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**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

2025

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
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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			
<i>Contact academic hours</i>		72	72			
including:						
Lectures (LC)		36	36			
Lab works (LW)		0	0			
Seminars (workshops / tutorials) (S)		36	36			
<i>Self-studies academic hours</i>		81	81			
<i>Evaluation and assessment academic hours</i>		27	27			
<i>Course work / project, credits</i>			2			
Course workload	academic hours	180	180			
	credits	5	5			

5. COURSE CONTENTS

Modules	Contents (topics)	Academic activities types *
Section 1. Single Degree of Freedom (SDOF) Systems	Topic 1.1. Basics of Structural Dynamics Topic 1.2. The Goal of Dynamic Analysis Topic 1.3. The main Dynamic loads on the building Topic 1.4. Single Degree of Freedom System	LC, S
Section 2. Free Vibration of Single Degree of Freedom Systems	Topic 2.1. Undamped free Vibration Topic 2.2. Energy in undamped free Vibration Topic 2.3. Damped free Vibration.	LC, S
Section 3. Response to Harmonic Excitation and Periodic Excitation	Topic 3.1. Undamped Harmonic Excitations Topic 3.2. Damped Harmonic Excitations Topic 3.3. Periodic Excitations	LC, S
Section 4. Response to Arbitrary , Step and	Topic 4.1. Response to step force and step force with finite rise time	LC, S

Modules	Contents (topics)	Academic activities types *
Pulse Excitation	Topic 4.2. Response to Ramp force Topic 4.3. Response to Pulse Excitation	
Section 5. Numerical Evaluation of Dynamic Response	Topic 5.1 Linear Interpolation of Excitation Method Topic 5.2 Central Difference Method Topic 5.3 Newmark's Methods	LC, S
Section 6. Generalized Single degree of Freedom Systems	Topic 6.1 Systems with Rigid body assemblage Topic 6.2 Systems with distributed mass and elasticity Topic 6.3 Lamped Mass System - Shear Building	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-structure-to-ec3-2023.pdf>

Additional readings:

1. Guddat J., Jongen H.T.H. 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/](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:

<i>associate professor</i>		<i>Rynkovskaya Marina</i>
_____	_____	_____
<i>position in the education department</i>	<i>signature</i>	<i>Igorevna</i>
		<i>Last name and first name</i>

**HEAD OF EDUCATIONAL
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<i>Head of the Department</i>		<i>Yazyev Serdar Batyrovich</i>
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**HEAD OF EDUCATIONAL
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		<i>Last name and first name</i>