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

Optimization Methods in Civil Engineering
course title

Recommended by the Didactic Council for the Education Field of:
08.04.01 Civil Engineering

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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

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higher education programme profile/specialisation title

2024

1. COURSE GOAL(s)

The goal of the course <u>Optimization Methods in Civil Engineering</u> is to gain knowledge and skills in research concerning the tasks related to optimization problems, which characterizes the stages of competence formation and ensures the achievement of the planned results of the development of the educational program.

The main objective of the course Optimization Methods in Civil Engineering is to get acquainted with the methods and tools of optimal programming problems and learn how to apply them in production and in scientific research.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course <u>Optimization Methods in Civil Engineering</u> 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 <u>«Optimization Methods in Civil Engineering»</u>

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 <u>Optimization Methods in Civil Engineering</u> 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 <u>Optimization Methods in Civil Engineering</u>.

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; Building materials: Special Topics; Structural Design in Steel: Special Topics; Modelling of Construction Processes	Desin Practice; Technological Practice; Pre-Graduation Practice

4. COURSE WORKLOAD

The total workload of the course <u>Optimization Methods in Civil Engineering</u> is <u>2</u> 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. Introduction to optimization	Topic 1.1 Methods of Operations Research. Historical development	LC, S
Section 2. Statement of optimization problem	Topic 2.1 Constrained and unconstrained optimization problems. Design Vector. Design Constraints constraint surface. Objective Function. Objective Function Surfaces	LC, S
Section 3. Classification of optimization problems	Topic 3.1 Classification Based on the Existence of Constraints. Classification Based on the Nature of the Design Variables. Classification Based on the Physical Structure of the Problem. Classification Based on the Nature of the Equations Involved	LC, S
Section 4. Classical optimization techniques	Topic 4.1 Single-variable optimization. Theorem of necessary and sufficient condition	LC, S
Section 5. Multivariable optimization with no constraints	Topic 5.1 The necessary and sufficient conditions for the minimum or maximum of an unconstrained function of several variables	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	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. Singiresu S. Rao, Engineering Optimization: Theory and Practice, Fourth Edition, 2022 by John Wiley & Sons, Inc.

Additional readings:

1. R.L. Fox, Optimization methods for Engineering Design, Addison-Wesley, Reading, MA, 2023
2. D.J. Wilde, Optimum seeking methods, Prentice Hall, Englewood Cliffs, NJ, 1964

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 <u>Optimization Methods in Civil Engineering</u>.

   * 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 <u>Optimization Methods in Civil Engineering</u> 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:

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