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**Федеральное государственное автономное образовательное учреждение
высшего образования «Российский университет дружбы народов»**

Инженерная Академия

(наименование основного учебного подразделения (ОУП)-разработчика программы аспирантуры)

Департамент строительства

(наименование базового учебного подразделения (БУП)-разработчика программы аспирантуры)

РАБОЧАЯ ПРОГРАММА ДИСЦИПЛИНЫ

Advanced structural mechanics

(наименование дисциплины/модуля)

Научная специальность:

2.1.9. Structural Mechanics / Строительная механика (англ.)

(код и наименование научной специальности)

Освоение дисциплины ведется в рамках реализации программы аспирантуры:

Structural Mechanics / Строительная механика (англ.)

(наименование программы аспирантуры)

2022 г.

1. GOALS OF THE DISCIPLINE / ЦЕЛЬ ОСВОЕНИЯ ДИСЦИПЛИНЫ

The purpose of mastering the discipline «Advanced structural mechanics» is preparation for the candidate's examinations and obtaining knowledge, skills and experience in the field of construction.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE / ТРЕБОВАНИЯ К РЕЗУЛЬТАТАМ ОСВОЕНИЯ ДИСЦИПЛИНЫ

The process of studying the discipline «Advanced structural mechanics» is aimed at the formation of the following competencies:

- possession of the methodology of theoretical and experimental research in the field of construction;
- possession of the culture of scientific research in the field of construction, including the use of the latest information and communication technologies;
- 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;
- possession of linear and nonlinear mechanics of structures and structures, physical and mathematical models, analytical and numerical methods of their calculation, including the calculation of structures and structures for reliability in extreme operating conditions.

3. SCOPE OF DISCIPLINE AND TYPES OF EDUCATIONAL WORK / ОБЪЕМ ДИСЦИПЛИНЫ И ВИДЫ УЧЕБНОЙ РАБОТЫ

The total workload of the discipline «Advanced structural mechanics» is 3 credit units.

Table 3.1. Types of educational work by periods of mastering the postgraduate program

Type of educational work	Total hours	Course			
		1	2	3	4
<i>Classroom lessons (total)</i>	<i>60</i>	<i>60</i>			
including:					
Lectures (LC)	30	30			
Laboratory work (LW)	-	-			
Practical lessons (PL)	30	30			
Independent work (total)	48	48			
<i>Control (test with assessment), total</i>	<i>-</i>	<i>-</i>			
Total labor intensity	hour	108	108		
	credits	3	3		

5. CONTENT OF THE DISCIPLINE / СОДЕРЖАНИЕ ДИСЦИПЛИНЫ

Table 5.1. The content of the discipline (module) by type of educational work

The name of the discipline section	Section content (topics)	Type of study work
Finite element analysis of structures	<p>Linear theory of space trusses and properties of bar elements. Linear theory of space frames and properties of frame members.</p> <p>Linear theory of plates and properties of finite plate elements. Linear theory of folded plates and properties of finite folded plate elements.</p> <p>Systems of linear equations: structure, solution, accuracy. Control of accuracy with adaptive methods.</p> <p>Data base, algorithms and interfaces for finite element applications on computers. Examples of practical applications in structural engineering.</p>	LC, PL
Structural dynamics	<p>Linear and nonlinear equations of motion for load bearing systems. Spatial and time discretisation of dynamic boundary value problems. Methods of solution for linear and nonlinear problems.</p> <p>Modal analysis with the finite element method. Time history analysis with the finite element method.</p> <p>Constructed facilities with wind and wave excitation. Constructed facilities subjected to traffic loads and ground vibration. Constructed facilities subjected to earthquake loadings. Computer models for dynamic analysis.</p>	LC, PL
Structural stability	<p>Concepts of structural stability: singularity, instability, imperfections, load perturbation. Linear and nonlinear formulations of stability problems.</p> <p>Second order stress analysis of plane frames. Second order stability analysis of plane frames. First order theory of space frames with uniform and non-uniform torsion. Second order stress analysis of space frames. Second order stability analysis of space frames (torsional-flexural buckling).</p> <p>Bifurcation theory and load path continuation. Buckling of thin plates. Introduction to the buckling of arches and shells. Computer implementation and testing of all methods.</p>	LC, PL
Nonlinear structural analysis	<p>Geometrically nonlinear theory of elasticity. Theory of plasticity, damage and failure, nonlinear constitutive laws.</p> <p>Geometrically nonlinear theory of space trusses: formulation, finite elements. Nonlinear load-displacement behaviour, limit points</p>	LC, PL

The name of the discipline section	Section content (topics)	Type of study work
	<p>(snap-through, bifurcation). Incremental-iterative methods of solution for nonlinear quasi-static problems.</p> <p>Geometrically nonlinear theory of frames: formulation, finite elements, nonlinear. Load-displacement behaviour, limit points (snap-through, bifurcation).</p> <p>Physically nonlinear behaviour of trusses and frames, tension-only members. Computer models and interfaces for nonlinear truss and frame analysis. Examples of practical applications in structural engineering.</p>	
Finite element analysis of structures	<p>Linear theory of space trusses and properties of bar elements. Linear theory of space frames and properties of frame members.</p> <p>Linear theory of plates and properties of finite plate elements. Linear theory of folded plates and properties of finite folded plate elements.</p> <p>Systems of linear equations: structure, solution, accuracy. Control of accuracy with adaptive methods.</p> <p>Data base, algorithms and interfaces for finite element applications on computers. Examples of practical applications in structural engineering.</p>	LC, PL

6. MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE / МАТЕРИАЛЬНО-ТЕХНИЧЕСКОЕ ОБЕСПЕЧЕНИЕ ДИСЦИПЛИНЫ

Table 6.1. Logistics of discipline

Type of auditorium	Auditorium equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture room	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	
Classroom for practical training	An auditorium for conducting seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	
Computer class	Computer class for conducting classes, group and individual consultations, current control and intermediate certification, equipped with personal computers (in the amount of 12 pcs),	RUDN University software: Plaxis 2D Suit (Network license). Plaxis Professional (version 8) +

Type of auditorium	Auditorium equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
	a board (screen) and technical means of multimedia presentations.	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
Educational-methodical room for independent, research work of students	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS.	418

* - аудитория для самостоятельной работы обучающихся указывается обязательно!

7. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE / УЧЕБНО-МЕТОДИЧЕСКОЕ И ИНФОРМАЦИОННОЕ ОБЕСПЕЧЕНИЕ ДИСЦИПЛИНЫ

Main literature:

1. Engineering Mechanics [Электронный ресурс] : Graduate/advanced undergraduate textbook. - Электронные текстовые данные. - : Springer Berlin Heidelberg, 2009. - Системные требования: Windows XP и выше. - ISBN 978-3-540-89937-2.
http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327461&idb=0

Additional literature:

1. Jaap Schijve. Fatigue of Structures and Materials [Electronic resource]: Graduate / advanced undergraduate textbook / S. Jaap. - Electronic text data. -: Springer Netherlands, 2009. - System requirements: Windows XP or higher. - ISBN 978-1-4020-6808-9.
http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327393&idb=0

2. Galishnikova V.V. Computational Mechanics [Text / electronic resource] = Computational Mechanics: Education and Methodical Complex / V.V. Galishnikov. - The book is in English; Electronic text data. - M.: PFUR, 2013. -- 155 p. - ISBN 978-5-209-05047-6: 194.47.
http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=404256&idb=0

3. Structural mechanics [Text]: Textbook: Transl. from the Russian / Ed. by A.Darkov. - The book is in English. - Moscow: Mir, 1989. -- 646 p. : il. - 4.40.

4. Taoufik Boukharouba. Damage and Fracture Mechanics [Electronic resource]: Contributed volume / B. Taoufik, E. Mimoun, P. Guy. - Electronic text data. -: Springer Netherlands, 2009. - System requirements: Windows XP or higher. - ISBN 978-90-481-2669-9.
http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=327316&idb=0

5. Computational and Experimental Mechanics of Advanced Materials [Electronic resource]: Contributed volume. - Electronic text data. -: Springer Vienna, 2009. - (CISM International Center for Mechanical Sciences; 514). - System requirements: Windows XP or higher. - ISBN 978-3-211-99685-0.

http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=326990&idb=0

6. International Journal for Computational Civil and Structural Engineering [https://doaj.org/toc/2588-](https://doaj.org/toc/2588-0195)

[0195?source=%7B%22query%22%3A%7B%22filtered%22%3A%7B%22filter%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22terms%22%3A%7B%22index.issn.exact%22%3A%5B%222587-9618%22%2C%222588-0195%22%5D%7D%7D%2C%7B%22term%22%3A%7B%22_type%22%3A%22article%22%7D%7D%5D%7D%7D%2C%22query%22%3A%7B%22match_all%22%3A%7B%7D%7D%7D%7D%2C%22from%22%3A0%2C%22size%22%3A100%7D](https://doaj.org/toc/2588-0195?source=%7B%22query%22%3A%7B%22filtered%22%3A%7B%22filter%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22terms%22%3A%7B%22index.issn.exact%22%3A%5B%222587-9618%22%2C%222588-0195%22%5D%7D%7D%2C%7B%22term%22%3A%7B%22_type%22%3A%22article%22%7D%7D%5D%7D%7D%2C%22query%22%3A%7B%22match_all%22%3A%7B%7D%7D%7D%7D%2C%22from%22%3A0%2C%22size%22%3A100%7D)

7. Magazine "The Finite Element Method for Solid and Structural Mechanics" <https://www.sciencedirect.com/science/article/pii/B9781856176347000181?via%3Dihub>

8. Journal "Structural Mechanics of Engineering Constructions and Buildings" <http://journals.rudn.ru/structural-mechanics>.

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
- EBS "Doe" <http://e.lanbook.com/>

Methodical instructions for students on mastering the discipline (module):*

Methodological instructions for the implementation of students' IWS are contained in the book: Galishnikova V.V. Computational Mechanics [Text / electronic resource] = Computational Mechanics: Education and Methodical Complex / V.V. Galishnikov. - The book is in English; Electronic text data. - M.: PFUR, 2013. -- 155 p. - ISBN 978-5-209-05047-6: 194.47.

* - все учебно-методические материалы для самостоятельной работы обучающихся размещаются в соответствии с действующим порядком на странице дисциплины в ТУИС!

8. FUND OF ASSESSMENT TOOLS FOR INTERMEDIATE CERTIFICATION OF STUDENTS IN THE DISCIPLINE (MODULE) / ОЦЕНОЧНЫЕ МАТЕРИАЛЫ И БАЛЛЬНО-РЕЙТИНГОВАЯ СИСТЕМА

ОЦЕНИВАНИЯ УРОВНЯ СФОРМИРОВАННОСТИ КОМПЕТЕНЦИЙ ПО ДИСЦИПЛИНЕ

Evaluation materials and a point-rating system for assessing the development of the discipline are presented in the Appendix to this Work Program of the discipline.

* - ОМ и БРС формируются на основании требований соответствующего локального нормативного акта РУДН.

DEVELOPERS:

Ass. Professor at the Department of
Civil engineering



Shambina S.L.

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