Federal State Autonomous Educational Institution of Higher Education
«RUDN University»
Engineering Academy

THE WORKING PROGRAMME OF THE DISCIPLINE

Name of discipline: Methodology of Scientific Research

Direction: 01.06.01 Mathematics and Mechanics

Scientific specialty: Dynamics and strength of machines, devices and equipment (technical sciences)

1. **Goals and objectives of the discipline:** organization of research activities in the chosen field; to give an idea about the scientific methodology of conducting research, about research methods in relation to the subject area; formation of a systematic analysis of scientific information; formation of a systematic approach for the use of already developed methods of research activities in order to obtain new scientific knowledge and develop new methods of scientific research; the formation of ideas about the evolution of scientific natural science; the formation of a holistic systemic scientific worldview; familiarization with terms and concepts; improvement of basic professional knowledge and skills of graduate students in the field of technology research activities; the formation of the ability to identify the main aspects of the research problem; formation of the ability to apply previously acquired knowledge in research work; the formation of practical skills in planning and organizing all stages of scientific research; ensuring a high level of independent research activities.

2. Place of discipline in the structure of HEC:

The discipline " Methodology of Scientific Research " refers to the variable part of block 1 of the curriculum.

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix of EP HE.

Table № 1

Prior and subsequent disciplines aimed at the formation of competencies

№	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
Universal competences			
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 (UK-2)	History and philosophy of science	Priority areas for the development of mathematics and mechanics
2	willingness to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems (UK-3)	Foreign language	Priority areas for the development of mathematics and mechanics Foreign language in the field of professional communication Russian in the field of professional communication
3	the ability to plan and solve problems of one's own professional and personal development (UK-5)	History and philosophy of science Fundamentals of teaching methods for the development of engineering applications based on mathematical modeling using informatics and computer technology in higher education	Priority areas for the development of mathematics and mechanics Dynamics, strength of machines, devices and equipment
General professional competencies			
4	ability to independently carry out research activities in the		Priority areas for the development of

	relevant professional field using modern research methods and information and communication technologies (GPC-1)		mathematics and mechanics Dynamics, strength of machines, devices and equipment Technology and engineering of nanodevices and systems System analysis, management and information processing Modern problems of control theory
5	willingness to teach in basic educational programs of higher education (GPC-2)	Fundamentals of teaching methods for the development of engineering applications based on mathematical modeling using informatics and computer technology in higher education	Priority areas for the development of mathematics and mechanics
Professional competence			
6	willingness to apply promising research methods and solve professional problems, taking into account global trends in the development of technical objects for various purposes (PC-1)	Research methodology	Dynamics, strength of machines, devices and equipment Technology and engineering of nanodevices and systems System analysis, management and information processing Modern problems of control theory
7	the ability to identify the essence of scientific and technical problems arising in the course of professional activity, and to apply for their solution the physical and mathematical apparatus, theoretical, calculated and experimental research methods, methods of mathematical and computer modeling (PC-2)		Dynamics, strength of machines, devices and equipment Technology and engineering of nanodevices and systems System analysis, management and information processing Modern problems of control theory
8	willingness to carry out research work and solve scientific and technical problems in the field of applied mechanics based on the achievements of engineering and technology, classical and technical theories and methods, physical-mechanical, mathematical and computational models that		Priority areas for the development of mathematics and mechanics Dynamics, strength of machines, devices and equipment Technology and engineering of nanodevices and systems System analysis, management and information processing

	have a high degree of adequacy to real processes, machines and structures (PC-3)		Modern problems of control theory

3. Requirements for the results of mastering the discipline:

The process of studying the discipline is aimed at the formation of the following competencies:

- 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 ability to plan and solve problems of one's own professional and personal development (UC-5)
- ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies (GPC-1)
- willingness to teach in basic educational programs of higher education (GPC-2)
- willingness to apply promising research methods and solve professional problems, taking into account global trends in the development of technical objects for various purposes (PC-1)
- the ability to identify the essence of scientific and technical problems arising in the course of professional activity, and to apply for their solution the physical and mathematical apparatus, theoretical, calculated and experimental research methods, methods of mathematical and computer modeling (PC-2)
- willingness to carry out research work and solve scientific and technical problems in the field of applied mechanics based on the achievements of engineering and technology, classical and technical theories and methods, physical-mechanical, mathematical and computational models that have a high degree of adequacy to real processes, machines and structures (PC-3)

