organize and manage the work of a team, developing a team strategy to achieve the set goal
UK-4	Able to apply modern communication technologies, including in foreign language(s), for academic and professional interaction
OPK-(No.)	<u>General professional competencies</u>
OPK-1	Able to find, formulate and solve current and significant problems in applied and computer mathematics
OPK-2	Able to create and explore new mathematical models in the natural sciences, improve and develop concepts, theories and methods
OPK-3	Capable of independently creating application software based on

	modern information technologies and network resources, including domestically produced ones
PC-(No.)	<u>Professional competencies</u>
PC-4	Capable of conducting patent research, determining forms and methods of legal protection and defense of rights to the results of intellectual activity, and managing rights to them to solve problems in the field of development of science, engineering and technology
PC- 7	Able to create and explore new mathematical models in the natural sciences, industry and business, taking into account the capabilities of modern information technology, programming and computer equipment
PC- 6	Able to use modern methods of development and implementation of specific algorithms of mathematical models based on programming languages and application packages for modeling
PC- 8	Capable of participating in the management of projects for the creation of information systems and software systems at various stages of the life cycle
PC- 9	Able to take into account knowledge of the problems and trends in the development of the software market in professional activities

4. Structure and volume of the final qualifying work

The final qualifying work must fully correspond to the approved research topic, contain elements of novelty, be relevant, and have theoretical and practical significance.

The final qualifying work may have the following structure: title page (Appendix 1), assignment (Appendix 2), schedule (Appendix 3), content, introduction, main text, conclusion, bibliography (list of sources used), appendices.

The title page contains the following details: the name of the founder of SKFU, the name of the university, institute (branch), department, the title of the final qualifying work topic, the last name, first name, patronymic of the author of the work indicating the year, group, and form of study; the academic degree, title, position, initials and last name of the scientific supervisor, reviewer, the column "Date of defense", "Assessment", place and year of defense.

The assignment for the final qualifying work includes the initial data for the final qualifying work, an assignment for studying the object and subject of the research and collecting material for the work, an assignment for each section of the final qualifying work with an indication of the deadline for its issuance and the deadline for completion.

It is recommended that the final qualifying work be submitted in a volume of at least 40 pages of printed text.

5. Contents of the final qualifying work

The content includes the titles of sections and subsections of the work, indicating the page where each part begins.

The introduction contains the rationale for the problem, its relevance, purpose, and objectives, a definition of the methodological basis of the study, the structure and methods of the research, and a determination of the theoretical and/or practical significance of the work. The introduction reveals the relevance of the topic, reflects the rationale for the choice of the research topic, its scientific novelty, and its practical significance.

The introduction should define the object of the study (the process or phenomenon that leads to the achievement of the goal; the problematic situation to be studied) and the subject of the study (the part of the object that the study is focused on). The subject of the study most often coincides with the definition of its topic or is very close to it.

The introduction includes the formulation of the purpose of the research – solving the stated scientific problem, obtaining new knowledge about the subject and object, and the tasks that the graduate student sets for himself to achieve the goal.

The research objective should be formulated based on the chosen topic. It determines the entire logic of the thesis, which should be aimed at achieving it.

The research objectives specify the main theoretical and practical directions of the study. It is recommended to set no more than 3-4 objectives and to plan the study so that it is aimed at solving these objectives. At the final stage of the study, it is necessary to conduct revisions to determine the extent to which the objectives have been achieved and the purpose of the study. The formulation of the objectives can be revised if necessary.

The object of research is the scientific direction on the materials of which the qualifying work is carried out.

The subject of the research is determined by the topic of the qualifying work.

The introduction defines and characterizes specific methods for solving the stated problems. The methodological basis of the study is materialistic axiology, within which the individual is viewed as the highest value and the end in itself of social development; the theory of knowledge; the principles of the relationship between theory and practice; the unity of consciousness and activity; the fundamental principles of educational development; and the conceptual foundations for restructuring the domestic educational system.

The main text should typically be divided into theoretical and empirical sections. There should be at least two of these. Section titles should be extremely brief and accurately reflect their main content. A section title cannot be the same as the final qualifying work's title. It is preferable that sections and subsections not differ significantly in length. Each section presents an independent aspect of the topic being studied. Subsections should be logically interconnected and conclude with conclusions.

The main text of the thesis addresses the research objectives in a logical, consistent manner. Each section addresses one of the objectives posed in the introduction and serves as the basis for the subsequent section. The main text of the final qualifying work should demonstrate a thorough understanding of the chosen topic, knowledge of the sources used, and the ability to compare different points of view.

At the end of each section, it is necessary to summarize the material presented and formulate conclusions.

The conclusion contains the overall findings of the work, prospects for further study, and implications for practice. This section is short, but particularly important, as it presents the final results of the work.

The conclusion includes several theses. Their number typically corresponds to the number of subsections. The conclusion briefly formulates answers to the purpose and objectives of the study in the form of theses; it presents conclusions representing theoretical and practical significance for the topic under study; and it formulates possible avenues and prospects for continuing the work. Discussions of the findings and references to literary sources are not permitted in the conclusion.

The bibliography (list of references) is prepared in accordance with GOST requirements for bibliography; it lists all scientific literature and documentation sources used by the student.

This list constitutes a significant part of the final qualifying work and reflects the student's independent creative work. The bibliography must include all sources mentioned and cited in the work, including scholarly literature and reference publications. These include mandatory references such as monographs, research articles, and theses. The use of archival sources and periodicals is also permitted. Foreign literature and online sources are also required in the final qualifying work.

Appendices include tables, charts, graphs, diagrams and other materials illustrating or confirming the main theoretical positions and conclusions.

The content of the final qualifying work must comply with the requirements of the standards and include:

- introduction - justification for the choice of subject and statement of the research problem, carried out on the basis of a literature review, including taking into account periodical scientific publications, and the results of a patent search;
- theoretical section - including research methods and tools;
- empirical section - results obtained during the preparation of the final qualifying work, which have scientific novelty, theoretical, applied or scientific-methodological significance; testing of the obtained results and conclusions in the form of reports at scientific conferences or prepared publications in scientific journals and collections;
- conclusion;
- list of references (list of used sources);
- applications (if necessary).

The final qualifying work must be completed using modern methods and models, and, if necessary, with the involvement of specialized computer software packages and graphic material (tables, illustrations, etc.).

6. Registration of the final qualifying work

Proper formatting of a final thesis is an important and essential requirement, and is one of the criteria for its evaluation. The final thesis must be edited and proofread. The final thesis must be prepared in at least two identical copies and bound.

The final qualifying work must be printed using modern text editors.

Each section of the work—introduction, chapter, conclusion, etc.—begins on a new page. "Introduction," "Conclusion," chapter and section titles, "References," and "Appendices" are in bold. Underlining the title and hyphenation are not permitted.

The title page is included in the overall work but is not numbered. The table of contents page of the final qualifying thesis includes the titles of all chapters and paragraphs, along with their initial page numbers. Page numbers are continuous (for the entire text of the thesis) and are written in Arabic numerals at the top or bottom of the page.

Chapters and sections are numbered using Arabic numerals. The introduction, conclusion, references, and appendices are not numbered.

Rules for the design of tables and illustrative material

Formulas are written on a new line and numbered in Arabic numerals on the right side of the sheet at the formula level, enclosed in parentheses. Formulas are numbered sequentially within a section. Formulas placed in appendices should be numbered separately in Arabic numerals within each appendix, with the appendix designation preceding each numeral. Formulas are typed in the Microsoft Equation Editor. Equation, Times font New Roman font, italic. Formulas must clearly distinguish between letters, numbers, superscripts, and subscripts. A formula is an integral part of the sentence in which it appears. Therefore, punctuation marks are placed according to the rules for writing sentences. The meaning of all formula symbols must be explained immediately after the formula is written. For example,

Deductions are determined from the ratio

$$x_i = x - [x/p_i] \cdot p_i, (1.2)$$

where x is the number in the PSS, p_i are the modules of the ROC, $i = \overline{1, n}$, $i \in Z$.

References in the text to the formula's ordinal number are given in parentheses. For example, the mathematical model is represented by the set of formulas (1.5)... (1.8).

In-text figures should be placed immediately after the text in which they are first mentioned, or on the following page. They are numbered using Arabic numerals within subsections. The figure number consists of the subsection number and the sequential number of the illustration, separated by a period. The figure caption is placed below it, midline. The word "Figure" is written

in full. A period is not included at the end of the caption. One blank line should be left above and below the figure.

For example,

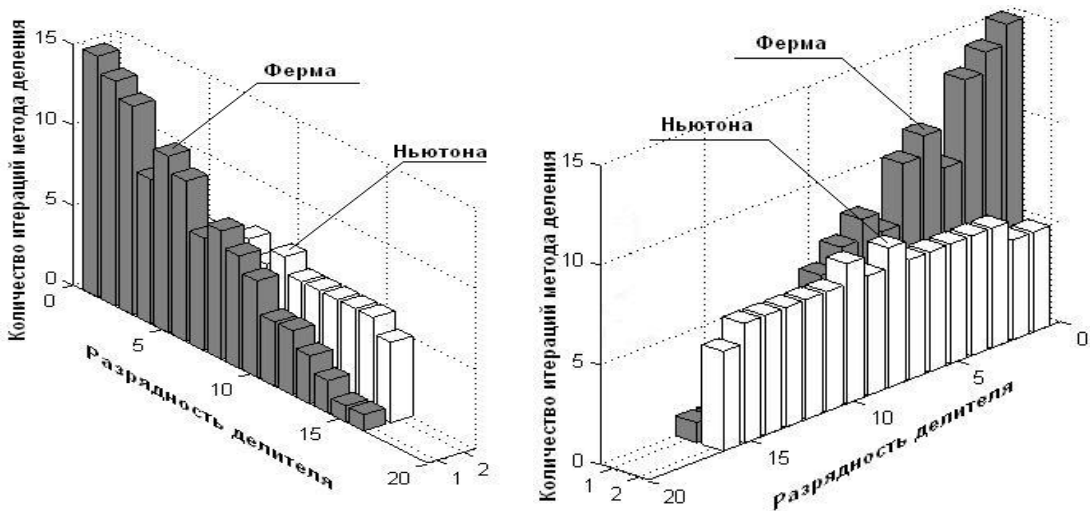


Figure 3.1 – Estimation of the number of iterations of Fermat and Newton methods

References to figures are made by their numbers, indicated in the text. For example, Figure 3.1 shows the evaluation of iterations of Fermat's and Newton's methods.

