

«RUDN University»

Engineering Academy

SCIENTIFIC RESEARCH PROGRAM

Direction: 01.06.01 Mathematics and Mechanics

Scientific specialty: Dynamics, strength of machines, devices and equipment (Technical Science)

Moscow,
2021

1. **The goal** of the postgraduate student's scientific research is to acquire practical skills in independent research work, to consolidate the theoretical knowledge gained during classroom, practical, laboratory and educational research classes, as well as to introduce the graduate student to the social environment in order to acquire social and personal competencies necessary for work in the professional field.

2. **Tasks:**

- study of the program of research work of the organization (department, laboratory of the research institute, department, department) in which research is carried out;
- mastering modern methods and methodology of scientific research; - improving the skills and abilities of independent research activities;
- accumulation of experience in scientific and analytical activities, as well as mastering the skills of presenting the results obtained in the form of reports, publications, reports.

In accordance with the types and tasks of professional activity, practice may include:

- study of installations, equipment, instruments, techniques and techniques of the experiment; theoretical and experimental research; processing, analysis and interpretation of the results of the experiment;
- computer modeling of the studied processes and phenomena; obtaining scientifically significant results; preparation and analysis of literary sources necessary for writing a scientific report; preparation of the report and possible publications.

3. The place of research practice in the structure of the educational program of higher education

The research program was developed on the basis of the RUDN University educational system (higher education level - training of highly qualified personnel) in the direction of training 06.01.01 Mathematics and Mechanics and belongs to Block 3 "Scientific Research".

Scientific research in the system of training highly qualified personnel is a component of professional training for research activities in a higher educational institution and is a type of practical activity of graduate students to carry out scientific work, including scientific research within the framework of their Ph.D. thesis, approbation of the results obtained and writing a thesis.

The implementation of scientific research is based on the knowledge, skills and competencies of the graduate student obtained in the study of the following disciplines:

- Research methodology;
- Modern problems of control theory;
- System analysis, management and information processing.

The knowledge, abilities and skills acquired by graduate students in the performance of scientific research are widely used in research activities, culminating in the writing of a thesis.

4. Forms of scientific research

Scientific research is carried out in the form of individual independent work under the guidance of a scientific advisor.

The forms of conducting can be:

- fulfillment of tasks of the scientific supervisor in accordance with the approved plan of research work;
- participation in interdepartmental seminars, theoretical seminars (on the research topic), as well as in the scientific work of the department;
- Speaking at conferences of young scientists held at RUDN University, in other universities, as well as participating in other scientific conferences and round tables;
- preparation and publication of theses of reports, scientific articles;
- participation in a real research project carried out in the department within the framework of budgetary and extrabudgetary research programs (or within the framework of the received grant).

The result of the work is the preparation and defense of a Ph.D. thesis.

5. Place and time of scientific research

Scientific research is carried out within the framework of the implementation of the curriculum for the preparation of graduate students in the direction 01.06.01 Mathematics and Mechanics, the profile of Dynamics, strength of machines, devices and equipment.

Research forms - research work. The base of research practice is the laboratories of the Department of Mechanics and Mechatronics. In some cases, it can be carried out in the laboratories of industry research institutes and academic institutes (within the framework of an agreement on creative cooperation).

The methods of carrying out the practice are stationary practice, it is carried out continuously - by allocating a continuous period of study time in the calendar training schedule.

6. Competencies of the student, formed as a result of scientific research

The scientific research of the graduate student is aimed at the formation of the following universal, general professional and professional competencies:

- the ability to critically analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems, including in interdisciplinary areas (UC-1);
- willingness to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems (UC-3);
- the ability to plan and solve problems of one's 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)

As a result of scientific research, the student develops professional competencies and, based on the results of the practice, the graduate student must demonstrate the following results:

To have an idea:

- about the current state of science, the main directions of scientific research, priority tasks;
- on the procedure for introducing the results of scientific research and development.

To know:

- principles of operation of modern scientific equipment when conducting scientific research in their field;
- methods of searching for literary sources on the topic being developed with the aim of using them when performing a dissertation, patent search;
- research methods and experimental work;
- methods of analysis and processing of experimental data;
- information technology in scientific research, software products related to the professional sphere;
- requirements for the design of scientific and technical documentation.