As a result of studying the discipline, the student must:

To Know: the classification of scientific research; classification of scientific theories; methodological principles of building scientific concepts; the content of the main stages of scientific research, its logic and structure; requirements for scientific hypotheses put forward; methods of scientific research, verification, confirmation and refutation of scientific hypotheses; modern methods of scientific research and the possibility of their application in the field chosen by the graduate student;

To be able to: adapt modern scientific achievements to their own scientific activities and to self-education; perceive and critically analyze information based on a systemic scientific worldview; identify and formulate topical scientific problems; to determine promising areas of scientific research in the field of professional activity; reasonably substantiate the relevance of your own research; to be guided in the formulation of the problem, to determine the methods and means of its solution, to develop a research program; choose and substantiate the methods of scientific research and processing of the data obtained, the willingness to systematically defend their point of view; to apply in practice the previously acquired knowledge and skills of organizing research work public speaking and academic discussion; independently master new research methods; form the content of the text of the dissertation research;

To possess: the skills of generalization, analysis, systematization and critical assessment of scientific information, incl. research results; skills in the formation of topics and programs of scientific research; the skills of organizing and conducting independent scientific research; modern methods of scientific research in the subject area; skills of preparation, design and presentation of the research report; scientific discussion skills;

4. The scope of the discipline and types of educational work

The total labor intensity of the discipline is _____ credit units.

Type of educational work		Total hours	Semesters			
Classroom lessons (total)				2		
Including:		-	-	-	-	-
Lectures						
Practical lessons		20		20		
Seminars						
Laboratory works						
Independent work (total)		88		88		
Total labor intensity	hour	108		108		
	credit units	3		3		

5. Discipline content

5.1. Contents of discipline sections

№	The name of the discipline section	Section content (topics)
1.	A short excursion into the history of the Methodology of the Scientific Approach. Proactive approach. Scientific research as a special kind of activity	Objectives. Means and objects of scientific research. Scientific knowledge from the position of an active approach. New paradigms of the scientific approach.
2.	Research types	Types of research (historical, empirical, analytical, theoretical, etc.) The main stages of research. Correlation between a general scientific problem and a specific research topic. The concept of the relevance of the topic. Basic principles and requirements for choosing a research topic. Composition and decomposition of goals and structuring of research objectives. Criteria for evaluating scientific activity
3.	Direction of scientific research and experimental technological work	The focus of research and development work. Planning and business planning of scientific research and experimental and technological works. Scientific forecasting and expected economic efficiency.
4.	Adoption and execution of decisions. Implementation of research results	Adoption and execution of decisions. Implementation of research results
5.	Experiment Methodology	Experiment methodology. Errors. Experimental data processing
6.	Simulation in scientific research	Simulation in scientific research. Familiarization with modern methods

(The content is indicated in didactic units. At the discretion of the developers, the material may not be presented in the form of a table)

5.2. Sections of disciplines and types of classes

№	The name of the discipline section	Lect.	Practical lessons	Lab. exercises	Seminar	ISW	Total hours

1.	A short excursion into the history of the Methodology of the Scientific Approach. Proactive approach. Scientific research as a special kind of activity		3			15	18
2.	Research types		3			15	18
3	Direction of research and development work		3			15	18
4	Adoption and execution of decisions. Implementation of research results		3			15	18
5	Experiment Methodology		4			14	18
6	Simulation in scientific research		4			14	18

6. Laboratory workshop - *not provided*

№	Discipline section number	Name of laboratory work	Labor intensity (hours)
1.			