It is recommended to create illustrations (drawings), drawings, diagrams and slides in graphic editors: Corel Draw , Smart Draw , Power Point or Visio .

It is recommended that graphs be created using Microsoft software. A graph with a grid but no arrows . The graph's grid is determined by the scale (uniform or logarithmic) of the coordinate axes. Grids are not applied to graphs that show the qualitative nature of a function's change. The graph axes indicate the parameter name and unit of measurement. If the figure contains multiple graphs, they are drawn with different lines (solid, dashed, etc.) or different colors. Graphs are assigned serial numbers, with a subsequent explanation of which serial number corresponds to which parameter.

For example,

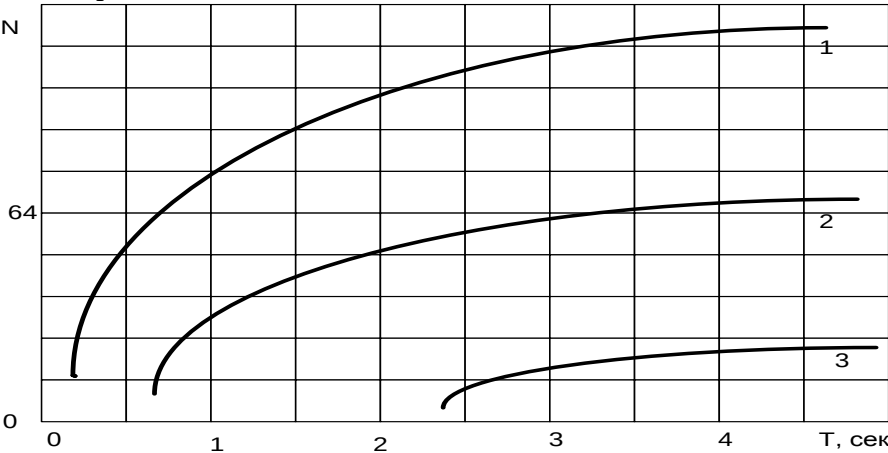


Figure 3.2 – Dependence of cracking time on key bitness

Digital material can be presented in the form of tables using Microsoft programs. Word , Microsoft Excel . Tables are numbered with Arabic numerals throughout the work. The table title is placed above the upper left corner of the table, followed by its sequential number. A period is not included after the table title. For example,

Table 3.1 – Estimated number of iterations of Fermat and Newton methods

Digit capacity of the dividend	Number of method iterations		Win $\approx F/N$
	Farm (F)	Newton (N)	
32	25	6	4.2
64	53	6	8.8
128	105	6	17.5

The distance between the text and the table, as well as between the table and the following text, is one line.

If the table is carried over to the next page, then above the upper left corner is written: Continuation of table 3.1. For example,

Continuation of Table 3.1

Digit capacity of the dividend	Number of method iterations		Win $\approx F/N$
	Farm (F)	Newton (N)	
256	203	6	33.8
512	411	6	68.5
1024	829	6	138.2

Tables are referenced by their numbers. For example, Table 3.1 presents the assessment of ... (or see Table 3.1). The font size in the table, depending on its content, is chosen by the author.

The final qualifying work must be bound in a hard cover.

Tables are placed in the text of the work immediately after the first reference to them or on the page following the first reference.

Rules for citing and formatting links to used sources

A reference is an indication of the source to which the author refers. Such sources can include not only literary works but also graphs, diagrams, and other sources.

References must be placed directly in the text. There are two options for citing authors. In the first option, the last name of the author(s) and the year of publication of the literary source are indicated in parentheses. For example : (Aleksandrova, 2015), (Baranov, Bogdanova, 2012), (Kosolapov et al., 2015). If the text contains data from several sources, the groups of information are separated by semicolons: (Birzhakov , 2011; Grozova , 2014). If the reference is to a collective monograph edited by someone, its title is shortened to the first two or three words: (Current Issues..., 2009). In the second option, the number of the literary source from the list of references of the master's thesis is indicated in square brackets. For example : [10], [10; 18]. If a quote from the text is given, the page number is also indicated, for example [3, p.15].

In the text of the final qualifying work, when mentioning any author, his initials should be indicated first, then the last name, for example: in the opinion of I.N. Gulyaev... , as P.M. Durovich emphasizes ... In a bibliographic reference, on the contrary, the last name is indicated first, then the initials of the author, for example : Gulyaev I.N., Durovich P.M., etc.

Quotes from monographs, scientific articles, and other sources in the work should be made accurately, preserving all the original features. If a quoted phrase is not quoted in full, place a period (three dots) where the text has been omitted, omitting punctuation before and after the end. Quotes are set off in the text with quotation marks.

When referring to illustrations and tables, it is correct to use the following expressions: depicted, shown, applied, given.

Rules for formatting a bibliography

A bibliographic description of a source includes the following elements: author (surname, initials), title of the work, place and year of publication, serial number of the volume, issue, number (for a journal), part, and number of pages. References in the list are arranged alphabetically or systematically by chapter, chronologically, or by the order of their citation within

the work. The most common arrangement is alphabetical. With alphabetical arrangement, references are grouped in strict alphabetical order by surname, initials, and titles of books, articles, etc. Foreign-language publications are arranged after the list of Russian-language works, also in alphabetical order.

Examples of literary design

books, monographs

Chervyakov N. I. Neurocomputers in residual classes.

– M.

270 p.

Standards, patents

GOST 7.32 - 2001. Report on scientific research work. Structure and rules of design.

Introduced . 2002-07-01.

– M.: Publishing house of sta

Dictionaries and encyclopedias

Mathematical Encyclopedic Dictionary / edited by Yu. V. Prokhorov .

– Mos

Encyclopedia, 1988.

– 847 p.

articles in the journal

Chervyakov N. I., Chernova M. V. Algorithm of integer division in the system of residual classes // Infocommunication technologies.

–12007. – Vol. 5. – No. 4.

articles in the collection

Chervyakov N. I., Chernova M. V. Integer division in the system of remainder classes // Infocommunication technologies in science, production and education: Third international scientific and technical conference (May 1-5, 2008).

– Stav

Caucasus State Technical University , 2008. – P. 198 -204.

conference materials

Chernova M. V. Problems that determine the need for transition to error-free calculations // Physical and mathematical sciences at the current stage of development of Stavropol State University: Proceedings of the 51st scientific and methodological conference of teachers and students of Stavropol State University "University Science for the Region" (April 3-24, 2006). - Stavropol: Publishing house of SSU, 2006. - P. 105-108.

Dissertations

Kopytkova L.B. Mathematical models of neural network implementation of modular computing structures for high-speed digital filtering: dis . candidate of physical and mathematical sciences: 05.13.18. – Stavropol, 2001. – 223 p.

Abstracts of dissertations

Kopytkova L.B. Mathematical models of neural network implementation of modular computing structures for high-speed digital filtering: abstract of dissertation Cand. of Phys. and Mathematics: 05.13.18. – Stavropol, 2001.

Internet sources

Encyclopedia Krugosvet . Science and technology. Computer science [Electronic resource] // Universal popular science online encyclopedia. URL: <http://www.krugosvet.ru> (date accessed: 03/28/2012).

Rules for application design

The appendix is placed at the end of the thesis, immediately following the bibliography. If the thesis contains a large number of appendices, they can be compiled into a separate volume. The presence of an "Appendices" volume is indicated in the table of contents of the thesis.

Appendix page numbers should be continuous and continue the overall page numbering of the main text. If there is more than one appendix, they are numbered using Arabic numerals without a number sign (Appendix 1, Appendix 2) in the upper right corner and have a subject heading. Each appendix begins on a new page. The main text is linked to the appendices by in-text links.

7. The procedure for completing a final qualifying work and the procedure for preparing a final qualifying work for defense

The procedure for defending a final qualifying work is determined in accordance with the Regulation on the procedure for conducting state final certification for educational programs of higher education - bachelor's programs, specialist programs and master's programs at the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" and the Regulation on the procedure for completing final works at the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University".

The student is granted the right to choose the topic of their final qualifying thesis. Upon written application by the student (or several students completing the final qualifying thesis jointly), the graduating department may, in accordance with the established procedure, grant the student(s) the opportunity to prepare and defend a final qualifying thesis on a topic proposed by the student(s), provided that the feasibility of its development for practical application in the relevant field of professional activity or at a specific professional site is justified (Appendix 7).

The student's assigned final qualifying work is completed in accordance with the assignment to study the object and subject of the research and to gather material for the work. The final qualifying work assignment is approved by the department head, with a deadline specified.

Seven calendar days before the start of pre-graduation practice, the director of the institute (branch) shall approve the topics of final qualifying theses for final year students based on submissions from the heads of graduating departments, as well as the supervisors indicating their academic degree, title and position.

