Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
RUDN University

Academy of Engineering
(educational division (faculty/institute/academy) as programme developer)

Department of Construction Technology and Structural Materials
(department realizing the PhD program)

COURSE SYLLABUS

Structural Mechanics
(course title)

Scientific specialty:

2.1.9. Structural Mechanics
(scientific speciality code and title)

The course instruction is implemented within the PhD programmes:

Structural Mechanics
(PhD program title)

2026 г.

1. DISCIPLINE (MODULE) GOAL

The purpose of mastering the discipline «Structural Mechanics» is to gain knowledge, skills, and experience in the field of calculation 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 and also preparation for the candidate's examinations and obtaining knowledge, skills and experience in the field of construction.

2. REQUIREMENTS TO PHD-STUDENTS ON FINISHING THE COURSE

Mastering the discipline «Structural Mechanics» is aimed at preparing for passing candidate exams, as well as mastering the competencies:

Proficiency in the methodology of theoretical and experimental research in the field of construction;

Proficiency in the culture of scientific research in the field of construction, including using the latest information and communication technologies;

Proficiency in methods for developing scientific and methodological foundations for research, improvement, theoretical, experimental and technical and economic justification for the use of various technical solutions and technologies in construction;

Proficiency in innovative scientifically based methods for designing structures and devices for obtaining water from natural sources, its preparation for various needs, transportation to places of consumption, subsequent processing with rational use in technological cycles, taking into account the requirements for ensuring environmental safety, increasing the cost-effectiveness and reliability of the functioning of water management systems in populated areas, industrial enterprises and territorial-industrial complexes.

3. WORKLOAD OF THE DISCIPLINE AND TYPES OF ACTIVITIES

The overall workload of the discipline «Building designs, buildings and constructions» is 3 credit units (108 academic hours).

Types of activities		**Total ac. hrs.**	**Semesters**
			3
Classroom activities (total), including:		60	60
в том числе:			
Lectures (LC)		30	30
Laboratory activities (LA)		–	–
Practical lessons/Seminars (PC)		30	30
Independent work		48	48
Intermediate certification (test with assessment/exam)		–	–
Overall workload	ac. hrs.	108	108
	credits	3	3

4. CONTENT OF THE DISCIPLINE

Name of the discipline section	**Contents of the section (topic)**	**Type of study work**
Section 1. Finite element analysis of structures	Linear theory of space trusses and properties of bar elements. Linear theory of space frames and properties of frame members. Linear theory of plates and properties of finite plate elements. Linear theory of folded plates and properties of finite folded plate elements. Systems of linear equations: structure, solution, accuracy. Control of accuracy with adaptive methods.	LC, PC

	Data base, algorithms and interfaces for finite element applications on computers. Examples of practical applications in structural engineering	
Section 2. Structural dynamics	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. Modal analysis with the finite element method. Time history analysis with the finite element method. 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.	LC, PC
Section 3. Structural stability	Geometrically nonlinear theory of elasticity. Theory of plasticity, damage and failure, nonlinear constitutive laws. Geometrically nonlinear theory of space trusses: formulation, finite elements. Nonlinear load-displacement behaviour, limit points (snap-through, bifurcation). Incremental-iterative methods of solution for nonlinear quasi-static problems. Geometrically nonlinear theory of frames: formulation, finite elements, nonlinear. Load-displacement behaviour, limit points (snap-through, bifurcation).	LC, PC
Section 4. Nonlinear structural analysis	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.	

5. EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Room Type	Room Equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline
Class for Seminars	Room for seminar-type classes, equipped with a set of specialized furniture, board (screen) and technical / multimedia gadgets	Not necessary
Self-Work Class	Room for self-working (can be used for lecture and seminars activities), equipped with a set of specialized furniture, board (screen) and technical / multimedia gadgets and computers with an access to EIPES	Not necessary

6. METHODOLOGICAL SUPPORT AND LEARNING MATERIALS

Main readings:

1. Advanced Finite Element Method in Structural Engineering. 2009. Publisher: Springer Berlin Heidelberg. ISBN: 978-3-642-00316-5

2. Yudina, AF Metallicheskie i zhelezobetonnye konstruktsiy [Metal and reinforced concrete structures]. Editing: textbook for universities / A.F. Yudin. - 2nd ed., Rev. and add. - Moscow: Yurayt Publishing House, 2019 .-- 302 p. - (Series: Specialist). - ISBN 978-5-534-06927-3. - Text: electronic // EBS Yurayt [site]. - URL: https://biblio-online.ru/bcode/434494 (date of access: 01.04.2019).

