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 programme developer

COURSE SYLLABUS

Structural Stability
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 Stability is to gain knowledge, skills, skills and experience in the field of design of building structures that characterize the stages of competence formation and ensure the achievement of the planned results of the development of the educational program.

Various structures and structures designed and constructed by an engineer must necessarily have strength, that is, the ability to resist destruction under the action of external loads applied to them, rigidity, that is, the ability to resist deformations, and stability – the ability of a structure to maintain one form of balance. The solution of these three tasks is the main content of the course.

The main objectives of the course Structural Stability are:

- study of the concept of free vibrations of building structures;
- consideration of the types of dynamic impact of loads on building structures;
- familiarity with the requirements for building structures to ensure stability;
- study of ways to solve problems in the calculation of building structures for stability and dynamic impacts.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course Structural Stability 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 Stability»

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

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course Structural Stability 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 Stability.

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: Special Topics; Structural Dynamics; Structural Design in Reinforced Concrete;	Desin Practice; Technological Practice; Pre-Graduation Practice

		Building materials: Special Topics; Structural Design in Steel: Special Topics; Modelling of Construction Processes	

4. COURSE WORKLOAD

The total workload of the course Structural Stability is 2 credits.

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

Type of academic activities		**Total academic hours**	**Semester(s)**			
			3			
Contact academic hours		36	36			
including:						
Lectures (LC)		18	18			
Lab works (LW)		0	0			
Seminars (workshops / tutorials) (S)		18	18			
Self-studies academic hours		18	18			
Evaluation and assessment academic hours		18	18			
Course work / project, credits						
Course workload	academic hours	72	72			
	credits	2	2			

5. COURSE CONTENTS

Modules	**Contents (topics)**	**Academic activities types ***
Section 1. Concepts of structural stability	Topic 1.1 Definition of stability. Instability without large displacements. Order and linearity of structural theories; First order theory of an axially loaded bar Topic 1.2 Second order theory for Euler columns; Behavior of geometrically imperfect columns; Behavior of columns with load perturbation Topic 1.3 Instability with large displacements: Nonlinear mathematical model of a 2-bar truss; Solutions of governing equations; Types of in stability for shallow and steel trusses	LC, S
Section 2. Second order plane frame analysis	Topic 2.1 Members of a frame: Governing equations for a member and their solution. Topic 2.2 Member stiffness matrix: Exact stiffness coefficients; Limit expressions for the stiffness co efficient Topic 2.3 Member load vector: Exact load	LC, S

Modules	Contents (topics)	Academic activities types *
	coefficients; Limit expressions for the load coefficients Topic 2.4 Algorithms for second order plane frame analysis. Limitations of second order analysis	
Section 3. Single columns and column groups	Topic 3.1 Single columns: Boundary conditions for single columns. Elastically supported single columns. Topic 3.2 Effective length and slenderness of columns. Linked Columns Topic 3.4 Columns in frames: Translation and rotation restraints at nodes; Single column with girder restraint and side-sway. Columns in portal frames Topic 3.4 Columns in multi-storey buildings. General method for the analysis of column stability in frames.	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. (2021). The Behavior and Design of Steel Structure to EC3. Fourth edition. Published by Taylor & Francis,
New York, 490. https://civteam.files.wordpress.com/2013/03/the-behaviour-and-design-of-steel-structuresto-ec3-2021.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 // Structural Mechanics of Engineering Constructions and Buildings. 2023. №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, 2019. – 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 Stability.

* 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 Stability 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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