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

Mathematical methods of experimental data processing
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 Mathematical The goal of the course methods of experimental data processing is obtaining knowledge, skills, skills and experience in the development of computer-oriented computational algorithms for solving engineering problems 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 Mathematical methods of experimental data processing are:

- study of the principles and theory of numerical methods for solving mathematical and engineering problems;
- - introduction to the basic concepts of function approximation methods, linear programming and optimization methods in the field of solving construction problems;
- - consideration of the application of computational methods in various fields of construction science for the development and implementation of mathematical models in the subject area;
- study of the possibilities of working with modern means of solving problems by numerical methods in the construction field.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course Mathematical methods of experimental data processing 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 «Mathematical methods of experimental data processing»

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-1.3 Selects ways to solve the problem, analyzes the possible consequences of their use
GC-7	Able: to search for the neces-sary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using algorithms when working with data received from various sources to effectively use the information to solve problems ; to assess information, its reliability, to build logical conclusions on the basis of incoming information and data	GC-7.1 Searches for relevant sources of information and data, perceives, analyzes, remembers and transmits information using digital tools and algorithms when working with data from various sources in order to effectively use the information to solve problems; GC-7.2 Evaluates information, its reliability, builds logical conclusions on the basis of incoming information and data
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-2	Able to analyze, critically comprehend and present information, search for scientific	GPC-2.2 Able to analyze, critically comprehend information, acquire new knowledge; GPC-2.3 Able to present found and meaningful

	and technical information, acquire new knowledge, including with the help of information technology	information, including with the help of information technology
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
PC-1	Conducting scientific research in the field of construction	PC-1.3 Able to analyze and process research results

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course Mathematical methods of experimental data processing 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 Mathematical methods of experimental data processing.

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
GC-7	Able: to search for the neces-sary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using algorithms when working with data received from various sources to effectively use the information to solve problems ; to assess information, its reliability, to build logical conclusions on the basis of incoming information and data		Geoinformation Systems and Applications; Life Cycle Economics of Buildings; BIM-Technology in Construction Management; Independent Research Work (obtaining basic skills of research work); Introductory 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-2	Able to analyze, critically comprehend and present information, search for scientific and technical information, acquire new knowledge, including with the help of information technology		Independent Research Work (obtaining basic skills of research work); Introductory 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
PC-1	Conducting scientific research in the field of construction		Sustainability in Civil Engineering; Geometric Shaping and Analysis of Shells; Independent Research Work (obtaining basic skills of research work); Independent Research Work; Pre-Graduation Practice

4. COURSE WORKLOAD

The total workload of the course Mathematical methods of experimental data processing 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:					
Lectures (LC)	18	18			
Lab works (LW)	0	0			
Seminars (workshops / tutorials) (S)	18	18			
Self-studies academic hours	72	72			

Type of academic activities		Total academic hours	Semester(s)			
			1			
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. Sample characteristics as random variables are ways to represent the results of experiments.	Topic 1.1 Discrete and continuous random variables. Selective characteristics. Laws of random variable distribution. Topic 1.2 Computer simulation of a random variable with a given distribution law: normal and logo - normal distribution, Poisson distribution, distribution of equal probability.	LC, S
Section 2. Methods for screening out measurement misses	Topic 2.1 The "3-sigma" rule. The Chauvenet criterion. Criteria of Romanovsky, Irwin, Dixon, variation-al scope	LC, S
Section 3. The concept of a parametric criterion. The power of the criterion. Confidence probability	Topic 3.1 The concept of parametric criteria. The power of the criterion. Confidence probability Topic 3.2 Errors of the first and second kind. The use of computer technologies for the elimination of erroneous values.	LC, S
Section 4. Fundamentals of optimization. Construction of mathematical models.	Topic 4.1 The concept of the objective function, the limitations of the decision-making domain. Topic 4.2 The Brandon method	LC, S
Section 5. Methods of decision-making under conditions of uncertainty and multicriteria	Topic 5.1 Criteria of Wald, Laplace, Hurwitz, Savage, mixed criteria.	LC, S
Section 6. Ranking of factors. Processing of survey results	Topic 6.1 Ranking methods. Calculation of the concordance coefficient	LC, S
Section 7. Methods of cluster analysis	Topic 7.1 Ways of forming clusters. Calculation of the characteristics of cluster centers, dispersion	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 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 Office 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. Ipatova, E.R. Methodologies and technologies of system design of information systems: textbook / E.R. Ipatova, Yu.V. Ipatov. - 2nd ed., erased. - Moscow: Flinta Publishing House, 2024. - 257 p. : tab., schemes. - (Information Technology). - p. 95-96 - ISBN 978-5-89349-978-0; Access mode: URL: http://biblioclub.ru/index.php?page=book&id=79551.

2. Tsarev, R.Yu. Algorithms and data structures (CDIO): textbook. Siberian Federal University. - Krasnoyarsk: SFU, 2016. - 204 p. ISBN 978-5-7638-3388-1; Access mode: URL: http://biblioclub.ru/index.php?page=book&id=497016.

Additional readings:

1. Automated information systems in the economy / ed. M.V. Vasilyeva. - Moscow: Student Science, 2012. - Part 1. Collection of student papers. - 1064 p. - ISBN 978-5-00046-053-5; Access mode: http://biblioclub.ru/index.php?page=book&id=225482

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 methods of experimental data processing.

* 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 Mathematical methods of experimental data processing 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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