THE WORKING PROGRAM OF THE DISCIPLINE

Name of the discipline: <u>Mathematical methods of experimental data processing</u>

Recommended for educational field: <u>08.04.01 Civil Engineering</u>

Specialization (profile): <u>Civil Engineering and Built Environment , Mechanics of materials and engineering structures, Built environment of smart city</u>

1. Goals and objectives of the discipline:

The purpose of mastering the discipline " Mathematical 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 discipline " 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. Place of discipline in the structure of EP VO:

The discipline " Mathematical methods of experimental data processing " refers to the basic part 1 of the curriculum. Its study is based on the material of previous disciplines, and it is also the basis for the study of subsequent disciplines of the curriculum, the list of which is presented in table 1.

Prior and subsequent disciplines aimed at the formation of competencies

№	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
General cultural competences			
	GC-1	The discipline is taught in the first semester of the first year of study in the master's program	Mathematical modelling
General professional competencies			
	GPC-1 GPC-6		Applications of Finite Element Method for Civil Engineering problems
			Project management
			Reliability and safety of structures
Professional competencies (type of professional activity of a civil engineer)			
	PC-11		
Vocational Competencies of Specialization Structural mechanics			

3. 3. Requirements for the results of mastering the discipline:

GC-1- Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy
GPC-1 student is able to solve the problems of professional activity based on the use of theoretical and practical foundations, the mathematical apparatus of fundamental sciences
GPC-6- Able to carry out research of objects and processes in the field of construction and housing and communal services

PC-11- Preparation of a section of design documentation for metal structures of buildings and structures

As a result of studying the discipline, the student must:

Know:

- *basic concepts of function approximation methods, linear programming methods, and optimization*

- principles of the theory of numerical methods for solving mathematical and engineering problems;
- regularities and features of the application of numerical methods and computer modeling.

Be able to:

- use computational methods to build models based on experimental data.- be able to use the appropriate computer developments,

- use computational technologies to build algorithms for solving problems using numerical methods,

- use computer simulation to find optimal solutions.

Own:

- information support for solving computational problems by modern means,
- organizations of information support for solving computational problems in construction.

4. Scope of discipline and types of educational work

The total workload of the discipline is 4 credit units.

Type of educational work	Total hours	Semesters			
		1			
Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). **lessons (total)**	36	36			
Including:	-	-	-	-	-
Lectures	18	18			
Practical lessons (PL)	18	18			
Seminars (S)	-	-			
Laboratory work (LW)	-	-			
Independent work (total)	90	exam			
Total labor intensity	144	144			
hour cred-its	4	4			

5. Content of the discipline

5.1. Contents of discipline sections

№	Section name / Topic of the lesson	*Lectures*	*PL.*	*LW*	Independent	Total.
	1 semester					
1.	**Section 1. Sample characteristics as random variables are ways to represent the results of experiments.**	*2*	*2*	*-*	*18*	*22*
	Topic 1.1. Discrete and continuous random variables. Selective characteristics. Laws of random variable distribution.	*1*	*1*	*-*	*10*	*12*
	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.	*1*	*1*	*-*	*8*	*10*

№	Section name / Topic of the lesson	Lectures	PL.	LW	Inde-pendent	To-tal.
2.	**Section No.2. Methods for screening out measurement misses.**	*2*	*2*	-	*10*	*14*
	Topic 2.1. The "3-sigma" rule. The Chauvenet criterion. Criteria of Romanovsky, Irwin, Dixon, variational scope	*2*	*2*	-	*10*	*14*
3.	**Section No.3. The concept of a parametric criterion. The power of the criterion. Confidence probability.**	*4*	*6*	-	*4*	*14*
	Topic 3.1. The concept of parametric criteria. The power of the criterion. Confidence probability	*2*	*4*	-	*2*	*8*
	Topic 3.2. Errors of the first and second kind. The use of computer technologies for the elimination of erroneous values.	*2*	*2*	-	*2*	*6*
4.	**Section No. 4. Fundamentals of optimization. Construction of mathematical models.**	*4*	*12*	-	*24*	*40*
	Topic 4.1. The concept of the objective function, the limitations of the decision-making domain.	*2*	*2*	-	*12*	*16*
	Topic 4.2: The Brandon method	*2*	*10*	-	*12*	*24*
5.	**Section No.5. Methods of decision-making under conditions of uncertainty and multicriteria.**	*2*	*8*	-	*2*	*12*
	Topic 5.1. Criteria of Wald, Laplace, Hurwitz, Savage, mixed criteria.	*2*	*8*	-	*2*	*12*
6.	**Section No. 6. Ranking of factors. Processing of survey results.**	-	-		*14*	*14*
	Topic 6.1. Topic: Ranking methods. Calculation of the concordance coefficient	-	-		*14*	*14*
7.	**Section No. 7. Methods of cluster analysis.**	*2*	*14*		*12*	*28*
	Topic 7.1. Ways of forming clusters. Calculation of the characteristics of cluster centers, dispersion.	*2*	*14*		*12*	*28*
	Exam		*60*		*84*	*144*

