

*Federal State Autonomous Educational Institution of
Higher Education
"Peoples' Friendship University of Russia"*

Academy of Engineering

**FINAL STATE
EXAMINATION PROGRAM**

Direction of preparation: 06.01.01 Mathematics and mechanics

Scientific specialty: Dynamics, Ballistics, Control of Motion of Aircraft and Spacecraft
(Technical Sciences)

Moscow,
2021

1. Purpose and objectives of the final state examination

Final state examination (hereinafter - GIA) is carried out by state examination commissions (hereinafter - GEK) **in order to** determine the conformity of the results of mastering the basic educational program by students Dynamics, ballistics and traffic control of aircraft (technical science) (technical sciences) to the requirements of the educational standard of RUDN University, approved by the Rector's Order *No. 831* dated *November 10, 2016*.

The main **tasks of the** final state examination are:

- completion of the formation and determination of the student's level of competence formation, provided for by the RUDN educational standard in the direction University01.06.01 Mathematics mechanics (universal, general professional and professional);

- determination of the level of theoretical and practical readiness of the graduate to solve scientific and professional problems in the areas of professional activity defined by the educational standard of the RUDN University;

- making a decision by the State Electoral Commission on awarding a student who has fully mastered the educational program qualification "*Researcher. Teacher-researcher*".

2. Forms and place of final state examination in the structure of the educational program

State final attestation refers to the basic part of Block 4 of the curriculum.

State final certification for the educational program Dynamics, ballistics and traffic control of aircraft (Engineering) in the direction 01.06.01 Mathematics and Mechanics is carried out in the form of preparation for passing and passing the state exam, as well as the presentation of a scientific report on the main results of the prepared scientific and qualification work (dissertation).

3. The list of planned results of mastering the educational program

As a result of mastering the educational program Dynamics, ballistics and traffic control of aircraft (Engineering) in the direction 01.06.01 Mathematics and mechanics, the graduate must have the following universal, general professional and professional competencies: the

- ability to critical analysis and assessment modern scientific achievements, generating new ideas in solving research and practical problems, including in interdisciplinary fields (UC-1);
- the ability to design and carry out complex research, including interdisciplinary, based on a holistic systemic scientific worldview using knowledge in the field of history and philosophy of science (UC-2);
- willingness to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems (UC-3);
- the readiness to use modern methods and technologies of scientific communication in the state and foreign languages, including the readiness for communication in oral and written forms in Russian and foreign languages to solve the problems of professional activity, possession of foreign language communicative competence in official business, educational and professional, scientific, socio-cultural, everyday-everyday spheres of foreign language communication (UC-4);

- the ability to plan and solve problems of their own professional and personal development (UC-5);
- the ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies (GPC-1);
- readiness for teaching in the basic educational programs of higher education (GPC-2);
- the readiness to apply promising research methods and solve professional problems, taking into account the world trends in the development of aviation and rocket and space technology (PC-1);
- the ability to create and research mathematical and software models of products and processes associated with the functioning of objects of aviation and rocket technology (PC-2);
- readiness to develop and research methods of analysis, synthesis, optimization and forecasting of the quality of the processes of functioning of aviation and rocket technology (PC-3);
- the ability to select and transform mathematical models of phenomena, processes and systems in the field of rocket and space technology in order to study them (PC-4);
- the ability to develop mathematical models, methods, computer technologies and decision support systems in scientific research, design and engineering activities (PC-5).
- the ability to develop new mathematical models of objects of aviation and rocket-space technology, to develop analytical and approximate research methods (PC-6).
- readiness to teach training courses, disciplines (modules), conduct certain types of training sessions in Russian and foreign languages for higher education programs (PC-7).
- the ability to organize educational, research and project activities of students in higher education programs (PC-8)

4. Scope of final state examination and types of educational work

State final certification is carried out in the form of contact work and in the form of independent work of students (Table 1).

