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

Numerical methods for Civil Engineering
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 Numerical methods for Civil Engineering is to complete the study of knowledge, 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.

The objectives of the course Numerical methods for Civil Engineering are to study the theoretical foundations of analytical and numerical methods for calculating structures, analyze methods for calculating building structures, justify and select engineering methods for calculating structures, and develop practical skills for calculating structures using numerical methods using computer technology.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course Numerical methods for Civil Engineering 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 «Numerical methods for Civil Engineering»

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 practical foundations, the mathematical 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-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 Numerical methods for Civil Engineering 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 Numerical methods for Civil Engineering.

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 practical foundations, the mathematical apparatus of the fundamental sciences		Independent Research Work (obtaining basic skills of research work); Desin 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 Numerical methods for Civil Engineering is 4 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:						
Lectures (LC)		18	18			
Lab works (LW)		18	18			
Seminars (workshops / tutorials) (S)		0	0			
Self-studies academic hours		81	81			
Evaluation and assessment academic hours		27	27			
Course work / project, credits						
Course workload	academic hours	144	144			
	credits	4	4			

5. COURSE CONTENTS

Modules	**Contents (topics)**	**Academic activities types ***

Modules	Contents (topics)	Academic activities types *
Section 1. Fundamentals of variational methods for calculating structures	Topic 1.1 Solving problems of bending beams by Variational methods. Topic 1.2 Fundamentals of the Variational methods. Topic 1.3 Lagrange's variational principle. Topic 1.4 Direct variational methods for solving problems in the theory of elasticity. Topic 1.5 Solution of plate bending problems by Variational methods.	LC, LW
Section 2. Fundamentals of the Finite element method (FEM)	Topic 2.1 Functions of the shape and stiffness matrix of the final element. Topic 2.2 Structural stiffness matrix based on FEM. Calculation of the SSS of the construction. Topic 2.3 Calculation of the plate by the Finite element method.	LC, LW
Section 3. Variational-difference method for calculating structures	Topic 3.1 Introduction to the Variational-difference method for calculating structures. Topic 3.2 Example of calculating a plate using the Variational-difference method.	LC, LW

* - 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: MathCAD
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. Pimenov V.G. Numerical methods in 2 parts. 2023, 111 p.
2. V. N. Ivanov Fundamentals of numerical methods for calculating structures (2007). RUDN. 64 pages.
3. Turchak L.I., Plotnikov P. V. Fundamentals of numerical methods: a textbook (2022). 304 p.

Additional readings:

1. Ivanov V. N. Analytical methods for calculating non-canonical shells. RUDN Publishing House, 2010, 542 p.
2. Krahotkina E.V. Numerical methods in scientific calculations: (2015). 162 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 Numerical methods for Civil Engineering.

* 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 Numerical methods for Civil Engineering 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		*Rekach F.V.*
position in the education department	*signature*	*Last name and first name*
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HEAD OF EDUCATIONAL DEPARTMENT:

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