7. Practical lessons (seminars)

№	Discipline section number	Practical lessons (seminars)	Labor intensity (hours)
1.	1.	Scientific approach methodology. Proactive approach.	1
2.	1.	Types of research. Theoretical and experimental research.	2
3	2	Mathematical modeling of physical processes	3
4	3	Direction of research and development work	3
5	4	Adoption and execution of decisions. Implementation of research results	3
6	5	Experiment Methodology	4
7	6	Simulation in scientific research	4

8. Material and technical support of the discipline:
(describes the material and technical base necessary for the implementation of the educational process in the discipline (module)).

---

9. Information support of the discipline
(the list of information technologies used in the implementation of the educational process by discipline (module) is indicated, including a list of software and information reference systems (if necessary))
a) software Standard software for personal computers
b) ProjectLibre software
c) databases, information and reference and search engines Yandex, Google.

10. Educational and methodological support of the discipline:
(indicates the availability of printed and electronic educational and information resources)
a) main literature

1. Mokiy M. S., Nikiforov A. L., Mokiy V. S.; Pod red. Mokiya M. S. METODOLOGIYA NAUCHNYKH ISSLEDOVANIY. Uchebnik dlya magistratury Nauchnaya shkola: Gosudarstvennyy universitet upravleniya (g. Moskva). S.255. 2017 Grif UMO VO ISBN:978-5-9916-1036-0
2. Rukovodstvo k Svodu znaniy po upravleniyu proyektami (PMBOK), 2012
3. Polkovnikov A.V., Dubovik M.F. Upravleniye proyektami (polnyy kurs MVA). M.: Eksmo, 2011.

4. Upravleniye proyektami: fundamental'nyy kurs: uchebnik / A. V. Aleshin, V.M.An'shin, K. A. Bagrationi i dr. ; pod red. V. M. An'shina, O. N. Il'inoy ; Nats. issled. un-t «Vysshaya shkola ekonomiki». — M.: Izd. dom Vysshey shkoly ekonomiki, 2013.— 620 s.
5. Sosnin, E.A. Upravleniye innovatsionnymi proyektami: Uchebnoye posobiye / E.A. Sosnin. - Rn/D: Feniks, 2013. - 202 c.

b) additional literature

1. Natsional'nyy standart Rossiyskoy Federatsii GOST R 54869-2011 «Proyektnyy menedzhment. Trebovaniya k upravleniyu proyektom»
2. Novikov D.A., Sukhanov A.L. Modeli i mekhanizmy upravleniya nauchnymi proyektami v vuzakh. - M.: Institut upravleniya obrazovaniyem RAO, 2005. - 80 s.
3. Polkovnikov, A.V. Upravleniye proyektami. Polnyy kurs MVA / A.V. Polkovnikov, M.F. Dubovik. - M.: Olimp-Biznes, 2013. - 552 c.
4. N'yuton, R. Upravleniye proyektami ot A do YA / R. N'yuton. - M.: Al'pina Pablisher, 2016. - 180 c.

11. Methodical instructions for students on mastering the discipline (module)

In practical lessons in the discipline, control activities are carried out in order to identify the acquired knowledge, abilities, skills and competencies. As part of independent work, graduate students study the educational and methodological support of the discipline, prepare homework, work on questions and assignments for self-preparation, search and review scientific publications and electronic sources of information. Independent work should be systematic and supervised by the teacher, taken into account by the teacher for the certification.

To improve the quality level of mastering the discipline, a graduate student should prepare for a lecture, since it is the leading form of organizing student education and implements functions that contribute to:

- the formation of the basic concepts of the discipline,
- stimulating interest in the discipline, topics of its study,
- systematization and structuring of the entire body of knowledge in the discipline,
- orientation in the scientific literature, revealing the problems of the discipline.

Preparing for the lecture is as follows:

studying the material of the previous lecture,

analysis of the topic of the upcoming lecture (according to the thematic plan, according to the lecturer's information),

familiarization with educational material on the textbook and teaching aids,

analysis of the place of the studied topic in their professional training,

preparation of questions that can be asked to the lecturer at the lecture.