To be able to:

- to formulate the goals and objectives of scientific research; choose and justify research methods;
- work on modern scientific equipment when conducting scientific research; - to formalize the results of scientific research (report, scientific article, abstracts).

Skills:

- work on modern scientific equipment during scientific research;
- work with applied scientific packages and editorial programs used in research and development;
- analysis, systematization and generalization of scientific and technical information on the research topic;
- analysis of the reliability of the results obtained;

- analysis of the scientific and practical significance of the research, as well as the technical and economic efficiency of the development;
- presentations with reports and reports at conferences and scientific seminars.

7. Structure and content of scientific research

The base of scientific research is the laboratories of the Department of Mechanics and Mechatronics. In some cases, they can be carried out in the laboratories of industry research institutes and academic institutes (within the framework of an agreement on creative cooperation).

In the process of performing scientific research, the postgraduate student continues to work on a single topic of research work of the departments, independently receiving experimental data. The topic of scientific research coincides with the topic of a future scientific report.

The scientific supervisor of the graduate student is appointed as the head of scientific research. The head carries out general organizational activities and current control over the progress of scientific research. If necessary, in addition to the scientific supervisor, a scientific consultant is appointed - a scientific employee who is in charge of the research facility, on which the graduate student will receive experimental results during the period of scientific research.

Before the start of scientific research, the head gives the graduate student an assignment, which indicates a section of a single research topic that is to be developed during the period of scientific research; experimental technique; the amount of experimental data and the timing of each specific experiment; literary sources that need to be worked out by a graduate student during the period of scientific research.

The total workload of scientific research is 129 credit points 4644 hours.

№	Sections of scientific research	Activities	Competency code	Labor intensity (credit unit)	Forms of control
1	Introduction	Conversation with the supervisor: drawing up a research plan.	GPC-1 UC-1	5	Department certification
2	Execution of experiments corresponding to the chosen profile of graduate school	Statement of the goal and objectives of the study. Review and analysis of information on the research topic. Conducting theoretical and experimental research.	UC-1,3,5 GPC-1	50	Department certification. Monitoring results
3	Processing and presentation of the obtained results	Processing of experimental data, analysis of results. Preparation of scientific publications and speeches at all-Russian and international conferences.	GPK-1 UC-1,3,5	34	Department certification. Scientific publications. Participation in conferences
4	Preparation of a scientific and qualification work (dissertation) for the	Preparation of a scientific and qualification work (dissertation) for the degree of candidate of technical sciences	UC-1,3,5 GPC-1	40	Report. Department certification

degree of candidate of technical sciences					
---	--	--	--	--	--

8. Educational, research and development technologies used in scientific research

The main technologies used in the process of scientific research are:

- briefing; consultation;
- scientific and methodological work; workshop;
- independent work.

9. Educational and methodological support of independent work of graduate students

- multimedia equipment and personal computers;

Resources of the information and telecommunications network "Internet":

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

- RUDN electronic library system – RUDN ELS <http://lib.rudn.ru/MegaPro/Web>
- ELS «University library online» <http://www.biblioclub.ru>
- ELS Yurayt <http://www.biblio-online.ru>
- ELS «Student advisor» www.studentlibrary.ru
- ELS «Lan» <http://e.lanbook.com/>

2. Databases and Search Engines:

- electronic fund of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- Google search engine <https://www.google.ru/>
- SCOPUS database <http://www.elsevierscience.ru/products/scopus/>
- e-library <http://elibrary.ru/defaultx.asp>.

The independent work of a postgraduate student is carried out in accordance with an individual plan developed jointly with the scientific advisor. The graduate student in his work uses sources on the topic of his scientific research. At the same time, the graduate student is obliged to familiarize himself with the works on the topic of his research, recommended to him by his supervisor.

10. Educational-methodical and informational support of scientific research

1. Methodology of Scientific Research: Education and Methodical Complex / T.B. Ivanova. - M.: PFUR, 2013 - 117 p. - ISBN 978-5-209-05048-3 : 167.79.65 - I93 http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=404340&idb=0

2. Research Methods in Education [Текст] / L. Cohen, L. Manion. - Sixth edition ; Книга на английском языке. - London and New York : Routledge Taylor & Francis Group, 2007 – 657 p. : il. - ISBN 978-0-415-36878-0 : 2091.42.

