

**THE WORKING PROGRAM OF THE DISCIPLINE**

**Name of the discipline** Problem solving techniques in Civil Engineering

**Recommended for educational field:** 08.04.01 Civil Engineering

**Specialization (profile):** Civil Engineering and Built Environment ,

Mechanics of materials and engineering structures,

Built environment of smart city

## 1. Goals and objectives of the discipline:

**The purpose** of mastering the discipline "Problem solving techniques in Civil Engineering" / "Methods for solving scientific and engineering problems in construction" is the acquisition of knowledge, skills and experience in the field of scientific and technical tasks in construction with modern materials and technologies that characterize the stages of formation of competences and providing the achievement of the planned results of mastering the educational program.

**The main objectives** of the discipline " Methods for Solving Scientific and Engineering Problems in Civil Engineering " / "Problem solving techniques in Civil Engineering " are: development of innovative materials, technologies, structures and systems, including the use of scientific achievements; organization and improvement of the production process at the enterprise or site, control over compliance with technological discipline, maintenance of technological equipment and machines; mathematical modeling of processes in structures and systems, computer methods for implementing models, development of computational 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, organization of the implementation of the results of research 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 VO:

The discipline "Methods for Solving Scientific and Engineering Problems in Civil Engineering" / "Methods for solving scientific and technical problems in construction" refers to the basic part 1 of the curriculum. Its study is based on the material of previous disciplines, and it is also the basis for the study of subsequent disciplines of the curriculum, the list of which is presented in table 1.

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

No	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
General cultural competences			
	GC-3, GC-6,	Matrix Algebra & Basic Mathematics courses	Mathematical Modelling /
General professional competencies			
	GPC-4, GPC-5, GPC-6, GPC-7	Since this course is a Masters level course, it is expected that the students should be exposed to Structural Analysis, Matrix Algebra & Basic Mathematics courses	Mathematical Modelling /
		Basics of Linear Algebra; Introductory calculus (differentiation, integration, differential equations); Computer aided design; Engineering statics	Design in Reinforced Concrete

			Linear Theory of Elasticity
Professional competencies (type of professional activity of a civil engineer)			
	PC-16	Basic knowledge of linear algebra (matrix analysis) is necessary for this course	Finite Element Method for Civil Infrastructure
Vocational Competencies of Specialization Structural mechanics			

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

*GC-3 is able to organize and direct the work of the team, developing a team strategy to achieve the goal*

*GC-4 is able to use modern communication technologies, including in a foreign language, for academic and professional interaction*

*GPC-4 is able to use and develop design and administrative documentation, as well as participate in the development of regulatory legal acts in the construction industry and housing and communal services*

*GPC-5 is able to conduct and organize design and survey work in the field of construction and housing and communal services, to carry out technical expertise of projects and author supervision of their compliance*

*GPC-6 is capable of carrying out research of objects and processes in the field of construction and housing and communal services*

*GPC-7 is able to manage an organization operating in the construction industry and housing and communal services, organize and optimize its production activities*

*PC-16 Organizational and pedagogical support of students*

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

#### **Know:**

- in the field of methods of mathematical analysis.
- know the state standards and be able to use them.
- basic methods of calculation and design of building structures.
- know the main theoretical provisions of the discipline:
- requirements for products and quality of information and theoretical support of the calculation base.
- knowledge of specialized software and computing systems.

#### **Be able to:**

- use modern information technologies.
- be able to use the appropriate computer developments.
- use modern software and computing systems for the calculation of building structures.
- use information technology to solve specific tasks.

- use information technology to solve specific tasks;
- use information technology in professional activities

#### **.Own:**

- application of theoretical knowledge in practice.
- search for the necessary information.
- use of the latest automated projecting systems.
- use of information support in the calculation of structures and structures.
- organization of high-quality calculation of structures and structures.
- search for new software and computing systems to solve the tasks.

#### 4. Scope of discipline and types of educational work

The total workload of the discipline is 4 credit units.