5.2. Sections of disciplines and types of classes

No.	Discipline section No.	Lectures.	Practice	Lab. works	Independent work of students	Total hour.
1.	**Section 1. Sample characteristics as random variables are ways to represent the results of experiments.**	*2*	*2*	-	*18*	*22*
2.	**Section No.2. Methods for screening out measurement misses.**	*2*	*2*	-	*10*	*14*

No.	Section					
3.	**Section No.3. The concept of a parametric criterion. The power of the criterion. Confidence probability.**	*4*	*6*	*-*	*4*	*14*
4.	**Section No. 4. Fundamentals of optimization. Construction of mathematical models.**	*4*	*12*	*-*	*24*	*40*
5.	**Section No.5. Methods of decision-making under conditions of uncertainty and multicriteria.**	*2*	*8*	*-*	*2*	*12*
6.	**Section No. 6. Ranking of factors. Processing of survey results.**	*-*	*-*		*14*	*14*
7.	**Section No. 7. Methods of cluster analysis.**	*2*	*14*		*12*	*28*

6. Laboratory workshop
No laboratory workshop provided.

7. Practical exercises (seminars)

No.	Discipline section No.	Subjects of practical classes (seminars)	Labor capacity (hour.)
	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.	
	Section No.2. Methods for screening out measurement misses.	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.	
		Topic 2.1. The "3-sigma" rule. The Chauvenet criterion. Criteria of Romanovsky, Irwin, Dixon, variational scope	
	Section No.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.	
	Section No. 4. Fundamentals	Topic 4.1. The concept of the objective function, the limitations of the decision-making domain.	

		of optimization. Construction of mathematical models.		
			Topic 4.2: The Brandon method	
		Section No.5. Methods of decision-making under conditions of uncertainty and multicriteria.	Topic 5.1. Criteria of Wald, Laplace, Hurwitz, Savage, mixed criteria.	
		Section No. 6. Ranking of factors. Processing of survey results.	Topic 6.1. Topic: Ranking methods. Calculation of the concordance coefficient	
		Section No. 7. Methods of cluster analysis.	Topic 7.1. Ways of forming clusters. Calculation of the characteristics of cluster centers, dispersion.	

8. Material and technical support of the discipline:

Auditorium with a list of logistics	Location
Lecture room - Specialized room number 20 - "Modeling of large-span building structures" Equipment and furniture: - a set of specialized furniture; - chalk board; - projection screen; - multimedia projector EPSON EMP-X5.	Moscow, st. Ordzhonikidze, 3

9. Information support of the discipline
Resources of the Internet information and telecommunications network»:
1. EBS RUDN and third-party EBS to which university students have
access on the basis of concluded contracts:
-EBS RUDN Electronic Library System – EBS RUDN
http://lib.rudn.ru/MegaPro/Web
- EBS "University Library online" http://www.biblioclub.ru
-EBS Yurayt http://www.biblio-online.ru
-EBS "Student Consultant" www.studentlibrary.ru
-EBS" Doe " http://e.lanbook.com/
2. Websites of ministries, departments, services, industrial enterprises and
companies whose activities are specialized for this discipline:
- Website of the Ministry of Construction and Housing and Communal Services
Russian Federation http://www.minstroyrf.ru/
3. Databases and search engines:
- electronic fund of legal and regulatory and technical documentation