3. Shkljar M.F. Osnovy nauchnyh issledovaniĭ. M.: Izdatel'sko-torgovaja korporacija «Dashkov i K°», 2012. – 244 p.

4. Osnovy nauchnyh issledovaniĭ: ucheb. posobie / B.I. Gerasimov i dr. –M.: FORUM, 2011. – 269 p.

5. Denisov S.L. Kak pravil'no oformit' dissertaciju i avtoreferat: Metod. posobie. – 2- e izd., pererab. i dop. - M.: GJeOTAR-Media, 2005. – 85 p.

6. Kuzin F.A. Dissertacija: Metodika napisaniĭa. Pravila oformleniĭa. Porjadok zashhity: prakt. posobie dlĭa doktorantov, aspirantov i magistrrov / Kuzin F.A.; pod red. Abramova V.A. –M.: Os'-89, 2008. – 447 p.

7. Mareev S.N. Filosofija nauki. Uchebnoe posobie dlĭa aspirantov i soiskatelej. – Iz-vo: Infra-M, 2015.

When passing research practice, graduate students also use the literature recommended by the supervisor.

- multimedia equipment and personal computers;
- full-text databases and resources, access to which is provided from the RUDN University network;
- electronic library RFBR
- e-library <http://elibrary.ru/defaultx.asp>.

11. Material and technical support of scientific research

1. Lecture halls with multimedia projectors; laboratories with equipment and instruments for laboratory work.
2. Scientific laboratories equipped with appropriate equipment.
3. Computers for calculating and processing results and access to information systems.
4. Specialized software for scientific research and independent work of students:
 - MATLAB R2008b (361405 2008 г.);
 - Mathcad 14 (7A1354555);
 - Borland Developer Studio 2006 (License Certificate Number: 33080, 33081, 33082).

12. Interim certification forms

Control over the progress of scientific research is carried out by weekly consultations of a postgraduate student with a scientific advisor; verification by the scientific supervisor of the laboratory journal; speeches of graduate students on the subject of scientific research in the framework of a scientific seminar, speeches at scientific conferences; providing information on the progress of scientific research at the certifications conducted at the department.

After completing scientific research, the graduate student writes a report, which sets out all the results obtained in accordance with the assignment.

The results of scientific research are summarized by the graduate student in the report, which should contain: title page; introduction, which shows the relevance of the topic of scientific research; a literary review, compiled on the basis of the results of the study of literary sources, reflecting the known theoretical data and experimental results on the selected topic; conclusions; R&D list; experimental technique; discussion of the obtained results of the literature; table of contents.

The volume of the report is determined by the characteristics of the individual plan of the graduate student.

At the end of scientific research, the graduate student passes the test (defends the report) with a differentiated assessment at a conference in the presence of teachers and leading employees of the department. When evaluating the results of the work, the characteristics given by the head are taken into account.

When defending the report on the implementation of scientific research, the graduate student makes a report of no more than 10 minutes, in which he sets out the results obtained, gives their interpretation and reads out the conclusions. Then the graduate student answers questions on the topic of the work. A postgraduate student who has not completed the research program, received a negative review of the work or an unsatisfactory assessment when defending a report, is sent again for revision and is not allowed to defend a scientific report. In some cases, the rector may consider the issue of the further stay of the graduate student in a higher educational institution.