Type of educational work	Total hours	Semesters			
		3			
<b>Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). lessons (total)</b>	36	36			
Including:	-	-	-	-	-
<i>Lectures</i>					
<i>Practical lessons (PL)</i>	54	54			
<i>Seminars (S)</i>	-	-			
<i>Laboratory work (LW)</i>	-	-			
<b>Independent work (total)</b>	18	ЭК-за-мех			
hour	Total labor intensity	108	108		
	cred-its	3	3		

#### 5. Content of the discipline

##### 5.1. Contents of discipline sections

№	The name of the discipline section	Section content (topics)
1.	<b>Introduction</b>	Topic 1.1 Science as a continuously evolving system of knowledge of objective laws of nature, society and thinking. The goal of science. Scientific research. Purposes of scientific research. The theoretical studies.
		Topic 1.2 Applied research. Technical and technological development. The purpose of development. Scientific and technical information. The scientific direction. The scientific problem. The wording of the problem and making hypotheses. Scientific theme.
2.	<b>Experimental studies</b>	Topic 2.1 The basics of methodology of experimental studies. Natural experiments. Artificial experiments. The computational experiments. Laboratory experiment
		Topic 2.2 Full-scale experiment. Research (search) experiment. The goals and objectives of experimental research. Experiment planning. The planning matrix. Regression analysis. factorial experiment.
3.	<b>Development of technical and technological solutions scientific and technical problems.</b>	Topic 3.1 Copyright. Patent law. The invention. Useful model. An industrial design. Application for intellectual property object. Methods of preparing the patent application. A patent search
		Topic 3.2 Selection of unique. Criticism of peers. Selection of the prototype. Criticism of the prototype. Drawing description.

4.	<b>Processing and analysis of research results</b>	Comparison of results of theoretical and experimental studies. The matching criteria. Criteria of adequacy of theoretical and experimental dependencies.
		Topic 4.2 Mathematical processing of experimental data. Analysis of experimental results. Preparation of research results for publication and scientific periodicals. Scientific report. Abstract. Dissertation.

## 5.2. Sections of disciplines and types of classes

No.	Discipline section No.	Lectures.	Practice	Lab. works	Seminars	Independent work of students	Total hour.
1.	<b>Introduction</b>	4	8	0	0	14	26
2.	<b>Experimental studies</b>	4	10	0	0	14	28
3.	<b>Development of technical and technological solutions scientific and technical problems</b>	4	8	0	0	14	28
4.	<b>Processing and analysis of research results</b>	4	8	0	0	14	28

## 6. Laboratory workshop

No laboratory workshop provided.

## 7. Practical exercises (seminars)

No.	Discipline section No.	Subjects of practical classes (seminars)	Labor capacity (hour.)
1.	<b>Introduction</b>	Science as a continuously evolving system of knowledge of objective laws of nature, society and thinking. The goal of science. Scientific research. Purposes of scientific research. The theoretical studies. Applied research. Technical and technological development. The purpose of development. Scientific and technical information. The scientific direction. The scientific problem. The wording of the problem and making hypotheses. Scientific theme.	
2.	<b>Experimental studies</b>	The basics of methodology of experimental studies. Natural experiments. Artificial experiments. The computational experiments. Laboratory experiment. Full-scale experiment. Research (search) experiment. The goals and objectives of experimental research. Experiment planning. The planning matrix. Regression analysis. factorial experiment.	
3.	<b>Development of technical and</b>	Copyright. Patent law. The invention. Useful model. An industrial design. Application for intellectual property object. Methods of preparing the patent application. A patent search Selection of unique. Criticism of peers. Selection of the prototype. Criticism of the prototype. Drawing description.	

	<b>technological solutions scientific and technical problems</b>		
4.	<b>Processing and analysis of research results</b>	Comparison of results of theoretical and experimental studies. The matching criteria. Criteria of adequacy of theoretical and experimental dependencies. Mathematical processing of experimental data. Analysis of experimental results. Preparation of research results for publication and scientific periodicals. Scientific report. Abstract. Dissertation.	

### 8. Material and technical support of the discipline:

<b>Auditorium with a list of logistics</b>	<b>Location</b>
<b>Lecture room</b> - Specialized room number 298 - "Modeling of large-span building structures" Equipment and furniture: - a set of specialized furniture; - chalk board; - projection screen; - multimedia projector EPSON EMP-X5.	Moscow, st. Ordzhonikidze, 3
Classroom for independent work-Computer class No. 352 A set of specialized furniture; technical means: PolyVision Webster TSL 610 interactive whiteboard, Toshiba TLP XC3000 multimedia projector, Draper Luma 178x178 roll-up wall screen, Pirit Codex 1226 computer - 1 pc., GENIUS SP-i350 sound amplification equipment-1 pc., Xerox 3125-1 pc. printer, Epson 10V Photo scanner-1 pc., HP DesignJet 130+ NR (A1) plotter-1 pc., Pirit Doctrina computers-9 pcs., ViewSonic 22" LCD monitor VA2216w-9 pcs., 19" NEC monitor-1 pc., chalk board. Plaxis 2D Suit (Network license). Plaxis Professional (version 8) + Plaxis Dynamics Modul + PlaxFlow (version 1) - Education, 25 seats-registration number 90-07-019-00261-3 (2008), Abaqus, 20 seats-registration number 90-07-019-00317-7 (2010), MS-office corporate. (RUDN Software) - Registration Code: 86626883 Parent Program: 86493330 Status: Active	Moscow, st. Ordzhonikidze, 3

