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 higher education program developer

COURSE SYLLABUS

Structural Dynamics
course title

Recommended by the Didactic Council for the Education Field of:
08.04.01 Civil Engineering
field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:
Civil Engineering and Built Environment
higher education programme profile/specialisation title

2024

1. COURSE GOAL(s)

The goal of the course Structural Dynamics is to prepare the future specialist to solve problems and teach him to determine the dynamic characteristics of construction and engineering structures.

Loads that change rapidly in time cause the cross-sections of the structure to move with accelerations, resulting in inertial forces that need to be taken into account in the calculations, in addition, in some cases, stresses that vary in time can occur at certain points of the structure, which leads to material fatigue, so the purpose of the discipline is to teach calculations for the effect of dynamic loads caused by wind gusts, machines, engines and other mechanisms that cause vibrations of structures.

The dynamic calculation is aimed at providing the necessary structural strength and preventing large deformations. Stresses that are variable in time occur in structural elements under the influence of loads that are variable in magnitude or direction, as well as loads that move relative to the designed element. Numerous experiments confirm that under the action of alternating stresses, the destruction of materials occurs at stresses significantly lower than the dangerous stresses under static loading. Solving this problem is also the goal of the discipline.

The objective of the course is to teach students to determine the dynamic effects on structures and take them into account when calculating.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course Structural Dynamics implementation is aimed at the development of the following competences (competences in part):

Table 2.1. List of competences that students acquire during the course «Structural Dynamics»

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
PC-2	Development of project products based on the results of engineering and technical design for urban development activities	PC-2.1 Capable of performing engineering and technical design and developing design products for building structures, grounds and foundations; PC-2.2 Able to perform engineering and technical design and develop design products for engineering systems and engineering structures

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course Structural Dynamics refers to the *elective component* of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other disciplines (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course Structural Dynamics.

Table 3.1. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the internship results.

Competence code	**Competence descriptor**	**Previous courses / modules, internships**	**Subsequent courses / modules, internships**
PC-2	Development of project products based on the results of engineering and technical design for urban development activities	Digital technologies in construction; Structural Design in Steel; Nanotechnology in Civil Engineering; Structural Design in Reinforced Concrete;	Life Cycle Economics of Buildings; Applications of Finite Element Method for Civil Engineering problems; Sustainability in Civil Engineering;

		Building materials: Special Topics	Optimization Methods in Civil Engineering; Structural Stability; Geometric Shaping and Analysis of Shells; Engineering Systems of Buildings; Desin Practice; Technological Practice; Pre-Graduation Practice

4. COURSE WORKLOAD

The total workload of the course Structural Dynamics is 5 credits.

Table 4.1. Academic activities types by periods of the higher education programme

Type of academic activities		**Total academic hours**	**Semester(s)**			
			2			
Contact academic hours		72	72			
including:						
Lectures (LC)		36	36			
Lab works (LW)		0	0			
Seminars (workshops / tutorials) (S)		36	36			
Self-studies academic hours		81	81			
Evaluation and assessment academic hours		27	27			
Course work / project, credits			2			
Course workload	academic hours	180	180			
	credits	5	5			

5. COURSE CONTENTS

Modules	**Contents (topics)**	**Academic activities types ***
Section 1. General information about the dynamics of deformable systems	General concepts. Forces of inertia. The Dalembert principle. The main types of dynamic load. Dynamic tasks that are reduced to static calculation tasks. Calculation for inertial loads	LC, S
Section 2. Hit	Dynamic coefficient	LC, S
Section 3. Oscillations of systems with n degrees of freedom	Elastic natural oscillations of systems with one degree of freedom. Forced oscillations of systems with one degree of freedom. Resonance. Vibration damping. Elastic free oscillations of systems with several degrees of freedom. Determination of the number of degrees of freedom for flat rod systems. A system with two degrees of freedom	LC, S

Modules	Contents (topics)	Academic activities types *
Section 4. Free oscillations of rod systems as systems with distributed mass	Free vibrations of beams as systems with distributed mass. Longitudinal vibrations of a rod with a distributed mass. The solution is in the form of a traveling wave. A standing wave type solution. The method of displacements in problems of harmonic oscillations of rod systems. Free oscillations of rod systems with distributed mass. Free vibrations of the U-shaped frame.	LC, S
Section 5. Calculation of fatigue	Variable stresses. Stress cycle. Fatigue. The fatigue curve. The limit of endurance. The main factors affecting the value of the endurance limit.	LC, S

* - to be filled in only for full -time training: LC - lectures; LW - lab work; S - seminars.

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialized educational / laboratory equipment, software and materials for course study (if necessary)
Lectures	An auditorium for conducting lectures, equipped with a set of specialized furniture; a blackboard (screen) and technical means for multi-media presentations.	
Seminars	A classroom for conducting seminars, group and individual consultations, current and midterm assessment; equipped with a set of specialised furniture and technical means for multimedia presentations.	
Computer Labs	Not required.	
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment	

7. RESOURCES RECOMMENDED FOR INTERNSHIP

Main readings:

1. Trahair N.S., Bradford M.A., Nethercot D.A., Gardner L. (2023). The Behaviour and Design of Steel Structure to EC3. Fourth edition. Published by Taylor & Francis, New York, 490. https://civteam.files.wordpress.com/2023/03/the-behaviour-and-design-of-steel-structuresto-ec3-2023.pdf

Additional readings:

1. Guddat J., Jongen H.TH. Structural stability in nonlinear optimization : http://dx.doi.org/10.1080/02331938708843275

2. Second order structural theory for the stability analysis of columns/ Российский университет дружбы народов. / Vera V Galishnikova [и др.]. // Structural Mechanics of Engineering Constructions and Buildings. 2018. №14.3. С. 192-197. ISSN

1815-5235 DOI: 10.22363/1815-5235-2018-14-3-192-197
https://cyberleninka.ru/article/n/second-order-structural-theory-for-the-stability-analysis-ofcolumns
3. Chen W.F., Sohal I. Plastic Design and Second-Order Analysis of Steel Frames./ Springer-Verlag New York, 1995. – 509 p.

Internet sources:

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:
   - RUDN Electronic Library System (RUDN ELS) http://lib.rudn.ru/MegaPro/Web
   - EL "University Library Online" http://www.biblioclub.ru
   - EL "Yurayt" http://www.biblio-online.ru
   - EL "Student Consultant" www.studentlibrary.ru
   - EL "Lan" http://e.lanbook.com/
   - EL "Trinity Bridge"
2. Databases and search engines:
   - electronic foundation 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/

The training toolkit and guidelines for a student:

1. Collection of lectures on the course Structural Dynamics.

* The training toolkit and guidelines for the course are placed on the internship page in the university telecommunication training and information system under the set procedure..

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS INTERNSHIP RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course Structural Dynamics results are specified in the Appendix to the internship syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Associate Professor in the Department of Construction Technology and Structural Materials		M.I. Rynkovskaya
position, educational department	signature	name and surname
position, educational department	signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Head of the Department of Construction Technology and Structural Materials		A.V. Solovyeva
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HIGHER EDUCATION PROGRAMME:

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