Preparing for the practical exercises:

familiarization with the plan of the practical lesson: first with the main questions, then with the questions for discussion, assessment of the scope of the assignment;

studying the lecture notes on the topic of the practical lesson, highlighting the material necessary to study the questions posed;

familiarization with the recommended basic and additional literature on the topic, new publications in periodicals;

highlighting the basic concepts of the topic being studied, the possession of which contributes to the effective development of the discipline;

preparation of abstracts or mini-abstracts that can be used in public speaking in class.

The work program of the discipline in terms of goals, the list of knowledge, skills, terms and educational issues can be used by you as a guide in the organization of training.

Preparing for the test. It is necessary to prepare for the test purposefully, regularly, systematically and from the first days of training in this discipline. At the very beginning of the study

of the discipline, the graduate student gets acquainted with the program for the discipline, the list of knowledge and skills that the graduate student must possess, control activities, a textbook, textbooks for the discipline being studied, electronic resources, and a list of questions for credit.

The systematic implementation of educational work in lectures, practical classes and classes will allow you to successfully master the discipline and create a good base for passing the test.

Postgraduate students are required to attend classes, complete assignments of the head of the discipline, get acquainted with the recommended literature and prepare an essay for a round table (the choice of the topic of the essay is carried out in agreement with the head of the discipline and the supervisor). Postgraduate students carry out projects, creative tasks for independent work, taking into account the profile of the disciplines that they will implement in the process of industrial practice. The results of completing tasks for independent work are assessed on the basis of a point-rating assessment and are reflected in the educational route of the graduate student. When certifying a graduate student, the quality of work in the classroom is assessed (the ability to conduct a scientific discussion, the ability to clearly and succinctly formulate one's thoughts), the level of preparation for independent research activities of a specialist in the field of pedagogy of higher education, the history of pedagogy and education, the quality of assignments (presentations, reports , analytical notes, etc.).

12. Fund of assessment tools for intermediate certification of students by discipline (module)

<table>
<tr><th>PRS points</th><th>Traditional assessments</th><th>Points to translate grades</th><th>Grades</th><th>ECTS grades</th></tr>
<tr><td>95-100</td><td rowspan="2">5</td><td>95-100</td><td>5 +</td><td>A</td></tr>
<tr><td>86-94</td><td>86-94</td><td>5</td><td>B</td></tr>
<tr><td>69-85</td><td>4</td><td>69-85</td><td>4</td><td>C</td></tr>
<tr><td>61-68</td><td rowspan="4">3</td><td>61-68</td><td>3+</td><td>D</td></tr>
<tr><td>51-60</td><td>51-60</td><td>3</td><td>E</td></tr>
<tr><td>31-50</td><td rowspan="2">2</td><td>31-50</td><td>2+</td><td>FX</td></tr>
<tr><td>0-30</td><td>0-30</td><td>2</td><td>F</td></tr>
<tr><td></td><td>Passed</td><td></td><td>Passed</td><td>Passed</td></tr>
</table>

Explanation of the grading table:

Description of ECTS grades

A	***"Excellent"*** the theoretical content of the course has been mastered completely, without gaps, the necessary practical skills for working with the acquired material have been formed, all the educational tasks provided for by the training program have been completed, the quality of their implementation was assessed by the number of points close to the maximum.
B	***"Very well"*** the theoretical content of the course is mastered completely, without gaps, the necessary practical skills to work with the acquired material are basically formed, all the educational tasks provided for by the training program have been completed, the quality of most of them is assessed by the number of points close to the maximum.
C	***"Good"*** theoretical content of the course is mastered completely, without gaps, some practical skills of working with the material learned are not sufficiently formed, all study assignments provided for by the curriculum have been completed, the quality of performance of none of them was not assessed with the minimum number of points, some types of tasks were completed with errors.
D	***"Satisfactory"*** theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills to work with the acquired material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks may contain errors.

E	***"Mediocre"*** theoretical content of the course has been mastered partially, some practical skills have not been formed, many of the educational tasks provided for by the training program have not been completed, or the quality of some of them is estimated by the number of points close to the minimum.

The program was drawn up in accordance with the requirements of the HEC of the PFUR University

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