

## **THE WORKING PROGRAM OF THE DISCIPLINE**

**Name of the discipline** Methodology of Scientific Research

**Recommended for the direction of training / specialty**

08.06.01 Engineering and construction technologies

*(the code and name of the direction of training / specialty are indicated)*

**Focus of the program (profile)**

05.23.15 Structural mechanics (implemented in English)

*(name of the educational program in accordance with the direction (profile))*

## 1. Purposes and objectives of the discipline:

**The purpose** of the discipline "Methodology of Scientific Research" is to acquire knowledge, skills, skills and experience in the field of solving scientific and technical problems in construction, taking into account and using modern materials and technologies that characterize the stages of the formation of competencies and ensure the achievement of the planned development results.

The main **objectives** of the discipline are:

- development of innovative materials, technologies, structures and systems, including using scientific achievements;
- organization and improvement of the production process at an enterprise or site, control over the observance of technological discipline, maintenance of technological equipment and machines;
- mathematical modeling of processes in structures and systems, computer methods for the implementation of models, development of calculation methods and design automation tools;
- setting up and conducting experiments, metrological support, collection, processing and analysis of results, identification of theory and experiment;
- presentation of the results of the work performed, the organization of the implementation of research results and practical developments;
- assessment of the technical condition of buildings, structures, their parts and engineering equipment, development of expert opinions.

## 2. Place of discipline in the structure of EP HE:

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 No. 1

### Prior and subsequent disciplines aimed at the formation of competencies

№	Code and name of competence	Prior disciplines	Subsequent disciplines (groups of disciplines)
General cultural competences			
General professional competencies			
	GPC-1	-	Advanced Structural Mechanics. Technology and Organization of Construction. Analysis and Design of Structural Systems. Building designs, buildings and constructions: the theory of buildings and structures Scientific Research. State Exam. PhD Qualification Thesis and Presentation.
	GPC-2	-	Advanced Structural Mechanics. Technology and Organization of Construction. Analysis and Design of Structural Systems. Building designs, buildings and constructions: the theory of buildings and structures Scientific Research.

			Scientific Research 2. State Exam. PhD Qualification Thesis and Presentation.
	GPC-3		Scientific Research. Scientific Research 2. State Exam. PhD Qualification Thesis and Presentation.
	GPC-4		Practice in Obtaining Professional Skills and Professional Experience (Research Practice). Scientific Research. State Exam. PhD Qualification Thesis and Presentation.
Professional competencies (type of professional activity – structural mechanics)			
	PC-1		Scientific Seminar Technology and Organization of Construction. Analysis and Design of Structural Systems. Building designs, buildings and constructions: the theory of buildings and structures Practice in Obtaining Professional Skills and Professional Experience (Research Practice). Scientific Research. Scientific Research 2. State Exam. PhD Qualification Thesis and Presentation.
Professional specialized competencies			

### 3. Requirements for the results of mastering the discipline:

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

GPC-1 - possession of the methodology of theoretical and experimental research in the field of construction;

GPC-2 - possession of the culture of scientific research in the field of construction, including the use of the latest information and communication technologies;

GPC-3 - the ability to comply with the norms of scientific ethics and copyright;

GPC-4 - the ability to professionally operate modern research equipment and instruments;

PC-1 - possession of methods for the development of scientific and methodological foundations of research, improvement, theoretical, experimental and feasibility study of the use of various technical solutions and technologies in construction.

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

#### **Know:**

- features of scientific and technical problems in construction;

- patterns and features of its organization;
- requirements for products and quality of information support for construction services, methods of providing it;
- principles of methodological support of research work;
- operating principles of modern research equipment and instruments;
- basic principles and methods of development of scientific and methodological foundations of research, improvement, theoretical, experimental and feasibility study of the application of various technical solutions.

**Be able to:**

- use the methods of scientific research in construction; to use scientific and technical technologies in scientific research;
- use information technology in research activities;
- use information technology of entrepreneurial activity;
- carry out experimental and theoretical research using modern research equipment and instruments;
- the use of the basic principles and methods of theoretical, experimental and feasibility studies of various technical solutions in construction.