The supervisor of the final qualifying work provides assistance to the student in developing the content of the topic for the entire period of the final qualifying work, drawing up a calendar plan (Appendix 3), recommends the necessary literature, reference materials and other sources on the topic, conducts systematic consultations, checks the completion of the work in parts and as a whole, and prepares assignments for pre-graduation practice.

After completion of the pre-graduation internship, a public preliminary defense of the work is held, the results of which are recorded in the minutes of the meeting of the graduating department.

The completed final qualifying work, signed by the student and advisor, is submitted to the supervisor by the quality control officer. After the final qualifying work has been reviewed (including for plagiarism in accordance with the Antiplagiat System Regulations at North Caucasus Federal University), the supervisor signs it and, along with their written feedback on the student's work during the final qualifying work and the feedback of the co-supervisor, submits it to the head of the department. The feedback includes a description of all sections of the work.

Based on these materials, after the department meeting, the head of the department makes a note on the final qualifying work (FQA) approving the student's defense. If the student is not admitted to the defense, the matter is reviewed at a department meeting with the head of the department. The minutes of the department meeting regarding the denial of admission are submitted to the Institute Directorate and, along with a memorandum from the Institute Director, are sent to the Vice Rector for Academic Affairs for signature.

The final qualifying thesis, review, and comment(s) are submitted to the state examination committee no later than two calendar days prior to the defense of the final qualifying thesis. The paper version and electronic version of the final qualifying thesis in RTF, DOC, DOCX, and PDF formats (with text content) are submitted to the graduating department.

Preparation of a report and illustrative material

Master's students must thoroughly prepare for their final thesis defense. The presentation they make to the State Examination Committee significantly influences the final grade. The presentation should be concise, clear, and include the main points of the thesis. It should be 8-10 minutes long.

The report should be structured according to the following scheme:

Address: " *Dear Chairman and members of the State Attestation Commission! We present to you the final qualifying work on the topic...* "

In 2-3 sentences, a description of the relevance of the topic, the purpose, objectives, object and subject of the research is given.

The report continues: "In the process of solving the assigned tasks, the following results were obtained..." Then, the results are described for each chapter, and the report concludes with the words: "As a result of the conducted research, the following conclusions were made..." (the conclusions are formulated).

To make the research conducted by the graduate student and the conclusions drawn more visible, it is necessary to prepare a presentation of the report in electronic form (in the Power program) Point), which must correspond to the text of the report and must not be overloaded.

The main principles when composing a presentation are brevity, clarity, relevance, clarity (emphasizing key points), and memorability (reasonable use of striking effects).

The main requirement is that each slide must have a title, and the number of words per slide should not exceed 20. The presentation assists the speaker in delivering the report, but should not replace it. You can print out a few key slides as handouts.

The procedure for defending a final qualifying work

The defense of the final qualifying thesis is conducted at an open meeting of the state examination committee . The public defense of the final qualifying thesis is a mandatory component of the student's State Final Attestation (GFA).

The student is given no more than 15 minutes to present the main points of their final qualifying thesis. During the presentation, the student must highlight the relevance of the chosen topic, the object and subject of the research, the goal and main objectives, the scientific sophistication and novelty of the research, and the theoretical and practical results of the research.

Following the student's presentation, the chairperson and committee members ask questions. After the student answers the questions, the supervisor's review (Appendix 6) and the review (Appendix 5) of the work are read out (the supervisor and reviewer may speak during the student's defense). The student is then given the right to respond to the reviewer's comments.

Upon completion of the final theses defense, a meeting is called, attended only by the chairperson and committee members. At this meeting, the final theses and each student's defense are discussed. Based on the discussion, grades are entered into the minutes and the report card.

Following the examination committee meeting, students are informed of the results of their final theses defense.

8. Description of indicators and criteria for assessing competencies, as well as assessment scales

8.1 Description of indicators

Levels of development competencies (ies), indicator (s) Indicators	Descriptors			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
UK-2. Capable of managing a project at all stages of its life cycle.				
Learning outcomes for the course (module): ID-1 UK-2 As part of the project activities, it models the technological processes of creation and processing of materials taking into account economic factors and in accordance with the requirements of environmental and industrial safety	The technological process is modeled with gross errors or is absent. There is no cost-benefit analysis or it is performed incorrectly. Environmental and industrial safety requirements are ignored. The project does not contain new solutions and uses outdated technologies. The work does not correspond to the assignment, contains critical errors, and lacks a structured format.	A simplified technological process has been developed; inaccuracies or the absence of some stages are possible. The cost-effectiveness analysis is presented superficially or partially. Only basic safety aspects are taken into account, and measures to reduce environmental impact are not presented. Standard technologies are used without any attempts to optimize or introduce new solutions. The project is partially completed; there are logical inconsistencies or calculation errors.	The technological process is designed correctly, but may contain minor flaws or insufficient detail. An analysis of economic efficiency is presented, but the calculations are not detailed in all aspects. Basic safety requirements are met, but minor omissions are possible. Modern technologies are used, but without significant innovations or optimizations. The project meets the basic requirements of the assignment, but may contain minor flaws in the design or calculations.	The technological process has been developed with a high degree of detail, taking into account all key stages and factors. A detailed analysis of the economic efficiency of the process is presented, and cost and profitability calculations are carried out. The project complies with modern environmental and industrial safety requirements and takes into account measures to minimize negative impacts on the environment. Modern technologies and approaches to material processing are used, and process optimization elements have been introduced. The project fully complies with the assignment and is designed in accordance with established standards.
Learning outcomes for the course (module): Implements a new project into	The project plan is missing or presented in an unsystematic manner.	The project implementation plan has been presented, but contains significant gaps.	The project was planned thoroughly, but with some minor omissions in details.	A detailed project implementation plan is presented, taking into

Levels of development competencies (ies), indicator (s) Indicators	Descriptors			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
production and manages it at all stages of its life cycle	The project implementation is not carried out or is carried out with serious problems. There is no system for monitoring and analyzing performance indicators. The economic feasibility has not been worked out; there may be high risks of loss. There are no provisions for further development and scaling of the project. The project does not comply with regulatory requirements; there are critical errors in calculations, management and design.	The project is undergoing implementation with difficulties and management problems are being observed. Benchmarks are not monitored sufficiently and data analysis is fragmented. A general cost-benefit analysis is presented, but a detailed economic justification is missing. Issues of further development of the project have not been worked out or are proposed in general terms. The project is partially completed; there may be errors in calculations, management or design.	The project is being implemented successfully, but management could be optimized to increase efficiency. Key indicators are monitored, but there may be shortcomings in the control system. The economic feasibility of the project is presented, but may require more detailed calculations. Development paths for the project are being considered, but without in-depth consideration of scalability. The project complies with the main regulatory requirements, but there may be minor design flaws.	account all key aspects (goals, objectives, resources, risks, deadlines). The project was successfully implemented at all stages of the life cycle using modern management methods. A performance evaluation system has been implemented, ensuring timely monitoring of key performance indicators. Reasonable calculations of costs, profitability and potential profit are presented. Possibilities for further development and improvement of the project were taken into account, and scaling strategies were proposed. The project fully complies with technical, economic and legal norms and is designed in accordance with established standards.
UK-3. Capable of organizing and managing a team, developing a team strategy to achieve the set goal.				
Learning outcomes for the course (module): ID-1 UK-3 Manages the production activities of employees	There is no clear distribution of responsibilities and there is chaos in the work. Planning is absent or is carried out formally, and control over implementation is minimal. The management is ineffective,	There are gaps in the distribution of responsibilities and coordination of employees. Planning is underway, but there are significant deviations from deadlines and insufficient control. Human resources management is	Responsibilities are distributed, but minor shortcomings in work coordination are possible. The work plan has been drawn up and is being implemented, however, minor deviations	Employee responsibilities are clearly distributed, and effective coordination of work is ensured. A detailed work plan was developed and implemented, including

Levels of development competencies (ies), indicator (s) Indicators	Descriptors			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
	there is a lack of motivation and control over employees. Emerging problems are ignored or not resolved in a timely manner. Production processes are not optimized, which can lead to significant losses of time and resources. Production activities are carried out with serious violations of regulatory requirements.	at a basic level and employee motivation is weak. Problems are resolved with delays or not in full. There is no systematic approach to improving efficiency and reducing costs. Production activities are carried out with violations; there are organizational and regulatory shortcomings.	from the schedule are possible. Management is good, but there may be minor problems with staff motivation. Problems are resolved in a timely manner, but minor delays or shortcomings in the process are possible. Basic efficiency improvement methods are applied, but the optimization potential is not fully realized. Production activities comply with basic standards, but minor omissions may occur.	deadlines, resources, and milestones. Modern methods of personnel management are successfully applied, and employee motivation is ensured. Problems arising in the production process are quickly and effectively resolved. Strategies are applied to improve labor efficiency and minimize costs. Production activities are organized in full compliance with regulatory requirements.
Learning outcomes for the course (module): ID-2 UK-3 Prepares and presents presentations of plans and results of personal and team activities	The presentation does not have a clear structure, and the sequence of information delivery is chaotic. The main aspects of the topic are poorly covered or absent, and the materials are poorly prepared. The slides are overloaded with text, unreadable, or poorly formatted. The speaker reads the text without expression, does not use intonation, and makes many hesitations. There is no interaction with the audience and the material is presented formally. There is a lack of coordination within the team; speakers do not	The presentation has a weak structure, and the logic of presentation is broken in places. Only the main aspects are presented, important details or evidence base are missing. The slide design contains too much text, bad color combinations, or sloppy elements. The report is read monotonously, there may be frequent hesitation and a lack of expressiveness. Interaction with the audience is minimal, the performance is more like a monologue. During a team presentation, there is a lack of coordination among the speakers and an uneven	The presentation is logically structured, but there may be some minor flaws in the logic of presentation. The basic information is presented, but some aspects may be covered superficially. The presentation design is generally high quality, but there may be some text overload or minor visual flaws. The speaker presents the material confidently, but slight hesitation or monotony of speech is possible. There are attempts to interact with the audience, but they are	The presentation is clearly structured and contains a logical sequence of presentation of the material. All key aspects of the plan or performance results are presented and reliable data is used. The slides are professionally designed, the graphics are discreet, the fonts are legible, and the color scheme is not overloaded. The speaker presents the material confidently and clearly, uses expressive means of speech, and