Table 1 - The volume of final state examination and types of educational work

Type of educational work		Total, ac. hours	Semester
			8
<i>Preparation for passing and passing the state exam</i>			
Contact work of the student with the teacher		4	4
Independent work of the student, including passing the exam		104	104
Type of certification test		exam	
Total complexity of the certification test	academic hours	108	108
	credit units	3	3
<i>Preparation and presentation of a scientific report on the main results prepared scientific and qualification work</i>			
Contact work of the student with the teacher		8	8
Independent work of the student, including the defense of the WRC		208	208
Type of certification test		public presentation	
Total labor intensity of the certification test of	academic hours	216	216
	credit units	6	6
Total labor input of the GIA	academic hours	324	324
	credit units	9	9

5. State exam program

State exam program for the educational program Dynamics, ballistics and motion control of aircraft (Engineering) in the direction 06/01/01 Mathematics and mechanics a corresponds to the program of the minimum candidate for a scientific specialty 07/05/09 Dynamics, ballistics and traffic control of aircraft (Engineering), approved by order of the Ministry of Education and Science of Russia dated 08.10.2007, No. 274.

The state examination is conducted in writing using examination forms. Each exam form contains three questions.

The questions included in the examination card are interdisciplinary in nature and are aimed at determining the level of theoretical and practical preparedness of the graduate to solve scientific and professional problems in the areas of professional activity defined by the educational standard of RUDN University.

The total number of exam forms is determined by the number of graduate students admitted to the state exam. The student is given 120 minutes to prepare and defend a written answer to the form.

At the state exam by the members of the state examination commissions, the graduate may be asked additional questions in the field of his future professional activity, provided for by the educational standard.

The list of questions for preparing for the state exam, as well as the criteria for assessing the results of this stage of the final state certification are given in the fund of evaluation tools of the final state examination.

6. Requirements for a scientific report and the procedure for its submission

A scientific report on the main results of the prepared scientific and qualification work (dissertation) is a work performed by the student, demonstrating the level of his preparedness for independent scientific and professional activities.

The volume, structure and procedure for registration of the final qualifying work for postgraduate programs (scientific report) is regulated by the National Standard GOST R 7.0.11-2011 "Dissertation and thesis abstract. Structure and design rules", as well as the Regulations for the preparation and execution of scientific and qualification work (dissertation) on training programs for highly qualified personnel at the Peoples' Friendship University of Russia, approved by the Rector's Order No. 40 dated January 20, 2017.

7. Normative and educational-methodical provision of final state examination

1. Federal Law "On Education in the Russian Federation" dated December 29, 2012 No. 273-FZ.

2. The procedure for organizing and carrying out educational activities for educational programs of higher education - programs for the training of scientific and pedagogical personnel in postgraduate studies (postgraduate studies), approved by Order of the Ministry of Education and Science of Russia No. 1259 dated November 19, 2013.

3. The procedure for conducting state final certification for educational programs of higher education education - programs for the training of scientific and pedagogical personnel in postgraduate studies (postgraduate studies), residency programs, internship programs, approved by the Order of the Ministry of Education and Science of the Russian Federation of March 18, 2016, No. 227.

4. Regulations on the state final certification of students in higher programs education - programs for the training of scientific and pedagogical personnel in graduate school, approved by the order of the rector of January 20, 2017, No. 41.

5. Regulations for the use of the "Antiplagiat" system for checking written educational works at RUDN University, approved by the Rector's Order No. 228 dated March 30, 2018.

6. National standard GOST R 7.0.11-2011 "Thesis and thesis abstract. Structure and design rules".

7. Program of the minimum candidate for a scientific specialty 07/05/09 Dynamics, ballistics and control of the movement of aircraft (Technical sciences), approved by order of the Ministry of Education and Science of Russia dated 08.10.2007 No. 274

8. Basic literature indicated in the work programs of disciplines / modules of the educational program (in preparation for the state exam).