3. KrivoshaPCo, SN Architectural and building structures: a textbook for academic bachelor's degree / SN KrivoshaPCo, VV Galishnikova. - Moscow: Yurayt Publishing House, 2019 .-- 460 p. - (Series: Bachelor. Academic course). - ISBN 978-5-534-03143-0. - Access mode: HYPERLINK https://biblio-online.ru/bcode/432798

4. Tukhfatullin, BA Numerical methods of calculation of building structures. Finite element method: textbook. manual for academic bachelor's degree / BA Tukhfatullin. - 2nd ed., Rev. and add. - Moscow: Yurayt Publishing House, 2019 .-- 157 p. - (Series: Bachelor. Academic course). - ISBN 978-5-534-08899-1. - Access mode: HYPERLINK https://biblio-online.ru/bcode/442338

Additional readings:

1. Algorithms for Solving the Parametric Self-Adjoint 2D Elliptic Boundary-Value Problem Using High-Accuracy Finite Element Method [Text] = Algorithms for solving the Parametric Self-Adjoint elliptic boundary value problem in a two-dimensional domain by the high-order finite element method

// Bulletin of the Peoples ' Friendship University of Russia: Mathematics. Computer science. Physics. - 2017. - no. T. 25 (1). - C. 36-55. http://dx.doi.org/10.22363/2312-9735-2017-25-1

2. Gusev Alexander Alexandrovich. Finite Element Method of High-Order Accuracy for solving Two-Dimensional Elliptic Boundary-Value Problems of Two and Three Identical Atoms in a Line : article in English / A. A. Gusev / / Bulletin of the Peoples ' Friendship University of Russia: Mathematics. Computer science. Physics. - 2018. - no. t. 26 (3). - p. 226-243. http://journals.rudn.ru/miph/article/view/18988/16003

3. Solution of the Boundary-Value Problem for a Systems of ODEs of Large Dimension: Benchmark Calculations in the Framework of Kantorovich Method [Text] = Solution of boundary-value problems for systems of ODES of large dimension: reference calculations within the framework of the Kantorovich method. Computer science. Physics. - 2016. - No. 3. - p. 31-37.

http://journals.rudn.ru/miph/article/view/13387/12817

4. KrivoshaPCo, SN Construction of buildings and structures: textbook for SPO / SN KrivoshaPCo, VV Galishnikova. - Moscow: Yurayt Publishing House, 2019 .-- 476 p. - (Series: Professional Education). - ISBN 978-5-534-02348-0. - Access mode: HYPERLINK https://biblio-online.ru/bcode/433396

5. Dedyukh, RI Materials science and technology of structural materials. Fusion welding technology: textbook. manual for applied baccalaureate / RI Dedyukh. - Moscow: Yurayt Publishing House, 2019 .-- 169 p. - (Series: Universities of Russia). - ISBN 978-5-534-01539-3. - Text: electronic // EBS Yurayt [site]. - URL: https://biblio-online.ru/bcode/433979 (date of access: 01.04.2019).

6. Yudina, AF Building structures. Editing: textbook for SPO / A.F. Yudin. - 2nd ed., Rev. and add. - Moscow: Yurayt Publishing House, 2019 .-- 302 p. - (Series: Professional Education). - ISBN 978-5-534-07027-9. - Access mode: HYPERLINK https://biblio-online.ru/bcode/442133

Internet sourses:

ELS RUDN University and third party EBS, to which university students have accessbased signed contracts:

- RUDN Electronic Library System, http://lib.rudn.ru/MegaPro/Web ;
- ELS University Library Online, http://www.biblioclub.ru ;
- EBS Urayt, http://www.biblio-online.ru ;
- ELS Student Consultant, http://www.studentlibrary.ru ;
- EBS Lan, http://e.lanbook.com ;
- EBS Trinity Bridge http://www.trmost.ru

Databases and search engines:

- Electronic fund of legal and normative-technical documentation, http://docs.cntd.ru ;
- Yandex search system https:// www .yandex.ru ;
- Google search system https://www.google.com ;
- Reference database Scopus , http://www.elsevierscience.ru/products/scopus

Educational and methodological materials for students' self-work studying the discipline / module:

A course of lectures on the discipline «Structural Mechanics».

7. ASSESSMENT TOOLKIT AND GRADING SYSTEM FOR MIDTERM ATTESTATION OF STUDENTS IN THE DISCIPLINE (MODULE)

Assessment toolkit and a grading system to evaluate the level of competences (competences in part) formation as the course results are specified on the TUIS platform.

DEVELOPERS:

Associate Professor A.S. Markovich

HEAD OF THE DEPARTMENT

Head of Department S.B. Yazyev