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	coordinate information with each other. Either he doesn't answer questions, or he does so uncertainly, with mistakes and deviations from the topic.	distribution of roles. Answers to questions from the audience are given with difficulty, uncertainty or deviation from the topic are possible.	not always effective. There is interaction between speakers, but there may be inconsistency or uneven distribution of roles. Generally answers audience questions, but some answers may not be detailed enough.	maintains eye contact. The presentation is accompanied by explanations, examples, and may include questions for the audience or interactive elements. During a team presentation, the speakers were coordinated, roles were distributed logically, and interaction within the team was smooth. Confidently answers questions from the audience, demonstrating an understanding of the topic and the ability to argue their point of view.
UK-4. Able to apply modern communication technologies, including in a foreign language(s), for academic and professional interactions				
Learning outcomes for the course (module): ID-1 UK-4 Forms and defends one's own opinions and scientific positions, including in foreign language(s)	The judgments are unclear and there is no logical sequence. The argumentation is weak or absent, and the conclusions are not supported by evidence. Unable to defend his point of view; arguments are superficial or incorrect. Significant errors in presentation, does not know the relevant terminology. Does not actively participate in discussions or is unable to respond to objections with reason. The work does not meet academic standards and contains serious	The wording is unclear in some places, and logical inconsistencies are possible. The argumentation is weak and there is a lack of references or substantiated evidence. Defending a position is difficult, the arguments are superficial or incomplete. Foreign language is used with errors, and there may be difficulties in expressing complex scientific ideas. Participates in discussions, but does not always take counterarguments into account or	The judgments are logical, but there may be minor inaccuracies or stylistic excesses. The arguments are compelling, but some points could be supported by stronger evidence. Able to defend his position, but may allow minor flaws in the logic of reasoning. Presents a scientific position in a foreign language with minor errors and uses specialized vocabulary. Takes part in discussions, but	Own positions and conclusions are formulated clearly, logically, and reasonably. Evidence is presented, references to authoritative sources are made, and scientific theories and concepts are used correctly. Confidently defends his point of view, relying on logic, facts and scientific arguments. Freely expresses and defends his scientific positions in a foreign

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	logical and stylistic errors.	respond to them correctly. The work was completed with deviations from scientific standards; there may be errors in the formatting.	does not always fully analyze the opponents' arguments. The works meet academic standards, but minor stylistic flaws are possible.	language, using specialized vocabulary. Effectively conducts scientific debates, knows how to take into account alternative points of view and oppose them with arguments. Presentations and written works are prepared in accordance with academic standards.
Learning outcomes for the course (module): ID-2 ^{UK-4} Uses Russian and foreign languages as a means of business communication, clearly and distinctly presents problems and solutions, and justifies conclusions	The presentation is incoherent, the logic of the text is broken, and the material is difficult to perceive. A significant number of errors makes the text difficult to understand. Lack of argumentation or use of unsupported, weak arguments. Business communication norms are violated; stylistic and communication errors are possible. Unable to adapt communication style to business situations and experiences significant communication difficulties. Unable to use a foreign language in business communication, makes serious mistakes that interfere with understanding.	The presentation is not structured enough; there may be logical gaps or redundancy of information. Grammatical, spelling and punctuation errors that affect the perception of the text are allowed. The arguments presented are poorly supported by facts, and the conclusions are not convincing enough. Template phrases are used, mistakes in business communication style are made. Has difficulty adapting speech to different formats of business communication. Limited use of foreign language, errors in vocabulary and grammar leading to misunderstandings.	The presentation is coherent and clear, but there may be minor logical or stylistic flaws. Generally fluent in Russian and foreign languages, with occasional mistakes that do not affect understanding. Quite a compelling argument, but in some places there may be weak justification or a lack of evidence. In general, business communication standards are observed, but there may be minor violations of etiquette or style. Can adapt communication style, but sometimes has difficulty choosing the appropriate form of interaction. Uses a foreign language in business communication, but	The material is presented clearly, consistently and logically, and there are no semantic or stylistic errors. High level of proficiency in Russian and foreign languages, correct use of business vocabulary, absence of spelling, punctuation and grammatical errors. The conclusions are reasoned, supported by evidence, and use critical analysis of information. Business communication standards are observed, and professional terminology is used correctly and appropriately. Able to adapt communication style depending on the situation (official negotiations,

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			may have minor errors or lack confidence.	business correspondence, presentations, discussions). Freely uses a foreign language in business communication and argues his position without difficulty.
OPK-1. Capable of identifying, formulating, and solving current and significant problems in applied and computer mathematics.				
Learning outcomes for the course (module): ID-1 _{OPK-1} Finds and formulates significant problems of applied and computer mathematics.	Identifies unimportant or irrelevant issues. The analysis is superficial or non-existent, and there is no attempt to put the problem into context. The argumentation is weak or completely absent. Either does not use scientific sources or refers to unreliable data. Completely absent, the topic is addressed without any new perspective.	Identifies the problem, but it may be minor or not urgent enough. The problem statement is not clear enough or contains inaccuracies. The analysis is superficial, without sufficient consideration of the context and existing research. Explains the problem, but the arguments are poorly supported by facts or examples. Relies on a limited amount of material and sometimes uses unconfirmed or outdated data. There is no original approach; the problem is treated in a formulaic manner.	Identifies important issues, but there may be minor flaws in the choice of topics. Formulates the problem correctly, but may use redundant or insufficiently precise formulations. Analyzes the problem, but does not always cover all its aspects. Explains the significance of the problem, but the argumentation may not be deep enough. Uses scientific papers and articles, but may not have enough sources or may not have the most up-to-date data. Demonstrates unconventional thinking, but ideas are not always original or deeply developed.	Identifies problems of important theoretical and practical significance in applied and computer mathematics. Formulates the problem clearly and correctly, using mathematical terminology and argumentation. Explores the problem in a broad context, taking into account modern research and practical aspects. Explains the significance of the problem in a well-reasoned manner and provides examples of its impact on other areas. Based on scientific publications, modern research, and data from reliable sources. Offers an original or non-standard view of the problem, reveals new aspects.
Learning outcomes for the course	Poorly versed in mathematical	Familiar with the methods, but	Has a command of the basic	Demonstrates a strong

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(module): ID-2 _{OPK-1} knows and uses methods for solving significant problems of applied and computer mathematics.	methods, uses them inappropriately or with gross errors. Selects inappropriate or outdated methods to solve problems. Unable to solve a problem or makes critical errors. Cannot explain his choices, applies methods without understanding their essence. Does not own modern software or refuses to use it. Works mechanically, without analyzing or adapting methods to the task.	uses them without full understanding. Sometimes it chooses a less efficient solution method, which leads to additional calculations or errors. Solves problems, but there may be errors in calculations or algorithms. Explains the choice of method superficially, without comparison with alternatives. Uses mathematical software but does not use its advanced features. Uses standard methods without trying to optimize solutions.	methods for solving problems in applied and computer mathematics, but may make minor mistakes. Generally selects an appropriate method, but sometimes does not consider more effective alternatives. Solves problems correctly, but may have difficulty working with non-standard cases. Can explain his choice, but the reasoning is not always complete or deep. Can work with mathematical programs, but does not use them to their full potential. Can offer unconventional solutions, but without deep research.	command of modern mathematical methods, including analytical, numerical, and algorithmic approaches. Able to analyze a problem and select the optimal solution taking into account the specifics of the task. Successfully applies methods in practice, achieving correct and justified results. Clearly explains why the chosen method is appropriate for solving the problem, compares alternative approaches. Proficient in specialized software (MATLAB , Python , Maple , etc.) and applies it in calculations. Offers original ideas for modifying or adapting methods to solve complex problems.
OPK-2. Capable of creating and exploring new mathematical models in the natural sciences, improving and developing concepts, theories, and methods.				
Learning outcomes for the course (module): ID-1 _{OPK-2} Conducts research into new mathematical models in the natural sciences	Poorly oriented in the theoretical base and existing models. Unable to develop or adapt a mathematical model. Does not evaluate models or does so with gross errors. Applies methods incorrectly or does not use them at all. Doesn't see how mathematical	Familiar with basic mathematical models, but does not delve into their principles and rationale. Able to adapt existing models, but has difficulty developing new ones. Understands models but does not critically analyze them. Uses a limited set of methods and	Has a good understanding of key models but may struggle with new concepts. Develops mathematical models, but without significant innovation or deep analysis. Evaluates models but does not always suggest effective	Demonstrates a confident command of modern mathematical models applicable to the natural sciences. Develops and substantiates original mathematical models for describing natural phenomena and