Resources of the information and telecommunication network "Internet":

1. RUDN EBS and third-party EBS, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System - RUDN EBS <http://lib.rudn.ru/MegaPro/Web>
- EBS "University Library Online" <http://www.biblioclub.ru>
- EBS Yurayt <http://www.biblio-online.ru>
- EBS "Student's Consultant" www.studentlibrary.ru
- EBS "Lan" <http://e.lanbook.com/>

2. Databases and search systems:

- electronic fund of legal and regulatory and technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- search system Google <https://www.google.ru/>
- SCOPUS abstract database <http://www.elsevierscience.ru/products/scopus/>

Software:

1. Specialized software for preparing a scientific report and independent work of students:

- Windows 7 (Microsoft Subscription Enrollment for Education Solutions No. 86626883 dated 01.04.2018);
- Microsoft Office 2007 (Microsoft Subscription Enrollment for Education Solutions No. 86626883 dated 01.04.2018);
- Windows XP (Microsoft Subscription Enrollment for Education Solutions No. 86626883 dated 01.04.2018);
- Microsoft Office 2003 (Microsoft Subscription Enrollment for Education Solutions No. 86626883 dated 01.04.2018);
- MATLAB R2008b (361405 2008);
- Mathcad 14 (7A1354555);
- Borland Developer Studio 2006 (License Certificate Number: 33080, 33081, 33082);
- Notepad ++ (free application);
- Acrobat Reader DC (free application);

Methodological materials for independent work of students in the process of preparing a scientific report:

1. Regulations for the preparation and execution of scientific qualification work (dissertation) on training programs for highly qualified personnel at the Peoples' Friendship University of Russia, approved by the Rector's Order No. 40 of January 20, 2017.
2. Numerical Models for Differential Problems [Electronic resource]: Undergraduate textbook. - Electronic text data. -: Springer Milan, 2009. - (; 2). - System requirements: Windows XP or higher. - ISBN 978-88-470-1071-0. [http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc & id = 328049 & idb = 0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=328049&idb=0).
3. Evolutionary Design of Intelligent Systems in Modeling, Simulation and Control [Electronic resource]: Monograph. - Electronic text data. -: Springer Berlin Heidelberg, 2009 .-- (Studies in Computational Intelligence; 257). - System requirements: Windows XP or higher. - ISBN 978-3-642-04514-1. http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327239&idb=0.
4. Differential equations in applications [Text]: Transl. from the Russ. / VV Amel'kin. - The book is in English. - M.: Mir, 1990 .-- 279 p. : il. - ISBN 5-03-000521-8: 0.80.22.16 - A498.
5. Mathematical modeling and digital simulation for engineers and scientists / JM Smith. - The book is in English. - New York: Wiley, 1977 .-- 332 p. : il. - (A Wiley-Interscience publication). - 30.00. 3BT - S652.
6. Analysis, Partial Differential Equations and Applications [Electronic resource]: Proceedings. - Electronic text data. -: Birkhauser Basel, 2009 .-- (Operator Theory: Advances and Applications; 193). - System requirements: Windows XP or higher. - ISBN 978-3-7643-9898-9. http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327847&idb=0.
7. Elementary differential equations with applications / WR Derrick, SI Grossman. - The book is in English. - Reading: Addison-Wesley, 1976 .-- 597 p. : il. - (Addison-Wesley series in mathematics; 1470). - 13.30.3BM - D438.
8. Optimal Control of Coupled Systems of Partial Differential Equations [Electronic resource]: Proceedings. - Electronic text data. -: Birkhauser Basel, 2009 .-- (International Series of Numerical Mathematics; 158). - System requirements: Windows XP or higher. - ISBN 978-3-7643-8923-9. http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327783&idb=0.
9. Fuzzy Information and Engineering Volume 2 [Electronic resource]: Proceedings. - Electronic text data. -: Springer Berlin Heidelberg, 2009 .-- (Advances in Soft Computing; 62). - System requirements: Windows XP or higher. - ISBN 978-3-642-03664-4. http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=326966&idb=0.
10. Intelligent Distributed Computing 3 [Electronic resource]: Monograph. - Electronic text data. -: Springer Berlin Heidelberg, 2009 .-- (Studies in Computational Intelligence; 237). - System requirements: Windows XP or higher. - ISBN 978-3-

642-03214-1.

http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327251&idb=0.

