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

2026

1. COURSE GOAL(s)

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

The main objectives of the course are the following.

Various structures and structures, the design and construction of which the engineer is engaged in, must be correctly calculated from the point of view of mathematics and physics. For the calculation of complex structures, and especially when taking into account time factors, knowledge of partial differential equations is simply necessary.

The task of the course is to teach the student to solve complex mathematical problems, to be able to classify them and apply them in practice with different boundary conditions

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)
GC-1	Able to critically analyze problem situations on the basis of a systematic approach, to develop a strategy of action	GC-1.1 Analyzes the problem, identifying its basic components; GC-1.2 Identifies and ranks the information required to solve the task; GC-1.3 Selects ways to solve the problem, analyzes the possible consequences of their use
GPC-1	Able to solve problems of professional activity on the basis of theoretical and prac-tical foundations, the math-ematical apparatus of the fundamental sciences	GPC-1.1 Selects a mathematical model suitable for the professional problem to be solved, sets the required parameters and boundary conditions; GPC-1.2 Solves mathematical modeling problems using suitable analytical, numerical, or numerical-analytical methods; GPC-1.3 Solves professional problems using modern software systems for mathematical, digital modeling of structures
GPC-3	Able to set and solve scientific and technical problems in the field of construction, construction industry and housing and communal services on the basis of knowledge of industry problems and experience in their solution	GPC-3.1 Able to formulate and solve scientific and technical tasks in the field of building structures design
GPC-6	Able to carry out research of objects and processes in the field of construction and housing and communal services	GPC-6.2 Able to choose appropriate research methods and carry out research according to the chosen methodology; GPC-6.3 Capable of processing, analyzing and drawing up research results

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course Structural Stabilitty refers to the *core 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
GC-1	Able to critically analyze problem situations on the basis of a systematic approach, to develop a strategy of action		Geoinformation Systems and Applications; Independent Research Work (obtaining basic skills of research work); Introductory Practice; Desin Practice; Technological Practice; Independent Research Work
GPC-1	Able to solve problems of professional activity on the basis of theoretical and prac-tical foundations, the math-ematical apparatus of the fundamental sciences		Independent Research Work (obtaining basic skills of research work); Desin Practice; Independent Research Work
GPC-3	Able to set and solve scientific and technical problems in the field of construction, construction industry and housing and communal services on the basis of knowledge of industry problems and experience in their solution		BIM-Technology in Construction Management; Independent Research Work (obtaining basic skills of research work); Desin Practice; Technological Practice; Independent Research Work
GPC-6	Able to carry out research of objects and processes in the field of construction and housing and communal services		Geoinformation Systems and Applications; Independent Research Work (obtaining basic skills of research work); Independent Research Work

4. COURSE WORKLOAD

The total workload of the course Structural Stability is 3 credits.

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

Type of academic activities	Total academic hours	Semester(s)			
		1			
Contact academic hours	36	36			
including:					

Type of academic activities		Total academic hours	Semester(s)			
			1			
Lectures (LC)		18	18			
Lab works (LW)		18	18			
Seminars (workshops / tutorials) (S)		0	0			
Self-studies academic hours		72	72			
Evaluation and assessment academic hours		0	0			
Course work / project, credits						
Course workload	academic hours	108	108			
	credits	3	3			

5. COURSE CONTENTS

Modules	Contents (topics)	Academic activities types *
Section 1. Buckling of Columns.	Topic 1.1 Introduction. Topic 1.2. Neutral Equilibrium. Topic 1.3. Euler Load Topic 1.4. Differential Equations of Beam-Columns. Topic 1.5. Effects of Boundary Conditions on the Column Strength. Topic 1.6. Introduction to Calculus of Variations. Topic 1.7. Derivation of Beam-Column GDE	LC, LW
Section 2. Special Topics in Elastic Stability.	Topic 2.1 Energy Methods. Topic 2.2. Stability Criteria. Topic 2.3. Rayleigh-Ritz Method. Topic 2.4. The Rayleigh Quotient. Topic 2.5. Energy Method Applied to Columns Subjected to Distributed Axial Loads.	LC, LW
Section 3. Beam-Columns.	Topic 3.1 Transversely Loaded Beam Subjected to Axial Compression. Topic 3.2. Beam-Columns with Concentrated Lateral Loads. Topic 3.3. Beam-Columns with Distributed Lateral Loads. Topic 3.4. Effect of Axial Force on Bending Stiffness. Topic 3.5. Ultimate Strength of Beam-Columns.	LC, LW
Section 4. Continuous Beams and Rigid Frames.	Topic 4.1 Introduction. Topic 4.2. Continuous Beams. Topic 4.3. Buckling Modes of Frames. Topic 4.4. Critical Loads of Frames. Topic 4.5. Stability of Frames by Matrix Analysis. Topic 4.6. Second-Order Analysis of a Frame by	LC, LW

Modules	Contents (topics)	Academic activities types *
	Slope-Deflection Equations. Topic 4.7. Effect of Primary Bending and Plasticity on the Behavior of Frames. Topic 4.8. Stability Design of Frames.	

* - 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.	
Lab works	An auditorium for laboratory work, equipped with a set of specialized furniture and equipment.	Computer laboratory
Computer Labs	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (in the amount of 14 pcs), a board (screen) and technical means of multimedia presentations.	Software: MS Ofiice MathCAD Lira SCAD Office
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. Chai H. Yoo, Sung C. Lee Stability of Structures 2022 ISBN: 978-0-12-385122-2

Additional readings:

1. Choi, B. H., & Yoo, C. H. (2005). Strength of Stiffened Flanges in Horizontally Curved Box Girders. J. Engineering Mechanics, ASCE, Vol. 131(No. 2), 167–176, February 2005.
2. Knox, Gordon D. Engineering / by Gordon D. Knox ; edited by Ellison Hawes 275p. URL:http://dlib.rsl.ru/rsl01004000000/rsl01004445000/rsl01004445020/rsl01004445020.pdf
3. Jurgita Antuchevičienė (Ed.), Edmundas Kazimieras Zavadskas (Ed.), Jonas Šaparauskas (Ed.). Sustainability in Construction Engineering 2018 1 c. ISBN 9783038971665 URL: http://www.mdpi.com/books/pdfview/book/754 Resources of the Internet information and telecommunications network»

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 Mathematical Modelling.

* 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).