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	models can be applied in the natural sciences. Either he doesn't know the math programs or he uses them incorrectly. Cannot provide convincing evidence to prove the correctness of his conclusions. Does not participate in scientific research and conferences.	allows for inaccuracies in calculations. Applies models formally, without taking into account the real context. Knows basic software functions, but does not use advanced tools. Explains models superficially and does not always provide correct arguments. Works on scientific papers, but without significant contribution to research activities.	improvements. Has a command of analytical methods, but applies them with minor errors or without sufficient depth. Can apply models to real-world problems, but does not always take into account all the nuances. Has knowledge of mathematical software, but does not use it to its full potential. Generally substantiates his work, but does not always use the most relevant or substantiated sources. Prepares scientific materials, but does not always actively participate in scientific events.	processes. Able to critically evaluate existing models, identify their limitations and suggest improvements. Uses modern mathematical methods, including numerical, analytical and statistical approaches. Demonstrates how a mathematical model can be used to solve real scientific problems. Uses specialized software (MATLAB , Python , Wolfram Mathematica , etc.) for modeling and analysis. Provides compelling evidence to support the model's validity, drawing on relevant research and data. Presents research results at conferences, seminars or in scientific articles.
Learning outcomes for the course (module): ID-2_{OPK-2} Develops new and improves existing concepts, theories and methods	Not familiar with modern concepts, theories and methods. Incapable of formulating new scientific ideas. Does not introduce any changes to existing theories and methods. The ideas lack argumentation or contradict scientific principles. The developments have no practical value.	Familiar with the basic concepts, but does not have a deep enough understanding of their relationship to contemporary scientific problems. Makes minor modifications to existing methods, but does not formulate fundamentally new concepts. Improvements are minor or	Understands basic theories and methods, but does not always embrace the latest trends. Formulates new approaches, but they may require further refinement or clarification. Provides improvements to existing methods but does not make a significant scientific	Demonstrates excellent knowledge of current concepts, theories and methods, their history and modern development trends. Independently formulates and justifies new concepts, theories, or methods using a creative and scientifically

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	Does not have the necessary software. Does not participate in scientific discussions, conferences, or publications. Completely absent, only a template approach is used.	superficial, without serious analysis. There are errors or gaps in the logic of reasoning, the argumentation is weak. The proposed methods are difficult to adapt to real-world problems. Limited knowledge of specialized software, use of only basic functions. Rarely participates in conferences or publications, limiting himself to coursework or diploma theses. Uses standard approaches and does not show significant originality.	contribution. The ideas are clearly presented, but the argumentation may not be deep enough. New methods are applicable in practice, but there may be difficulties in adapting them. Has knowledge of the necessary software, but does not use it to its full potential. Presents his work, but publications or reports are limited to small studies. Demonstrates innovative thinking, but ideas require refinement or additional argumentation.	sound approach. Able to critically analyze current scientific approaches and make meaningful improvements. The ideas developed are distinguished by their clarity, internal logic and well-reasoned scientific validity. New or improved methods find application in real-world problems, as confirmed by examples and experiments. Proficient in mathematics, statistics, and software for developing and testing new theories. Presents the results of the work in the form of publications, conference reports, and scientific discussions. Offers original solutions, goes beyond standard methods, and formulates new scientific hypotheses.
OPK-3. Capable of independently creating application software based on modern information technologies and network resources, including domestically produced ones.				
Learning outcomes for the course (module): ID-1 OPK-3 Independently creates application software products	Does not know programming languages or uses them incorrectly. The program does not start or does not perform its stated functions. The code is chaotic, unreadable	Understands basic concepts but uses a limited set of tools. The program performs basic functions, but has shortcomings, errors, or insufficient functionality. The code is unstructured, does not	Proficient in basic programming languages and technologies, but sometimes makes minor mistakes. Creates functioning software, but it may need some improvement or optimization.	Proficient in modern programming languages (Python , C ++, Java , etc.), libraries and development tools. Independently develops and brings to operational status

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	and cannot be improved. Missing or implemented incorrectly. Ignores data protection and testing. There is a complete lack of documentation It is impossible to improve the program without rewriting it from scratch. Uses outdated or inappropriate tools. Cannot explain how the program works and what problems it solves.	scale well, or is complicated by redundant solutions. Uses a database, but makes mistakes in organizing data storage. Tests the program manually but does not use automated testing. The program description is superficial or absent. Fixing bugs requires significant changes to the code. Works only with basic tools, avoids new technologies. The description of the program's operation is incomplete or not clear enough.	The code structure is logical, but may not be the most efficient or flexible. Uses a database, but does not always optimize queries or data structure. Knows the basics of testing and security, but applies them selectively. Describes the main aspects of the program's operation, but the documentation may be incomplete. Makes corrections and changes, but this requires significant effort. Uses modern tools, but does not always master new technologies. Can explain functionality, but does not always justify technical solutions.	application software, including user interface, data processing and logic. Designs a competent software architecture, taking into account the principles of modularity, scalability, and performance. Confidently uses relational and non-relational databases (MySQL , PostgreSQL , MongoDB , etc.). Implements vulnerability protection, writes tests (unit testing, integration testing), and creates clear and structured documentation for users and developers. Can upgrade the product, implement new features and fix bugs.
Learning outcomes for the course (module): ID-2 ОПК-3 Knows and can find modern information technologies, including domestically produced ones, necessary for the creation of applied software products	Not familiar with modern information technologies. Cannot find or analyze technologies, uses only already known tools. Incapable of selecting and implementing the required technology in software product development. Uses limited, outdated, or inappropriate tools. Does not evaluate technologies, uses them without understanding	Familiar with some modern tools, but poorly aware of their relevance. Can find information, but is not always able to evaluate its reliability and applicability. Uses technology, but is often limited to basic capabilities. Works with a limited set of tools and avoids learning new ones. Selects technologies intuitively, without deep analysis.	He understands modern information technologies, but does not always know the latest updates. Finds the necessary technologies, but does not analyze them in depth. Uses found tools, but does not always fully exploit their capabilities. Works with multiple languages and frameworks , but may avoid complex or	Well-versed in modern information technologies, including domestic and foreign developments. Confidently and quickly finds the necessary technologies, analyzes their advantages and disadvantages. Able to select and effectively use tools for creating application software products.

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	their features.		new tools. Keeps up with new technologies, but is not always actively involved in professional communities.	programming languages , libraries, frameworks , cloud services and DevOps tools . Knowledge of domestic IT products (OS, databases, development platforms) and the ability to adapt them to specific tasks.
PC-4. Capable of conducting patent research, determining forms and methods of legal protection and defense of rights to the results of intellectual activity, and managing rights to them to solve problems in the field of development of science, engineering, and technology.				
Learning outcomes for the course (module): ID-1 PC-4 Makes rational choices regarding methods of protecting intellectual property rights;	Does not have sufficient knowledge about intellectual property protection and is unable to make an informed choice of protection method. Makes mistakes when completing documents, which can lead to registration refusal or vulnerability of intellectual property rights. Does not take into account legal risks, which may lead to the loss of exclusive rights to development or scientific work. Shows no interest in studying legislation and modern methods of protecting intellectual property. Unable to advise colleagues or participate in the process of legal protection of intellectual property.	Knows the basic methods of protecting intellectual property, but may have difficulty choosing the optimal method. Able to prepare basic documentation, but requires specialist assistance for complex legal issues. Does not always take into account all risks when choosing a protection method, which can lead to insufficient legal protection of the object. Has a superficial knowledge of patenting, licensing and copyright. Updates his knowledge irregularly, which may lead to the use of outdated security methods.	Possesses strong knowledge in the field of intellectual property protection, but may not always take into account all the nuances of specific cases. Makes the right choice of protection method, but in complex situations may require additional analysis or consultation with specialists. Able to prepare documentation for intellectual property protection, but it may require revision. Generally makes rational decisions, but may not take into account some strategic or economic factors. Keeps abreast of developments in the field of intellectual property, but does not always apply the latest methods in practice.	Deeply versed in the laws and regulations governing the protection of intellectual property, including patent law, copyright, trademarks and related rights. Confidently analyzes intellectual property and selects the most effective protection methods depending on the specifics of the development or scientific work. Able to competently prepare applications for patents, copyright certificates, register trademarks and draw up licensing agreements. Explains and justifies the choice of protection method, taking into account economic, legal and strategic aspects.

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				Monitors changes in legislation and implements modern approaches to protecting intellectual property. Provides advice to colleagues and helps organize the process of protecting intellectual property in scientific and industrial projects.
Learning outcomes for the course (module): ID-2 _{PC-4} Conducts patent research in the field of computing and communication systems.	Does not possess patent research methods and is unable to correctly analyze patent information. Makes mistakes in assessing the patentability of developments, which can lead to legal risks or denial of patent registration. Does not know how to work with patent databases, performs searches insufficiently comprehensively or with errors. Patent research reports do not meet requirements, contain incomplete or inaccurate data. Does not follow changes in patent legislation and shows no interest in studying modern methods of patent analysis.	Has a general understanding of patent research, but has difficulty analyzing complex technical solutions. Performs patent information searches but may not fully assess the novelty and patentability of a development. Analyzes only a limited range of sources, which may lead to incomplete or inaccurate conclusions. Able to prepare a report, but it requires significant revisions and additions. Updates his knowledge in the field of patent analysis irregularly, which reduces the effectiveness of research.	Has strong knowledge in the field of patent research and is able to analyze technical solutions from the point of view of patent law. Performs searches and analysis of patent information, but may not take into account some specific aspects of international patent law. Formulates well-founded conclusions about the patent purity of developments, but in complex cases requires additional consultations with specialists. Able to prepare a patent research report, but may not always consider all potential legal risks. Keeps abreast of new trends in the patent field, but does not always apply the latest search and analysis methods.	He has a deep understanding of patent law, regulations, and international agreements governing the protection of intellectual property in the field of computing and communications systems. Confidently conducts patent research, analyzes existing patents, and identifies the patent purity of developed solutions. Uses specialized databases (WIPO , EPO , USPTO , Rospatent, etc.) to search and analyze patent information. Provides sound assessments of the novelty and patentability of technical solutions and develops strategies for protecting intellectual property. Competently prepares