11. A.A. Amosov, Yu.A. Dubinsky, N.V. Kopchenova Computational methods for engineers. - M.: Higher. shk., 1994. -- 544 p.
12. Bakhvalov N.S., Zhidkov N.P. Numerical methods: A textbook for students of physical and mathematical specialties of higher educational institutions. - M.: BINOM. Knowledge Laboratory, 2015. -- 636 p.
13. Wentzel E.S. Probability theory. M.: Higher school, 2002. -- 575 p.
14. D.E. Knut The art of programming in 3 volumes - M.: Izd. house Williams, 2008. - T.1 - 720, T.2 - 832 p., T.3 - 824 p.
15. Ortega J., Poole W. Introduction to numerical methods for solving differential equations. - M.: Nauka, 1986. -- 288 p.
16. Samarskiy A.A. Numerical Methods: Tutorial. - M.: Nauka, 1989. -- 430 p.
17. Samarskiy A.A., Vabishchevich P.N. Numerical Methods for Solving Inverse Problems of Mathematical Physics: Textbook. - M.: Publishing house of LKI, 2014. -- 480 p.
18. Sukharev A.G., Timokhov A.V., Fedorov V.V. Optimization Methods Course. - Moscow: Nauka, 1986. -- 326 p.
19. Moiseev N.N. Numerical methods in the theory of optimal systems. - Moscow: Nauka, 1971. - 424 p.

8. Material and technical support of the final state examination

To prepare for the state exam and submit a scientific report, students use the premises for independent work.

To conduct a state examination and / or present a scientific report, a room with a capacity of 12 or more people is used, in which workplaces are equipped for all members of the state examination commissions, with the ability to listen to reports, view public presentations of speakers, keep records and minutes, there are places for listeners, those wishing to attend the procedure for submitting a scientific report. The necessary equipment of the room includes:

- equipment for public presentations, including a multimedia screen, a projector, audio equipment.
- a board to illustrate the answers to questions;
- tablets / stands of at least A1 format (if necessary), for placing graphic material on them within the framework of a scientific report.

The student can notify the issuing department of his wishes for additional material and technical equipment (if necessary) of the auditorium designated for conducting the final state examination with a written statement no later than a week before the defense procedure.

9. Fund of evaluation means

The fund of evaluation means, formed for the state final certification of students in the educational program Dynamics, ballistics and control of the movement of aircraft (Engineering) in the direction 01.06.01 Mathematics and mechanics, includes:

- a list of competencies, which must master the students as a result of mastering the educational program;

- description of indicators and criteria for assessing competencies, as well as assessment scales;
- typical control tasks or other materials necessary to assess the results of mastering the educational program;
- methodological materials that determine the procedures for assessing the results of mastering the educational program.

9.1 The list of competencies that students should master as a result of mastering the educational program

As a result of mastering the educational program Dynamics, ballistics and aircraft traffic control (Engineering) in the direction 01.06.01 Mathematics and mechanics, the graduate must have all the universal, general professional and professional competencies listed in clause 3 of this Program.

9.2 Indicators, criteria and scales for assessing competencies in the process of conducting the final state examination

According to the results of the state exam, an assessment is given in accordance with the point-rating system adopted by the RUDN University (score / ECTS / assessment of the Russian Federation, maximum 100 points).

The score based on the results of the state exam is determined by the results of checking the student's written answer to the exam ticket and (if necessary) by the quality of the student's answers to additional questions from the state examination commissions members.

Scale of evaluation and the criteria state examination are shown in Table 2.

