

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

**Name of the discipline** Linear Theory of Elasticity

**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 Linear Theory of Elasticity is to gain knowledge, skills and experience in the field of design of structures and structures that characterize the stages of competence formation and ensure the achievement of the planned results of the development of the educational program.

The main objectives of the discipline are:

Linear Theory of Elasticity is an experimental and theoretical science, where experimental data and theoretical research are widely used.

Various structures and structures, the design and construction of which the engineer is engaged in, must necessarily have strength, that is, the ability to resist destruction under the influence of external loads applied to them, rigidity, that is, the ability to resist deformation, and stability – the ability of the structure to maintain one form of balance. The objectives of the discipline are to teach the student to solve these three types of problems.

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

The discipline " Linear Theory of Elasticity " refers to the variable part of Block 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, a list of which is presented in table 1.

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

№	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
General cultural competences			
General professional competencies			
	GPC-1	Structural Dynamics Mechanics Mechanics of Composite Materials	Independent Research Work Modeling of construction processes
		Methods for Solving Scientific and Engineering Problems in Civil Engineering	Advanced Composite Materials
Professional competencies			
	PC-1 PC-2 PC-11	Computational methods and computer modeling in scientific research	Project Management (advanced)
		Design in Reinforced Concrete	Nonlinear Structural Mechanics
		Linear Theory of Elasticity	Diploma practice
Vocational Competencies of Specialization Structural mechanics			

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

*GPC-1- Able to solve problems of professional activity based on the use of theoretical and practical foundations, the mathematical apparatus of the fundamental sciences*

*PC-1- Conducting applied research in the field of engineering design for urban planning activities*

*PC-2- Development of design products based on the results of engineering design for urban planning activities*

*PC-11- Preparation of a section of design documentation for metal structures of buildings and structures*

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

**Know:**

- know the approach to solving specific tasks for commissioning, testing and commissioning of facilities,
- know engineering disciplines aimed at practical application,
- know the main theoretical provisions of the discipline: be able to apply the basic methods of mathematical analysis.

**Be able to:**

- use the accumulated knowledge to evaluate natural and natural – man made objects, determine the initial data for design and calculation justification,
- ability to use specialized software and computing systems,
- ability to use specialized software and computing systems.

**Own:**

- work with project documentation, the ability to search for the achievement of tasks,
- organization of high-quality calculation structures and structures.
- skills in using the relevant normative literature.

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

The total workload of the discipline is 3 credit units.

Type of educational work	Total hours	Semesters			
		1			
<b>Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). lessons (total)</b>	44	44			
Including:	-	-	-	-	-
<i>Lectures</i>	14	14			
<i>Practical lessons (PL)</i>	16	16			
<i>Seminars (S)</i>	14	14			
<i>Laboratory work (LW)</i>	-	-			
<b>Independent work (total)</b>	84	84			
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.	Section No 1. Equilibrium equations	Topic 1.1. The main hypotheses of the theory of elasticity. Equations of equilibrium in a

		rectangular coordinate system Topic 1.2. Equilibrium equations in the polar coordinate system. Boundary conditions. trajectory of a refractive Brachistochrone problem. Models based on the principle of least action and the principle of equilibrium.
2.	Section No 2. Solving problems of the theory of elasticity in displacements and stresses.	Topic 2.1 Theory of deformations. Equations of continuity of deformations. Topic 2.2 The relationship between stresses and deformations. c
3.	Section No. 3 Plane problem of elasticity theory.	Topic 3.1 Flat problem in a rectangular coordinate system. Topic 3.2 Plane problem in the polar coordinate System Topic 3.3 Calculation equations for calculation in stresses and deformations.
4.	Section No. 4 Solving problems of the theory of elasticity.	Topic 4.1 Solving problems in a rectangular coordinate system. Topic 4.2 Solving problems in the polar coordinate system.
5.	Section No. 5. Plate bending theory	Topic 5.1 Derivation of the Sophie Germain equation for a thin plate. Topic 5.2 Calculation of rectangular plates. Topic 5.3 Calculation of round plates.

## 5.2. Sections of disciplines and types of classes

No	Discipline section No.	Lectures.	Practice	Lab. works	Independent work of students	Total hour
1.	Topic 1.1. The main hypotheses of the theory of elasticity. Equations of equilibrium in a rectangular coordinate system	1.5	1	1.5	3	7
2.	Topic 1.2. Equilibrium equations in the polar coordinate system. Boundary conditions.	1.5	2	1.5	2	7
3.	Topic 2.1 Theory of deformations. Equations of continuity of deformations.	1	1	1	2	5
4.	Topic 2.3 Solving basic differential equations.	1	1	1	2	5
5.	Topic 3.1 Flat problem in a rectangular coordinate system.	1	1	1	2	5
6.	Topic 3.2 Plane problem in the polar coordinate system	1	1	1	2	5
7.	Topic 3.3 Calculation equations for calculation in stresses and deformations.	1	1	1	2	5

8.	Topic 4.1 Solving problems in a rectangular coordinate system.	1	2	1	3	7
9.	Topic 4.2 Solving problems in the polar coordinate system.	1	1	1	3	6
10.	Topic 5.1 Derivation of the Sophie Germain equation for a thin plate.	1	2	1	2	5
11.	Topic 5.2 Calculation of rectangular plates.	1	1	1	2	5
12.	Topic 5.3 Calculation of round plates.	1	1	1	1	5

## 6. Laboratory workshop

No laboratory workshop provided.