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				patent research, compiles reports with a detailed analysis of the technological landscape and potential legal risks. Monitors trends in the patent field and new developments in computing and communication systems, and applies current research methods.
PC- 7. Able to create and explore new mathematical models in the natural sciences, industry, and business, taking into account the capabilities of modern information technology, programming, and computer equipment.				
Learning outcomes for the course (module): ID-1 _{PC-7} With the help of modern information technologies, explores newly created mathematical models in the natural sciences of industry;	Ineffective or outdated information technologies are used , resulting in the creation of inaccurate or incomplete mathematical models. These models do not meet modern standards and do not take into account key parameters necessary for problem solving. Appropriate software and analysis tools are either absent or inadequate. Model analysis is superficial or nonexistent, and the research results are not meaningful or useful.	Basic or outdated information technology methods are used to study mathematical models. Models are created taking into account basic principles, but lack accuracy or do not account for all possible variables. The use of software tools is limited to standard functions, without in-depth data analysis. Simple approaches to problem solving are used, and the research results remain superficial, without providing new proposals or insights.	Modern information technologies are used to study mathematical models, but some aspects may not be fully developed. The models comply with basic principles and standards, but could be improved in terms of accuracy and the use of additional analytical methods. Current programs and algorithms are used, but more suitable tools for specific tasks could be used. The analysis results yield good conclusions, but are not always supported by additional hypotheses or proposals for	Utilizes advanced information technologies to research and create mathematical models in various fields of natural science and industry. The models are developed with high accuracy and meet current scientific and technical requirements. The research process includes comprehensive data analysis, model optimization, and the use of specialized software. Based on the results obtained, new hypotheses or improvements to existing models are proposed, demonstrating a deep understanding of the subject. Provided high level detail and precision

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				performances
Learning outcomes for the course (module): ID-2 _{PC-7} Conducts Parallel Computer and Network Technologies as part of his professional activities	Does not use parallel computing and networking technologies or applies them with minimal effectiveness. Knowledge and skills are insufficient to solve professional problems using these technologies. Technologies are not applied properly, leading to significant errors or inefficiencies. Important aspects such as performance, reliability, or security are not considered when using parallel computing and networking solutions.	Utilizes parallel computing and network technologies , but encounters difficulties in their application. Knowledge and skills allow for solving only basic problems or applying standard solutions without considering the specifics and peculiarities of work processes. Use of technologies is limited, and additional efforts may be required to achieve the desired results. Errors related to insufficient consideration of parallel computing or network interactions may be encountered during work.	Successfully utilizes parallel computer and network technologies in their professional work, applying them to solve standard problems. These technologies are used effectively, but there are minor shortcomings in the selection of tools or algorithms. The results meet basic requirements but can be optimized. Overall, their understanding of these technologies is sufficient to solve most problems; however, more complex situations may require additional effort.	Expertise in parallel computing and network technologies to solve problems in their work. Demonstrates deep knowledge and experience in applying these technologies to improve work efficiency. Applies advanced techniques and solutions, optimizes processes and operations, and achieves high results. Utilizes sophisticated tools and algorithms to implement parallel computing and work with network technologies, ensuring a high level of reliability and performance. Knowledge and skills enable not only the completion of tasks but also the development of new approaches and improvements.
Learning outcomes for the course (module): ID-3 _{PC-7} Uses modern programming languages and application software packages to implement specific algorithms and mathematical models	Ineffective use of modern programming languages and application packages leads to significant errors in the implementation of algorithms and mathematical models. The development process may be unstructured or rely on outdated and inappropriate tools, reducing	relies on basic or outdated programming languages and application packages, which limits the capabilities and effectiveness of problem solving. The work relies on standard solutions that are not always suitable for more complex or specific tasks. The implementation of algorithms and	Uses modern programming languages and application packages to implement algorithms and mathematical models, but sometimes the choice of tools may be subject to improvement or optimization. The implemented solutions	Utilizes modern programming languages and application packages to implement complex algorithms and mathematical models. Their work utilizes cutting-edge tools and technologies, enabling them to achieve

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	productivity and decision accuracy. A lack of understanding of the correct selection of tools for task implementation leads to ineffective results.	models may be functional, but requires improvements in terms of optimization, performance, and the use of current tools.	effectively solve the assigned tasks, but in some cases, more modern or specialized tools may be used . The work was completed with a sufficient degree of accuracy and performance, but some elements may require refinement or improvement.	high productivity, accuracy, and optimization of solutions. They demonstrate deep knowledge and skills in various programming languages and software, as well as in selecting the most appropriate tools for each task. Their work is characterized by a high degree of automation and implementation efficiency, as well as innovative solutions.
PC- 6. Able to use modern methods of development and implementation of specific algorithms of mathematical models based on programming languages and application packages for modeling				
Learning outcomes for the course (module): ID-1 _{PC-6} Using modern software packages for modeling, it explores newly created mathematical models;	You're using modeling software packages ineffectively, resulting in models that don't meet requirements. Model analysis and diagnostics are performed without taking into account important factors, making it difficult to identify and resolve problems. Models are not optimized, and approaches to their analysis require significant improvement to achieve accurate results.	You use basic modeling software, but your approach to model analysis and diagnostics is limited. Some model elements require refinement, and a systems approach is not always applied adequately. Modeling results may require improvement in accuracy and efficiency, and problem identification and resolution are often limited to superficial analysis.	You're choosing the right mathematical modeling packages, but in some cases, your choice of tools or approaches could be improved. Your model analysis and diagnostics are conducted within standard procedures, but not all possible aspects are always considered. The work is high-quality, but additional efforts are needed to optimize and improve the accuracy of the models.	Expertly selects and applies modern software packages for mathematical modeling. You successfully identify key aspects of models, conduct comprehensive analysis, and diagnose them using a systems approach. Your models are highly accurate and meet current standards. You effectively research and optimize models, identifying and resolving problems , allowing you to propose new solutions and improvements.
Learning outcomes for the course	Experiencing difficulties applying	uses standard algorithm	Successfully applies current	He confidently utilizes

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	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
(module): ID-2 _{PC-6} Uses modern methods for developing algorithms for mathematical models	modern algorithm development methods to mathematical models, resulting in low algorithm accuracy and performance. Their choice of methods does not always match the task requirements, making problem solving difficult. Significant improvement in skills in selecting and applying methods for developing effective algorithms is needed.	development methods, but their accuracy and efficiency leave much to be desired. Algorithms solve problems, but in some cases, optimization or the use of more complex approaches is required to achieve better results. It is necessary to work on improving our methods and increasing the efficiency of algorithm development.	methods for developing algorithms for mathematical models and achieves good results. Algorithms perform tasks correctly, but can be improved in terms of accuracy or performance. Proficient in existing approaches, but more complex situations may require the use of more specific methods to improve results.	cutting-edge methods for developing algorithms for mathematical models, achieving high accuracy and optimization. His developed algorithms solve complex problems and fully meet modern requirements. He effectively applies cutting-edge tools and approaches, demonstrating a deep understanding of the subject and a capacity for innovation. His work not only solves current problems but also proposes new, more effective solutions.
Learning outcomes for the course (module): ID-3 _{PC-6} Uses modern programming languages to implement specific algorithms and mathematical models	Difficulty using modern programming languages to implement algorithms and mathematical models. Code often fails to function correctly, is poorly structured, and does not meet the task requirements. Algorithm implementation results in low productivity , and the choice of tools is inappropriate. Significant effort is required to improve programming skills and optimize code.	Uses modern programming languages, but the implementation of algorithms and mathematical models leaves much to be desired . The code solves the problem, but has optimization or performance issues. The code structure and readability could be improved, and the choice of tools is not always optimal for the task. Required revision For achievements more high level .	Correctly uses modern programming languages to implement algorithms and mathematical models. The algorithms work, but could be improved in terms of performance and optimization. The code is readable and structured, but there is room for improvement. Overall, the approach is correct, but more suitable tools or methods could be used to improve efficiency.	She expertly utilizes modern programming languages to implement algorithms and mathematical models. Her code is highly performant, readable, and optimized. Her algorithms are implemented with all requirements in mind and deliver excellent results. Her choice of tools and methods is fully justified, allowing her to solve problems with maximum efficiency and accuracy.
PC- 8 Capable of participating in the management of projects for the creation of information systems and software systems at various stages of the life cycle				

Levels of development competencies (ies), indicator (s) Indicators	Descriptors			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
Learning outcomes for the course (module): ID-1 PC-8 Manages the development, development and maintenance of information systems and software systems	Struggles to manage the development of information systems and software packages. The development process is disorganized , and errors are made in the design and maintenance of systems. Management and maintenance tasks are performed irregularly or with serious shortcomings, resulting in non-compliance with requirements. It is impossible to ensure the stable operation of software packages and timely support.	Manages the development of information systems and software packages, but with some errors in the process. System development and support are underway, but in some cases, there is a lack of organization or attention to detail. Project management sometimes fails to meet all standards, leading to slowdowns or some flaws in software packages.	Effectively manages the development, implementation, and maintenance of information systems and software systems. The development process is organized, tasks are accomplished effectively, but in some cases, improved interactions between the development and maintenance phases could be achieved. Project management complies with standards, but there is room for further process optimization and improved system maintenance.	Expertly manages the development, implementation, and maintenance of information systems and software suites. All stages of system development and maintenance are organized and executed to a high standard, using advanced methods and tools. The project management process is optimized, allowing for prompt response to changes and ensuring stable system operation.
Learning outcomes for the course (module): ID-2 PC-8 Knows and applies software development trends in his/her professional activities	Difficulty identifying and applying software development trends in professional activities. Knowledge of current trends is limited, and their use in work is minimal . Unable to correctly adapt their actions to new technologies and approaches, which reduces the effectiveness of working with software. Significant improvement in understanding and applying current software trends is required.	Has basic knowledge of software development trends , but their application in professional work is limited. Knowledge of current trends is not always fully utilized. Sometimes, new technologies and methods fail to be effectively applied, which can reduce the effectiveness of software development and support processes. Potential exists for improvement and more active implementation of new approaches.	He is well-versed in software development trends and utilizes them in his professional work. His knowledge of current trends is often applied to project work, but could be improved by deepening the implementation of new technologies or more widely applying advanced methods. Overall, he utilizes trends effectively, but there is room for further growth and improvement in this area.	She is knowledgeable and actively applies current software development trends in her professional work. Knowledge of trends and the latest technologies is integrated into development processes , allowing for increased efficiency and innovation . Her application of new technologies and methods fully meets modern requirements and is actively implemented into projects to improve their quality and performance.
PC- 9 Able to take into account knowledge of problems and trends in the development of the software market in professional activities				