Table 2 - Scale of evaluation and criteria state exam

Evaluation scale	86-100 points	69-85 points	51-68 points	0-50 points
Criteria	<ul style="list-style-type: none"> - fully disclosed contents of the material examination card; - the material is presented correctly, in a certain logical sequence; - terminology is used accurately; - shown the ability to illustrate theoretical provisions with specific examples, to apply them in a new situation; - the answer sounded independently, without leading questions; - demonstrated the ability to creatively apply knowledge of theory to solving professional problems; - a high level of competence formation was demonstrated 	<ul style="list-style-type: none"> - the questions of the examination material are presented in a systematic and sequential manner; - demonstrated the ability to analyze the material, but not all conclusions are reasoned and evidentiary; - the assimilation of the main literature is demonstrated. - the answer contains one of the following shortcomings: - there are small gaps in the statement that did not distort the content of the answer; - a mistake or more than two shortcomings were made in the coverage of secondary questions, which are easily corrected at the comment of the examiner. 	<ul style="list-style-type: none"> - the content of the material is incomplete or inconsistently disclosed, but a general understanding of the issue is shown and skills are demonstrated that are sufficient for further assimilation of the material; - mastered the main categories on the considered and additional issues; - there were difficulties or mistakes in the definition of concepts, the use of terminology, corrected after several leading questions; - with incomplete knowledge of the theoretical material, insufficient formation of competencies, abilities and skills was revealed, the student cannot apply the theory in a new situation; - the assimilation of the main literature is demonstrated. 	<ul style="list-style-type: none"> - the main content of the educational material has not been disclosed; - found ignorance or misunderstanding of the most or the most important part of the educational material; - mistakes were made in the definition of concepts, when using terminology, which were not corrected after several leading questions. - competencies, skills and abilities are not formed.

The scientific report is assessed in accordance with the point-rating system adopted by the RUDN University (score / ECTS / RF score, maximum 100 points) according to the following indicators, which make it possible to assess the level of development of the competencies provided for by the educational program:

Indicators for evaluating the scientific report	Maximum score
- compliance with the content of the scientific report the approved topic of the NKR and the assigned task, the clarity of the formulation of the goals and objectives of the study	20
- the reliability, originality and novelty of the results obtained in the NKR	10
- the practical value of the completed NKR	10
- the style of presentation of the scientific report	5
- compliance with the approved requirements for the design of the NKR	10
- quality of presentation	10
- the quality of answers to the questions of the state examination commissions members	10
- the assessment of the scientific work of the graduate student by the head (feedback)	10
- the assessment of the NKR by the reviewer (review)	10
- the availability of publications on the topic of the work, certificates, awards, etc.	5

The scale and criteria for assessing the scientific report based on the results of the NKR are presented in Table 3.

Table 3 - Scale and criteria for assessing the scientific report

Compliance of the content of the scientific report with the approved NKR topic and the assigned task, the clarity of the formulation of the goals and objectives of the research				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	NKR has been fulfilled on a relevant topic, the goals and objectives of the research are clearly formulated.	The NKR was carried out on a topical topic, there are minor remarks on the formulation of the goals and objectives of the study.	The relevance of the NKR topic raises doubts. The goals and objectives of the NKR are formulated with significant remarks, not clearly enough. There is no link between the essence of the topic and the most significant directions for solving the problem under consideration.	The goals and objectives of the NKR do not correspond to the approved topic of the work and do not disclose the essence of the research being conducted.
Reliability, originality and novelty of the results obtained in NKR.				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	NKR has been fulfilled on a relevant topic, the goals and objectives of the research are clearly formulated.	The NKR was carried out on a topical topic, there are minor remarks on the formulation of the goals and objectives of the study.	The relevance of the NKR topic raises doubts. The goals and objectives of the NKR are formulated with significant remarks, not clearly enough. There is no link between the essence of the topic and the most significant directions for solving the problem under consideration.	The goals and objectives of the NKR do not correspond to the approved topic of the work and do not disclose the essence of the research being conducted.