**Possess:**

- the skills of scientific and technical support of construction enterprises; organization of meeting the needs of construction;
- the skills of organizing research work in construction;
- the ability to assess the correctness of the calculation results;
- performing an experimental and feasibility study of various technical solutions and technologies in construction.

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

The total workload of the discipline is 2 credit units.

Type of educational work		Total hours	Semesters			
			1	2		
<b>Classroom lessons (total)</b>			18	18		
Including:		-	-	-	-	-
<i>Lectures</i>		12	6	6		
<i>Practical lessons (PL)</i>		24	12	12		
<i>Seminars (S)</i>		0	0	0		
<i>Laboratory work (LW)</i>		0	0	0		
<b>Independent work (total)</b>		36	18	18		
Total labor intensity	hours	72	36	36		
	credits	2	1	1		

**5. Discipline content**

**5.1. Contents of discipline sections**

№	The name of the discipline section	Section content (topics)
1.	<b>Theoretical research</b>	Topic 1.1. Science as a continuously developing system of knowledge of the objective laws of nature, society and thinking. The purpose of science. Scientific research. Research objectives. Topic 1.2. Fundamentals of scientific research methodology. Theoretical research. Applied research. Technical and

		technological development. The purpose of the development. Topic 1.3. Scientific and technical information. Scientific direction. Scientific problem. Problem formulation and hypothesis. Scientific theme.
2.	<b>Planning experiments and observations</b>	Topic 2.1. Fundamentals of experimental research methodology. Goals and objectives of experimental research. Experiment planning. Planning matrix. Topic 2.2. Random balance method. Random balance method. Construction of interpolation models. Process optimization (planning extreme experiments). Regression analysis. Factorial experiment.
3.	<b>Experimental research</b>	Topic 3.1. Natural experiments. Artificial experiments. Computational experiments. Laboratory experiment. Natural experiment. Research (search) experiment. Confirmatory experiment. Topic 3.2. Method design and equipment selection. Preparation of samples and elements. Developing a plan for controlling variables. Topic 3.3. Carrying out an experiment. Processing and interpretation of results. Preparation of a scientific report.
4.	<b>Processing and analysis of research results</b>	Topic 4.1. Comparison of the results of theoretical and experimental studies. Matching criteria. Criteria for the adequacy of theoretical relationships to experimental ones. Topic 4.2. Mathematical processing of experimental data. Analysis of the results of experimental studies. Topic 4.3. Preparation of research results for publication and scientific periodicals. Scientific and technical report. Abstract.

## 5.2. Sections of disciplines and types of classes

№	The name of the discipline section	Lekts.	Practical lessons	Lab. lessons	Semin.	IWS	Total hour.
1.	<b>Theoretical research</b>	3	6	0	0	9	18
2.	<b>Planning experiments and observations</b>	3	6	0	0	9	18
3.	<b>Experimental research</b>	3	6	0	0	9	18
4.	<b>Processing and analysis of research results</b>	3	6	0	0	9	18

## 6. Laboratory workshop

*No laboratory workshop provided*

## 7. Practical lessons

№	Discipline section number	Practical lessons topics	Labor capacity (hour.)
1.	<b>1</b>	Scientific research. Research objectives. Fundamentals of scientific research methodology. Theoretical research. Applied research. Technical and technological development. The purpose of the development. Scientific and technical information. Scientific direction. Scientific problem. Problem formulation and hypothesis.	6