13. Fund of assessment tools for intermediate certification of students in scientific research

№	Supervised competency code (or part of it)	Controlled sections of the discipline	Name of the appraisal tool
---	--	---------------------------------------	----------------------------

1	UC-1	1. Introduction. Conversation with the supervisor: drawing up a research plan.	Attestation in the department. Monitoring results
2	UC-2	1. Statement of the goal and objectives of the study. Review and analysis of information on the research topic. Conducting theoretical and experimental research.	Attestation in the department. Monitoring results
3	UC-3	1. Statement of the goal and objectives of the study. Review and analysis of information on the research topic. Conducting theoretical and experimental research. 2. Preparation of a scientific and qualification work (dissertation) for the degree of candidate of technical sciences	Attestation in the department. Monitoring results Report.
4	GPC-2	1. Statement of the goal and objectives of the study. Review and analysis of information on the research topic. Conducting theoretical and experimental research. 2. Processing of experimental data, analysis of results. Preparation of scientific publications and speeches at all-Russian and international conferences.	Attestation in the department. Monitoring results Scientific publications. Participation in conferences
5	GPC-1	1. Statement of the goal and objectives of the study. Review and analysis of information on the research topic. Conducting theoretical and experimental research.	Attestation in the department. Monitoring results

The research program was developed on the basis of the RUDN University educational system (higher education level - training of highly qualified personnel) in the direction of training 06.01.01 Mathematics and Mechanics.

Evaluation criteria

Assessment method	Maximum points	Evaluation criteria
Report at the scientific and methodological seminar of the department (1 and 2 years of study)	100	86-100 points - the topic is substantiated, scientific arguments for the chosen topic are given, the main scientific schools dealing with this problem have been studied, reviews of the main scientific approaches to the topic under study have been prepared, the report is well structured, the speaker is confident that he is fluent in scientific rhetoric 69-85 - the topic is justified, scientific arguments for the chosen topic are given, the main scientific schools dealing with this problem are studied, reviews of the main scientific approaches to the topic under study are prepared, there are gaps in the structuring of the report, the report is not confident 51-68 - the topic is substantiated, scientific arguments for the chosen topic are given, the main scientific schools dealing with this problem have been studied, but reviews of the main scientific approaches to the topic under study

		<p>have not been prepared</p> <p>31-50 - the topic is justified, scientific arguments for the chosen topic are given, but the main scientific schools dealing with this problem have not been studied, reviews of the main scientific approaches to the topic under study have not been prepared</p> <p>11-30 - the topic is justified, but a sufficient number of scientific arguments are not given to justify the topic</p> <p>1-10 - the topic is not substantiated</p>
Report at the scientific and methodological seminar of the department (3rd and 4th years of study)	10	<p>7-10 points - a confident report accompanied by a presentation, the topic is fully disclosed.</p> <p>3-6 points - a confident report without a presentation or an error in structuring the report, the topic is not disclosed from all sides</p> <p>1-2 points - the report is poorly structured, the topic is not disclosed</p>
Publishing Articles	50 for 1 article	<p>46-50 points - the article was published in a journal indexed by international scientific citation databases (WoS, Scopus)</p> <p>36-45 points - the article was published in a journal indexed by specialized international scientific citation databases (Agris, Astrophysics, Chemical Abstracts, GeoRef and others)</p> <p>21-35 points - the article was published in the RSCI indexed journal with an Impact factor of at least 1</p> <p>11-20 points the article was published in the journal indexed by the RSCI with an Impact factor of at least 0.5</p> <p>6-10 article published in a peer-reviewed scientific journal indexed by RSCI with a nonzero Impact Factor</p> <p>1-5 article published in a peer-reviewed scientific journal</p>
Participation in the conference	10 for 1 article	<p>7-10 participation in an international full-time scientific conference</p> <p>4-6 participation in a face-to-face scientific conference</p> <p>1-3 participation in the correspondence conference</p>

Point-rating system

To assess the educational activities of graduate students, a point-rating system and ECTS assessments are used. The point-rating assessment of a graduate student is based on his knowledge, acquired skills and abilities. The maximum number of points that a graduate student can earn during a semester is 100, which corresponds to 100% mastering of the research program.

Point-rating system: 100 points

Grades:

96 - 100 - excellent A

86-94 - excellent B

69 - 85 - good C
61 - 68 - satisfactory D
51 - 60 - satisfactory E
31-50 - unsatisfactory FX
0-30 - unsatisfactory F

Positive grades, upon receipt of which the course is credited to the graduate student as passed, are grades A, B, C, D and E.

Developer

Assistant Professor of the Basic Department
of Nanotechnology and
Microsystem Technology



M.O. Makeev

Acting head

of the Basic Department
of Nanotechnology and
Microsystem Technology



S.V. Agasieva