Practical value of the performed NKR				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	The paper gives a new solution to a theoretical or practical problem that is essential for the professional field.	The work provides a partial solution to a theoretical or practical problem that is important for the professional field.	In the work, only the directions of solving the problem are considered, the results obtained are of a general nature or insufficiently reasoned.	The results are of no practical value
Style of presentation of the scientific report				
Scale	4-5 points	2-3 points	1 point	0 points
Criteria	There is a scientific style of presentation of the results of work with correct references to literary sources	There are minor remarks about the scientific style of presentation of the results and / or the correctness of references to sources	There are serious remarks about the scientific style of presenting the results of work and / or the correctness of references to sources	The style of presentation does not correspond to the scientific one, references to sources are incorrect
Compliance with the approved requirements for the design of the NKR				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	NKR fully complies with the requirements for registration of	NKR with minor remarks meets the requirements for registration of	NKR has significant comments on compliance with the requirements for registration of	NKR does not meet the requirements for registration
Quality of presentation and report				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	Presentation and the report fully reflect the content of the NKR, demonstrated a good command of the material of the work, confident, consistent and logical presentation of the research results.	There are minor comments on the presentation and / or report on the topic of NKR. Minor inaccuracies were made in the presentation of the results of the NKR, which did not distort the main content of the work.	There are significant comments on the quality of the presentation and / or report on the NKR topic. Significant inaccuracies were made in the presentation of the material, affecting the essence of understanding the main content of the NKR, the consistency of the presentation was violated.	The presentation and / or report does not reflect the essence of the NKR. No demonstrated proficiency in the material of the work.
Quality of answers to questions from HEC members				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	Answers to questions are given in full	Answers are given incompletely and / or with minor errors	Answers to questions are incomplete, with serious errors	Answers to no questions given
Assessment of the scientific work of the graduate student by the supervisor				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	Excellent	Good	Satisfactory	Unsatisfactory
Assessment of the NKR by the reviewer				
Scale	7-10 points	4-6 points	1-3 points	0 points
Criteria	Excellent	Good	Satisfactory	Unsatisfactory
Availability of publications on the topic of work, certificates, awards, etc.				

Scale	4-5 points	2-3 points	1 point	0 points
Criteria	The research results were tested in speeches at conferences, seminars, there are publications in print, the results are confirmed by a certificate of implementation, etc.	The results of the research are declared for a report at conferences, seminars, or accepted for publication in print, for implementation.	The research results are prepared for discussion at conferences, seminars, or prepared for publication in print, for implementation.	Research results are not planned for publication, presentation at conferences, seminars, for implementation

9.3 Typical control tasks or other materials necessary to assess the results of mastering the educational program

List of questions to prepare for the state:

Mathematical foundations

1. Elements of the theory of functions and functional analysis. The concept of Lebesgue measure and integral. Metric and normed spaces. Spaces of integrable functions. Sobolev spaces. Linear continuous functionals. Hahn-Banach theorem. Linear operators. Elements of spectral theory. Differential and integral operators.
2. Extreme tasks. Convex Analysis. Extreme problems in Euclidean spaces. Convex minimum problems. Mathematical programming, linear programming, convex programming. Minimax tasks. Foundations of the calculus of variations. Optimal control problems. Maximum principle. The principle of dynamic programming.
3. Probability theory. Math statistics. Axiomatics of probability theory. Probability, conditional probability. Independence. Random variables and vectors. Elements of the correlation theory of random vectors. Elements of the theory of random processes. Point and interval estimation of distribution parameters. Elements of the theory of testing statistical hypotheses. Elements of multivariate statistical analysis. Basic concepts of the theory of statistical decisions. Foundations of information theory.

Information technology

4. Decision making. General solution problem. Loss function. Bayesian and minimax approaches. Method of sequential decision making.
5. Operations Research and Artificial Intelligence Challenges. Expertise and informal procedures. Design automation. Artificial Intelligence. Pattern recognition.

Computer technologies

6. Numerical methods. Interpolation and approximation of functional dependencies. Numerical differentiation and integration. Numerical methods for finding an extremum. Computational methods of linear algebra. Numerical methods for solving systems of differential equations. Spline approximation, interpolation, finite element method. Fourier transforms, Laplace, Haar, etc. Numerical methods of wavelet analysis.
7. Computational experiment. The principles of the computational experiment. Model, algorithm, program.

8. Algorithmic languages. Introduction to high-level programming languages. Application packages.

Methods of mathematical modeling

9. Basic principles of mathematical modeling. Elementary mathematical models in mechanics, hydrodynamics, electrodynamics. The versatility of mathematical models. Methods for constructing mathematical models based on the fundamental laws of nature. Variational principles of constructing mathematical models
10. Methods of researching mathematical models. Stability. Checking the adequacy of mathematical models.
11. Mathematical models in scientific research. Mathematical models in statistical mechanics, economics, biology. Methods for mathematical modeling of measuring and computing systems. Reduction problems to an ideal device. Synthesis of the output signal of an ideal device. Checking the adequacy of the measurement model and the adequacy of the reduction results. Models of dynamic systems. Special points. Bifurcations. Dynamic chaos. Ergodic and agitated. The concept of self-organization. Dissipative structures. Exacerbation modes.