Levels of development competencies (ies), indicator (s) Indicators	Descriptors			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Average level (good) 4 points	High level (excellent) 5 points
Learning outcomes for the course (module): ID-1 _{PC-9} Selects software for their professional activities, taking into account market development trends.	Struggles to select software for their professional activities without considering current market trends. They often choose outdated or inappropriate software, which reduces work efficiency. They lack a deep understanding of current trends, and their software choices don't align with the needs of the modern market. Significant improvements are needed in selecting software solutions based on market dynamics.	They select software for their professional activities, but to some extent ignore current market trends. Sometimes, the chosen solutions do not meet all the requirements of the modern industry, which can reduce their effectiveness. Knowledge of market trends is applied to a limited extent, and software choices are not always optimal from a long-term perspective .	Selects software appropriately for their professional activities, taking into account market trends. Knowledge of current software trends is used to inform decision-making, but new or more suitable solutions may sometimes be missed. Overall, software selection meets current requirements, but there is room for improvement by considering broader trends.	She wisely selects software for her professional activities, taking into account current market trends. She carefully analyzes current and future developments, enabling her to select the most effective and innovative solutions. She skillfully adapts her solutions to changes in the software market, which helps increase productivity and maintain a high level of work.
Learning outcomes for the course (module): ID-2 _{PC-9} Takes into account the development trends of the software market and applies these development trends in professional activities	Fails to consider software market development trends in their professional activities. Lack of understanding of current software trends leads to the selection of outdated and ineffective solutions. New technologies are not implemented, reducing professional effectiveness. Significant improvement is needed in the analysis and application of software market development trends.	It takes into account some software market development trends, but the application of these trends in professional work is limited. Knowledge of new technologies and trends is not always used effectively. In some cases, it is not possible to fully integrate modern approaches and methods into work, which hinders the improvement of work processes. Application trends development requires further recesses .	Considers current software market trends and applies them to their professional work. Modern technologies and methods are integrated into work processes, but there are sometimes opportunities for deeper implementation of new solutions. Adopting software development trends contributes to improved work results, but there is room for further refinement.	She intelligently considers and actively applies current software market trends in her professional work. She continuously analyzes market changes and implements cutting-edge technologies and methods, which contributes to increased efficiency and innovation . Applying these trends leads to significant improvements in professional performance, ensuring high results and competitiveness.

8.2 Criteria for assessing competencies during the defense of the final qualifying work

To determine the level of development of students' competencies during the defense of their final qualifying work, the following assessment criteria have been developed:

"excellent" grade is awarded if the master's thesis is independent and creative in nature; it demonstrates the author's mastery of the necessary methods of economic and geographical research and demonstrated skill in using scientific and reference literature, as well as statistical data. During the defense, the master's student demonstrated a deep and comprehensive understanding of the topic, skills in academic debate, mastery of terminology, and familiarity with the relevant scientific literature. The thesis is well-formed and well-written, and illustrative materials were used to support the main points of the master's thesis. The supervisor's review and external peer review were positive.

"good" grade is awarded for a final qualifying thesis, which indicates that the author has prepared a study on a relevant scientific problem; formulated conclusions of significant practical significance; confidently defends their positions and conclusions, but also allows for inaccuracies; and the work is formatted in accordance with the requirements for final qualifying theses. The supervisor's review and external peer review are positive.

"satisfactory" grade is given if the final dissertation largely addresses the stated objectives, but contains controversial or erroneous statements, the presentation of the material is lacking in consistency, the work insufficiently utilizes the necessary references, the author makes inaccuracies in the report, the graduate student experienced difficulty answering the questions, or the work contains comments on its formatting. The supervisor's review and external peer review are positive, but with comments.

A grade of **"unsatisfactory"** is given if the final thesis's tasks are resolved incompletely, the student struggled to answer the questions, or the thesis contains comments on its formatting. The supervisor's review and external peer review are negative.

8.3 Description of the rating scale

The defense of the final qualifying work is assessed on a 5-point system.

9. List of recommended literature, information sources

Main literature:

1. Barsky, A. B. Introduction to neural networks [Electronic resource] / A. B. Barsky. - Electronic text data. - M.: Internet University of Information Technologies (INTUIT), 2016. - 358 p. - 2227-8397. - Access mode: <http://www.iprbookshop.ru/52144.html>
2. Барский А.Б. Параллельные информационные технологии [Электронный ресурс]: учебное пособие / А.Б. Барский. – Электрон. текстовые данные. – Москва, Саратов: Интернет-Университет Информационных Технологий (ИНТУИТ), Вузовское образование, 2017. – 503 с. – 978-5-4487-0087-3. Режим доступа: <http://www.iprbookshop.ru/67379.html>
3. Воскобойников Ю.Е. Современные проблемы прикладной математики. Часть 1. Лекционный курс [Электронный ресурс]: учебное пособие / Ю.Е. Воскобойников, А.А. Мицель. – Электрон. текстовые данные. – Томск: Томский государственный университет систем управления и радиоэлектроники, 2016. – 138 с. – 2227-8397. Режим доступа: <http://www.iprbookshop.ru/72049.html>
4. Voskoboinikov, Yu. E. Modern Problems of Applied Mathematics. Part 2. Workshop [Electronic resource]: study guide / Yu. E. Voskoboinikov, A. A. Mitsel. - Electronic text data. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2016. - 52 p. - 2227-8397. - Access mode: <http://www.iprbookshop.ru/72048.html>
5. Гадзиковский В.И. Цифровая обработка сигналов [Электронный ресурс] / В.И. Гадзиковский. – Электрон. текстовые данные. – М.: СОЛОН-ПРЕСС, 2015. – 766 с. – 978-5-91359-117-3. Режим доступа: <http://www.iprbookshop.ru/53863.html>

6. Gorozhanina, E. I. Neural networks [Electronic resource]: a tutorial / E. I. Gorozhanina. - Electronic text data. - Samara: Volga Region State University of Telecommunications and Informatics, 2017. - 84 p. - 2227-8397. - Access mode: <http://www.iprbookshop.ru/75391.html>
7. Knaub L. V., Novikov E. A., Shitov Yu . A. Numerical-theoretic methods in cryptography: a tutorial [Electronic resource] / Krasnoyarsk: Siberian Federal University, 2011. - 160 p. - 978-5-7638-2113-7. Access mode: <http://biblioclub.ru/index.php?page=book&id=229582>
8. Modular Arithmetic and Its Applications in Infocommunication Technologies: [monograph] / N. I. Chervyakov et al. – Moscow: FIZMATLIT, 2017. – 400 p.: ill., table, port. – Bibliography at the end of the section. – ISBN 978-5-9221-1716-6
9. Обработка информации в системе остаточных классов (СОК) [Электронный ресурс]: учебное пособие / Н.И. Червяков [и др.]. — Электрон. текстовые данные. — Ставрополь: Северо-Кавказский федеральный университет, 2016. — 225 с. — 2227-8397. Режим доступа: <http://www.iprbookshop.ru/69412.html>
10. Ozhiganov , A. A. Cryptography [Electronic resource]: a tutorial / A. A. Ozhiganov . — Electronic text data. — St. Petersburg : ITMO University, 2016. — 142 p. — 2227-8397. — Access mode: <http://www.iprbookshop.ru/67231.html>
11. Тарков М.С. Нейрокомпьютерные системы [Электронный ресурс] / М.С. Тарков. — Электрон. текстовые данные. — М.: Интернет-Университет Информационных Технологий (ИНТУИТ), 2016. — 170 с. — 5-9556-0063-9. Режим доступа: <http://www.iprbookshop.ru/52200.html>
12. Шаньгин В.Ф. Защита компьютерной информации. Эффективные методы и средства [Электронный ресурс] / В.Ф. Шаньгин. — Электрон. текстовые данные. — Саратов: Профобразование, 2017. — 544 с. — 978-5-4488-0074-0. Режим доступа: <http://www.iprbookshop.ru/63592.html>
13. Шаньгин В.Ф. Информационная безопасность и защита информации [Электронный ресурс] / В.Ф. Шаньгин. — Электрон. текстовые данные. — Саратов: Профобразование, 2017. — 702 с. — 978-5-4488-0070-2. Режим доступа: <http://www.iprbookshop.ru/63594.html>

Further reading:

1. Алан Оппенгейм Цифровая обработка сигналов [Электронный ресурс] / Оппенгейм Алан, Шафер Рональд. — Электрон. текстовые данные. — М.: Техносфера, 2012. — 1048 с. — 978-5-94836-329-5. Режим доступа: <http://www.iprbookshop.ru/26906.html>
2. Барский А.Б. Логические нейронные сети [Электронный ресурс] / А.Б. Барский. — Электрон. текстовые данные. — М.: Интернет-Университет Информационных Технологий (ИНТУИТ), 2016. — 492 с. — 978-5-94774-646-4. Режим доступа: <http://www.iprbookshop.ru/52220.html>
3. Интеллектуальные системы [Электронный ресурс]: учебное пособие / А.М. Семенов [и др.]. — Электрон. текстовые данные. — Оренбург: Оренбургский государственный университет, ЭБС АСВ, 2013. — 236 с. — 2227-8397. Режим доступа: <http://www.iprbookshop.ru/30055.html>
4. Некоторые актуальные проблемы современной математики и математического образования. Герценовские чтения — 2014 [Электронный ресурс]: материалы научной конференции / В.К. Алифатдаева [и др.]. — Электрон. текстовые данные. — СПб.: Российский государственный педагогический университет им. А.И. Герцена, 2014. — 256 с. — 978-5-8064-1960-7. Режим доступа: <http://www.iprbookshop.ru/22559.html>
5. Некоторые актуальные проблемы современной математики и математического образования. Герценовские чтения — 2015 [Электронный ресурс]: материалы научной конференции, 13–17 апреля 2015 г. / В.В. Агафонцев [и др.]. — Электрон. текстовые данные. — СПб.: Российский государственный педагогический

университет им. А.И. Герцена, 2015. – 240 с. – 978-5-8064-2095-5. Режим доступа: <http://www.iprbookshop.ru/51684.html>

6. Петров А.А. Компьютерная безопасность. Криптографические методы защиты [Электронный ресурс] / А.А. Петров. – Электрон. текстовые данные. – Саратов: Профобразование, 2017. – 446 с. – 978-5-4488-0091-7. Режим доступа: <http://www.iprbookshop.ru/63800.html>

7. Application of artificial neural networks and residual class systems in cryptography / N. I. Chervyakov [et al.]. – М.: FIZMATLIT, 2012. – 280 p.: ill., app. – ISBN 978-5-9221-1386-1

8. Number-theoretic methods in cryptography [Electronic resource]: a tutorial / compiled by F. B. Tebueva , V. O. Antonov. — Electronic text data. — Stavropol: North Caucasus Federal University, 2017. — 107 p. — 2227-8397. — Access mode: <http://www.iprbookshop.ru/75601.html>

9. Chervyakov N.I., Sakhnyuk P.A., Shaposhnikov A.V., Ryadnov S.A. Modular computing structures of neuroprocessor systems. - М.: Fizmatlit , 2003, 288 p.

10. Яхьяева Г.Э. Нечеткие множества и нейронные сети [Электронный ресурс]: учебное пособие / Г.Э. Яхьяева. – Электрон. текстовые данные. – Москва, Саратов: Интернет-Университет Информационных Технологий (ИНТУИТ), Вузовское образование, 2017. – 320 с. – 978-5-4487-0079-8. Режим доступа: <http://www.iprbookshop.ru/67390.html>

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
FEDERATION**

**Federal State Autonomous Educational Institution
higher education**

NORTH CAUCASIAN FEDERAL UNIVERSITY

Institute (branch) _____

Department _____

**Approved by order
at the institute
from _____ No. _____
Completed at the request of the organization
(enterprises) _____**

Admitted to defense
«_____» _____ **20**____
Head of Department (*name of department*)

(*academic degree, academic title, full name of
department head*)

(*signature of the head of the department*)

FINAL QUALIFICATION WORK

(*title of the thesis/diploma project*)

Reviewer:

(*full name*)

(*academic degree, title, position*)

Standard controller :

(*full name*)

(*academic degree, title, position*)

(*Signature*)

Date of defense:

«_____» _____ 201____

Grade _____

Completed by:

(*full name*)

student of the __ **year, group** _____

areas of training (profile) /

specializations _____

_____ **forms of education**

(*Signature*)

Supervisor:

(*full name*)

(*academic degree, title, position*)

(*Signature*)

Stavropol, 20 2 ____

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
FEDERATION

Federal State Autonomous Educational Institution
higher education

NORTH CAUCASIAN FEDERAL UNIVERSITY

Institute (branch) _____

Department _____

Field of study/specialty _____

Focus (profile)/specialization _____

"I APPROVE"

Head of Department

(signature, full name)

«___» _____ 20__

ASSIGNMENT FOR FINAL QUALIFICATION WORK
(DIPLOMA WORK)

Student _____ group _____
(full name)

1. Topic _____

Approved by the order of the Institute No. ____ dated “_”_”_ 20__.

2. The deadline for submitting the work for defense is “_”_”_ 20__.

3. Initial data for the study _____

4. Contents of the thesis:

4.1 _____

4.2 _____

4.3 _____

4.4 _____

4.5 Other sections of the thesis _____

Application _____

Date of assignment issue _____

Work supervisor _____

(Signature) (Full name)

The assignment was accepted for execution on “_”_”_ 20__
(Signature)

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
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**Federal State Autonomous Educational Institution
higher education**

NORTH CAUCASIAN FEDERAL UNIVERSITY

Institute (branch) _____

Department _____

Field of study/specialty _____

Focus (profile)/specialization _____

SCHEDULE

Last name, first name, patronymic (in full) _____

Theme of the WRC _____

Supervisor _____

No .	Name of the stages of completing the final qualifying work	Deadline for completion of work	Note

Work supervisor _ _____

(Signature) (Full name)

Head of Department _ _____

(Signature) (Full name)

Conclusion of the department on admission to defense

Final qualifying work on the topic _____
_____ Reviewed at the
department meeting _____
and student _____
is allowed to defend the final qualifying work in the State Examination Commission (minutes of
the department meeting from _____ No. ____).

Head of Department _____

(Full name , signature)

« _____ » _____ 20 ____

Review of the final qualifying work

Last name, first name, patronymic of the student

graduate of the North Caucasus Federal University

Specialty (field of study) _____

Topic of the final qualifying work_____

Date of submission of the final qualifying work for review
--

Date of return of the final qualifying work _____

Last name, first name , patronymic and position of the reviewer

" " 20

Reviewer's signature

Note to reviewers : When reviewing a final qualifying work, please note that the review must contain the following conclusions:

- about the relevance of the topic;
- on the degree of compliance of the completed final qualifying work with the assignment;
- the level of theoretical and scientific research development of the problem;
- quality of problem analysis;
- the completeness and problematic nature of the proposals made on the issue under consideration;
- the volume of experimental research and the possibility of implementation in production;
- about the degree of independence of development;
- characteristics of each section of the work (project) and the degree of use of the latest achievements of science and technology by the graduate student;
- assessment of the quality of the explanatory note and graphic part;
- a list of positive qualities of the work (project) and main shortcomings, critical comments;
- readiness of the graduate for practical activities in a market economy;
- the proposed assessment of the final qualifying work;
- a conclusion on the possibility of assigning a student a qualification in the relevant specialty (field of study) and issuing a document on education and qualifications.

Feedback on the work on the final qualifying work

About the student's
work _____

_____ *student's surname, first name, patronymic*

specialties (areas of training) _____

on the final qualifying work on the topic _____

Supervisor of the final qualifying work _____

_____ *Last name, first name, patronymic, academic degree, title and position*

1. Conclusion on the degree of compliance of the final qualifying work with the topic approved by the order of the director of the institute and the assignment for the final qualifying work

2. Characteristics of the student's work on completing the final qualifying work _____

3. Evaluation of the student as a specialist _____

4. Manager's comments: _____

5. Conclusion and assessment of the final qualifying work (meets or does not meet the requirements, recommended grade: excellent, good, satisfactory):

6. Conclusion on admission to defense in the state examination commission _____

«_____» _____ 20____
qualifying work

Signature of the head of the final

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
FEDERATION****Federal State Autonomous Educational Institution
higher education****NORTH CAUCASIAN FEDERAL UNIVERSITY****List of topics for final qualifying papers,
areas of training offered to students
02.04.01 Mathematics and Computer Science in 2026**

No. p/p	Topics of final qualifying works
1.	Investigating the potential of GANs in detecting hidden cyberattacks and generating synthetic data for training intrusion detection systems
2.	Development of a CNN/RNN-based model for malware classification and analysis based on behavioral and static features
3.	Creating a system to protect smart devices from DDoS , spam , and other threats using ensemble algorithms
4.	Using BERT/GPT and other language models to automatically analyze text and URLs for signs of fraud
5.	Developing a self-learning AI agent capable of dynamically adapting firewall and IDS/IPS rules to new threats
6.	Research into the interpretability of AI decisions in SOC (Security Operations Center) to increase trust in automated systems
7.	Network activity data analysis and predictive modeling for proactive response
8.	Research of attack methods on AI systems (FGSM, PGD) and development of defense mechanisms
9.	Creating a hybrid model for detecting attacks in distributed networks
10.	Using LLM to find and patch vulnerabilities in source code.

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
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**Federal State Autonomous Educational Institution
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NORTH CAUCASIAN FEDERAL UNIVERSITY**

I APPROVE

Head of Department

_____ Babenko M.G.

«___» _____ 20__

Schedule for completing the final qualifying work

Direction of training 02.04.01 Mathematics and Computer Science

Directionality (profile) Training Program for Electronic Information

Stages or sections of work	Completion deadlines
1. Issuing a task	
2. Start of work on the final qualifying work	
3. Sections of the final qualifying work	
3.1 Section 1_____	
3.2 Section 2_____	
3.3 Section 1_____	
4. Pre-defense	
5. Review	
6. Reading the review and feedback	
7. Submitting the final qualifying work , review, and assessment to the State Examination Commission	
8. Defense in the State Examination Committee	