http://docs.cntd.ru/
search engine Yandex https://www.yandex.ru/
- Google search engine https://www.google.ru/
- bibliographic database SCOPUS
http://www.elsevierscience.ru/products/scopus/
Construction Internet resources (foreign):
1. Arcat.Com: Architectural information on building materials,
manufacturers, specifications, BIM modules and CAD primitives, USA.2. ArchiBase.Net: Architectural Community. GDL objects, high-quality
textures, and artwork from all over the world.
3. Bau-Center.Com: German construction portal "Euronewspaper".
4. BuilderCentral.Com: A comprehensive guide to the builder and
designer, USA.
5. BuilderConstructor.com: Directory for builders and designers,
USA.
6. BuildingOnLine.Com: Portal construction industry on the Internet, USA.
7. ConstructionEducation.Com: International Portal for Education in
Construction, USA.
8. ENR.Construction.Com: The Construction Industry Bible: news and
characteristics of projects, materials in construction, architecture,
engineering. USA.
9. GreatPossibilities.Com: Construction Industry Catalog and
Classifier, USA.
10. Jet-Grouting.Com: Portal-forum for builders and designers
"Jet-Grouting".
11. PlanningPlanet.Com: Resource for specialists in planning and design
management, Online Forums (USA).

10. Educational and methodological support of the discipline:

Main literature:
1. Ипатова, Э.Р. Методологии и технологии системного проектирования инфор-мационных систем : учебник / Э.Р. Ипатова, Ю.В. Ипатов. - 2-е изд., стер. - Москва : Издательство «Флинта», 2016. - 257 с. : табл., схем. - (Информационные технологии). - Библиогр.: с. 95-96 - ISBN 978-5-89349-978-0 ; То же [Электронный ресурс]. - Режим доступа: URL: http://biblio-club.ru/index.php?page=book&id=79551.
2. Царёв, Р.Ю. Алгоритмы и структуры данных (CDIO) : учебник / Р.Ю. Царёв, А.В. Проко-пенко ; Министерство образования и науки Российской Федерации, Сибир-ский Федераль-ный университет. - Красноярск : СФУ, 2016. - 204 с. : ил. - Библиогр. в кн. - ISBN 978-5-7638-3388-1 ; То же [Электронный ресурс]. - - Режим доступа: URL: http://biblioclub.ru/in-dex.php?page=book&id=497016..

11. Methodical instructions for students on mastering the discipline (module)

Methodological guidelines for students on the development of the discipline (module)
Lectures are delivered in classrooms equipped with technical training facilities and video projectors.
Lectures should be presented in the form of PowerPoint presentations.
Laboratory work is carried out in a laboratory fully equipped for laboratory work.
Practical classes are held in classrooms equipped with technical training facilities. Practical tasks are analyzed, as well as examples of solving computational and graphical tasks.
Control measures consist of two control works (for 2 ak. one hour each), exam at the end of the se-mester.
Methodological recommendations for the student are posted in the TUIS.

12. Fund of assessment tools for intermediate certification of students in the discipline (module)
Materials for assessing the level of mastering the educational material of the discipline "Geometric Shaping and Analysis of Shells ", including a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of the assessment scales, typical control tasks or other materials necessary to assess knowledge, skills, skills and (or) experience of activity, characterizing the stages of the formation of competencies in the process of mastering the educational program, methodological materials that determine the procedures for assessing knowledge, skills, skills and (or) experience of activities that characterize the stages of the formation of competencies are developed in full and are available for students on the discipline page in TUIS RUDN.

The program is compiled in accordance with the requirements of the ES HE in the RUDN.

Developer:

Associate Professor of the Department of Civil Engineering   M. I. Rynkovskaya

Program Manager
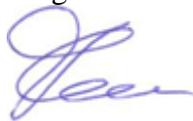
Associate Professor of the Department of Civil Engineering   M. I. Rynkovskaya

Director of the Construction Department   M. I. Rynkovskaya