Approximate topics of scientific research carried out at the department:

1. Ensuring the reliability of thermoelectric semiconductor devices during ultra-long operation using methods of physical and technological diagnostics.
2. Theoretical and numerical study of increasing the throughput of the system using the ME-SOA multi-electrode semiconductor optical amplifier in optical access networks.

9.4 Methodological materials defining the procedures for assessing the results of mastering the educational program

Methodology for assessing the results of the state exam

Based on the results of the state exam, an assessment is given in accordance with the point-rating system adopted by the RUDN University (score / ECTS / RF score).

According to the results of the state exam, a graduate student can receive a maximum of 100 points. The score is determined based on the results of checking the student's written answer to the exam ticket and (if necessary) the quality of the postgraduate student's answers to additional questions from the members of the state examination commissions. The grade received by the graduate based on the results of the state exam is put on the list of the state examination (by the chairman of the state examination commissions), in the minutes of the meeting of the state examination commission (by the secretary of the commission) and communicated to the student.

Methodology for assessing the results of submitting a scientific report

For the efficiency and convenience of the work of the state examination commissions members, it is recommended to provide them with a supporting document "*Worksheet for assessing the formation of competencies during the final state examination*", the form of which is given in Appendix 1.

In the process of hearing a scientific report, state examination commissions members give points for each of the submitted higher indicators. At the end of the presentation of the

report, each of the state examination commissions members summarizes all the points assigned.

The final assessment of the formation of competencies is an assessment given based on the results of hearing a scientific report by all members of the state examination commissions who attended the hearing. To determine the final grade, it is necessary to calculate and round off the arithmetic average of the grades given by all members of the state commission. In case of any controversial issues, the chairman of the state examination commissions has a casting vote.

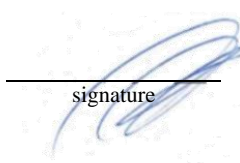
The total score received by the graduate student based on the results of the presentation of the scientific report is put down in the examination sheet (by the chairman of the state examination commissions) and in the minutes of the meeting of the state examination commissions (by the secretary of the commission).

WORKSHEET for assessing the formation of competencies during the GIA		
Direction of preparation:	09.06.01. "Informatics and computer technology"	
Educational program (scientific specialty):	05.07.09	
Dynamics, ballistics and control of the movement of aircraft (Engineering) (<u>Researcher. Teacher-researcher</u>)		
Name of the member of the State Electoral Commission:		
Date:		
Attestation test:	<i>Submission of a scientific report</i>	
Graduate name:		
Indicators for assessing the protection of FQP	Maximum score	Actual score
- compliance of the content of the scientific report with the approved NKR topic and the issued assignment, clarity of the formulation of the goals and objectives of the study	20	
- reliability, originality and novelty of the results obtained in the NKR	10	
- the practical value of the completed NKR	10	
- style of presentation of scientific report	5	
- compliance with the approved requirements for registration of NKR	10	
- quality of presentation and report	10	
- the quality of answers to questions from members of the GEC	10	
- assessment of the scientific work of the graduate student by the supervisor (review)	10	
- assessment of the NKR by a reviewer (review)	10	
- availability of publications on the topic of work, certificates, awards, etc.	five	
Score:	100	
Signature of the state examination commissions member		

Developers:

Associate Professor of the Department of
Mechanics and Mechatronics

position



signature

O.E. Samusenko

initials, surname

Senior Lecturer of the Department of
Mechanics and Mechatronics

position



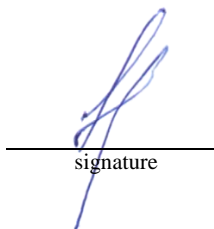
signature

T.A. Morozova

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Supervisor of the Master Program

Professor of the Department of
Mechanics and Mechatronics

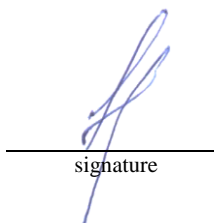


signature

Yu.N. Razumny

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signature

Yu.N. Razumny

initials, surname