## 7. Educational, methodological, and informational support of the discipline

Basic literature:

1. Timoshenko, Stephen P. Applied elasticity. Механические свойства материалов / By S. Timoshenko a. J. M. Lessells [Электронный ресурс]. - East Pittsburg (Pa.) : Westinghouse techn. night school press, 1925. URL:

<http://dlib.rsl.ru/rsl01004000000/rsl01004424000/rsl01004424424/rsl01004424424.pdf>

2. Kelvin W. T., Larmor J. Mathematical and physical papers Vol. 3: Elasticity, heat, electromagnetism. [Электронный ресурс]. - Cambridge : Univ. press, 1890. URL:

<http://dlib.rsl.ru/rsl01004000000/rsl01004430000/rsl01004430384/>

3. Styffe K. The elasticity, extensibility, and tensile strength of iron and steel :. with 9 lithographic plates / by Knut Styffe : translated from the Swedish, with an original appendix by Christer P. Sandberg : with a preface by John Percy [Электронный ресурс] 1869. 171 с. URL:

<http://dlib.rsl.ru/rsl01004000000/rsl01004449000/rsl01004449554/rsl01004449554.pdf>

Additional literature:

1. Goodwin Jim W., Hughes Roy W. Elasticity: High Deborah number measurements [Электронный ресурс] // Rheology for Chemists: An Introduction. 2000. ISBN 0-85404-616-X DOI: <http://dx.doi.org/10.1039/9781847551832-00015>

2. The Effects of Dough Mixing on GMP Reaggregation and Dough Elasticity During Dough Rest [Электронный ресурс] / Don C. [и др.]. // The Gluten Proteins. 2004. ISBN 978-0-85404-633-1 DOI: <http://dx.doi.org/10.1039/9781847552099-00223>

3. Hinchliffe A., Springborg Michael. Density functional theory [Электронный ресурс] // Chemical Modelling: Applications and Theory. 2002. №2. ISBN 0-85404-259-8 DOI: <http://dx.doi.org/10.1039/9781847553324-00096>

4. Laura E. Joyce. Luminol Theory [Электронный ресурс] 2017. 1 с. ISBN 9781947447127 URL:

[https://www.dropbox.com/s/s3bi27drvnkmkhy/Joyce\\_Luminol\\_Theory\\_Ebook.pdf?dl=0](https://www.dropbox.com/s/s3bi27drvnkmkhy/Joyce_Luminol_Theory_Ebook.pdf?dl=0)

1. EBS RUDN and third-party EBS, to which university students have access based on concluded contracts:

- Electronic library system of 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/>

## 2. Databases and search engines:

- electronic fund of legal and regulatory and 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/>

## 7. Practical exercises (seminars)

No.	Discipline section No.	Subjects of practical classes (seminars)	Labor capacity (hour.)
1.	Section 1.. Equilibrium equations	Topic 1.1. The main hypotheses of the theory of elasticity. Equations of equilibrium in a rectangular coordinate system	7
2.		Topic 1.2. Equilibrium equations in the polar coordinate system. Boundary conditions.	7
3.	Section 2	Topic 2.1. Theory of deformations. Equations of continuity of deformations.	5
4.		Topic 2.2. The relationship between stresses and deformations.	5
5.		Topic 2.3. Solving basic differential equations.	
6.	Section 3 Plane problem of elasticity theory	Topic 3.1.2D problem in a rectangular coordinate system.	5
7.		Topic 3.2. 2D problem in the polar coordinate system	5
8.		Topic 3.3. Calculation equations for the calculation of stresses and deformations.	5
9.	Section 4 Solving problems of the theory of elasticity.	Topic 4.1 Solving problems in a rectangular the coordinate system.	7
		Topic 4.2. Solving problems in the polar coordinate system.	6
10.	Section 5 The-ory of plate bending.	Topic 5.1. Derivation of the Sophie Germain equation	5
		Topic 5.2 Calculation of rectangular plates.	5
		Topic 5.3 Calculation of round plates.	5

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

Auditorium with a list of logistics	Location
Computer class No. 303 Set of specialized furniture: chalkboard, interactive whiteboard, system board unit P430. 0/i945/2G10/ SATA11/256Mb/FDD/KB+M - 14 pcs, Samsung 19”TFT 2x1.5W monitor-14 pcs, DesignJet 430 plotter (A1.4 Mb inkjet plotter). MS-office corporate, Registration Code: 86626883 Parent program: 86493330 Status: Active . (RUDN Software)	Moscow, st. Ordzhonikidze, 3

## 9. Information support of the discipline

a) Specialized software for conducting lectures and practical classes and independent work of students:  
 - MS-Office corporate, Registration Code: 86626883  
 Parent program: 86493330  
 Status: Active .  
 (RUDN Software)

Parent program: 86493330  
 Status: Active .  
 (RUDN Software)

b) databases, 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/>  
 - Site of the Ministry of Construction and Housing and Communal Services of the Russian Federation <http://www.minstroyrf.ru/>  
 - 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/>

## 10. Information support of the discipline

a) software  
 Specialized software for conducting lectures and practical classes, completing coursework and independent work of students:  
 RUDN University software: Plaxis 2D Suit (Network license). Plaxis Professional (version 8) + Plaxis Dinamics Modul + PlaxFlow (version 1) - Education Registration number 90-07-019-00261-3  
 MS-office corporate, Registration code: 86626883  
 Parent program: 86493330  
 Status: Active).

- b) databases, 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/>
  - Site of the Ministry of Construction and Housing and Communal Services of the Russian Federation <http://www.minstroyrf.ru/>
  - 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/>

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

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 "Linear Theory of Elasticity" (evaluation materials), 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 assessment scales, standard control tasks or other materials necessary for assessing knowledge, skills, skills and (or) experience of activity that characterize the stages of competence formation in the process of mastering the educational program, methodological materials that determine the procedures for evaluating knowledge, the skills, skills and (or) experience of activity that characterize the stages of competence formation have been developed in full and are available to students on the discipline page in the TUIS RUDN.

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



Developer:

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