### 9. Information support of the discipline

Resources of the Internet information and telecommunications network»:

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

-EBS RUDN Electronic Library System – 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/>

2. Websites of ministries, departments, services, industrial enterprises and companies whose activities are specialized for this discipline:

- Website of the Ministry of Construction and Housing and Communal Services Russian Federation <http://www.minstroyrf.ru/>

### 3. Databases and search engines:

- electronic fund of legal and regulatory and technical documentation

<http://docs.cntd.ru/>

search engine Yandex <https://www.yandex.ru/>

- Google search engine <https://www.google.ru/>

- bibliographic database SCOPUS

<http://www.elsevierscience.ru/products/scopus/>

Construction Internet resources (foreign):

1. Arcat.Com: Architectural information on building materials, manufacturers, specifications, BIM modules and CAD primitives, USA. 2. ArchiBase.Net: Architectural Community. GDL objects, high-quality textures, and artwork from all over the world.

3. Bau-Center.Com: German construction portal "Euronewspaper".

4. BuilderCentral.Com: A comprehensive guide to the builder and designer, USA.

5. BuilderConstructor.com: Directory for builders and designers, USA.

6. BuildingOnLine.Com: Portal construction industry on the Internet, USA.

7. ConstructionEducation.Com: International Portal for Education in Construction, USA.

8. ENR.Construction.Com: The Construction Industry Bible: news and characteristics of projects, materials in construction, architecture, engineering. USA.

9. GreatPossibilities.Com: Construction Industry Catalog and Classifier, USA.

10. Jet-Grouting.Com: Portal-forum for builders and designers "Jet-Grouting".

11. PlanningPlanet.Com: Resource for specialists in planning and design management, Online Forums (USA).

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

Main literature:

1. Kennett B. Planning and Managing Scientific Research [Electronic resource] 2014. 1 p. ISBN 9781925021585

URL: <http://www.oapen.org/download/?type=document&docid=477381>

Additional literature:

1. Thompson, C. Bertrand. The theory and practice of scientific management / by

C. Bertrand Thompson [Electronic resource] 319 p. URL:

<http://dlib.rsl.ru/rsl0100400000/rsl01004440000/rsl01004440823/rsl01004440823.pdf>

2. H. Morrow, Richard, G. Smith, Peter, A. Ross, David. Methods of analysis

[Electronic resource] 2015. 1 p. ISBN 9780198732860

URL: <http://www.oapen.org/view?docId=1000074.nxml>

3. Brugnano L., Iavernaro F. Advanced Numerical Methods in Applied Sciences

[Electronic resource] 2019. 1 p. ISBN 9783038976660

URL: <https://mdpi.com/books/pdfview/book/1360>

4. H. Morrow, Richard, G. Smith, Peter, A. Ross, David. Field laboratory methods [Electronic resource] 2015. 1 p. ISBN 9780198732860

URL: <http://www.oapen.org/view?docId=1000078.nxml>

5. Jevons W. S. The principles of science :. a treat on logic and scientific

method / by W. Stanley Jevons [Electronic resource]. - London : Macmillan, 1879. URL:

<http://dlib.rsl.ru/rsl0100400000/rsl01004427000/rsl01004427845/rsl01004427845.pdf>

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

Methodological guidelines for students on the development of the discipline (module)

Lectures are delivered in classrooms equipped with technical training facilities and video projectors. Lectures should be presented in the form of PowerPoint presentations.

Laboratory work is carried out in a laboratory fully equipped for laboratory work.

Practical classes are held in classrooms equipped with technical training facilities. Practical tasks are analyzed, as well as examples of solving computational and graphical tasks.

Control measures consist of two control works (for 2 ak. one hour each), exam at the end of the semester.

Methodological recommendations for the student are posted in the TUIS.

### **12. Fund of assessment tools for intermediate certification of students in the discipline (module)**

Materials for assessing the level of mastering the educational material of the discipline "Problem solving techniques in Civil Engineering", including a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of the 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 that determine the procedures for assessing knowledge, skills, skills and (or) experience of activities that characterize the stages of the formation of competencies are developed in full and are available for students on the discipline page in TUIS RUDN.

The program is compiled in accordance with the requirements of the ES HE in the RUDN.

Developer:

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