		Scientific theme.	
2.	2	Fundamentals of experimental research methodology. Goals and objectives of experimental research. Experiment planning. Planning matrix. Random balance method. Random balance method. Construction of interpolation models. Process optimization (planning extreme experiments). Regression analysis. Factorial experiment.	6
3.	3	Natural experiments. Artificial experiments. Computational experiments. Laboratory experiment. Natural experiment. Research (search) experiment. Confirmatory experiment. Method design and equipment selection. Preparation of samples and elements. Developing a plan for controlling variables. Carrying out an experiment. Processing and interpretation of results. Preparation of a scientific report.	6
4.	4	Comparison of the results of theoretical and experimental studies. Matching criteria. Criteria for the adequacy of theoretical relationships to experimental ones. Mathematical processing of experimental data. Analysis of the results of experimental studies. Preparation of research results for publication and scientific periodicals. Scientific and technical report. Abstract.	6

## 8. Material and technical support of the discipline

Classroom for practical and lecture classes -Computer class (room 357) for 12 seats with an interactive whiteboard SMARTBoard 690 and a multimedia video projector. Auditorium 340 for 80 seats with a screen and a video projector; a set of slides, control tests, scripts for conducting classes using interactive forms of organizing the educational process, selection of tasks for current control.

## 9. Information support of the discipline

- a) software - specialized software is not provided.
- b) databases, information and reference and search systems:
  - 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 abstract database <http://www.elsevierscience.ru/products/scopus/>
  - Electronic library system RUDN - EBS RUDN <http://lib.rudn.ru/MegaPro/Web>
  - EBS "University Library Online" <http://www.biblioclub.ru>
  - EBS Yurayt <http://www.biblio-online.ru>
  - EBS "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)
  - EBS "Doe" <http://e.lanbook.com/>
  - Archi.RU: Portal "Architecture of Russia".
  - Architector.RU: Information and reference site - a systematic presentation of information about building materials, products and problems of modern architecture, Russia.
  - Search system "Yandex", SPS "StroyKonsultant", Information and reference system "ZODCHIY" Version 9.01.

## 10. Educational and methodological support of the discipline:

- a) Main literature:

1. Svintsov A.P. Methods for solving scientific and technical problems in construction: Educational and methodological complex. M. Publishing house of RUDN. 2018. - 101 p.
2. Kashirin V.P. Theory of scientific research / V.P. Kashirin. –Krasnoyarsk: Krasnoyarsk state. agrarian un-t, 2007. - 184 p.
3. Sidnyaev N.I. Theory of experiment planning and analysis of statistical data / N.I. Sidnyaev. - M.: Yurayt, 2011. - 399 p.

б) Additional literature:

1. Planning an experiment in examples and calculations. / NI Bogdanovich and others; - Arkhangelsk: Northern (Arctic) Federal University, 2010. - 126 p.
2. Rykov VV Mathematical statistics and planning of experiment-M.: MAKS Press, 2010. - 303 p.
3. Kim EN Planning and organization of the experiment. / E. N. Kim, E. P. Lapteva-Vladivostok: Dalrybvtuz, 2009. - 188 p.
4. Rozhkov NF - Planning and organization of the measuring experiment. / N.F. Rozhkov. - Omsk: Publishing house of OmSTU, 2009. - 106 p.

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

Methodological instructions for mastering the discipline are contained in the book: A.P. Svintsov. Methods for solving scientific and technical problems in construction: Educational and methodological complex. M. Publishing house of RUDN. 2018. - 101 p.

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

The fund of assessment tools, formed for the current monitoring of progress and intermediate certification of students in the discipline "Methodology of Scientific Research" is presented in Appendix 1 to the work program of the discipline and includes:


- a list of competencies with an indication of the stages of their formation in the process of mastering the educational program;
- description of indicators and criteria for assessing competencies at various stages of their formation, description of assessment scales;
- typical control tasks or other materials necessary to assess knowledge, skills, skills and (or) experience of activity, characterizing the stages of the formation of competencies in the process of mastering the educational program;
- methodological materials defining the procedures for assessing knowledge, skills, skills and (or) experience of activities, characterizing the stages of the formation of competencies.

Current control, intermediate and final certifications are carried out on the basis of a point-rating system for assessing knowledge.

The program has been drawn up in accordance with the requirements of the ES HE RUDN University.

#### Developers:


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