Federal State Autonomous Educational Institution of Higher Education
"Peoples' Friendship University of Russia named after Patrice Lumumba"

Academy of Engineering
(name of the main educational unit (MEU) that developed the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

THEORY OF PROBABILITY AND MATHEMATICAL STATISTICS
(name of discipline/module)

Recommended for the field of study/specialty:

27.03.04 CONTROL IN TECHNICAL SYSTEMS
(code and name of the training area/specialty)

The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):

DATA SCIENCE AND SPACE SYSTEMS
(name (profile/specialization) of the educational institution of higher education)

2025

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Theory of Probability and Mathematical Statistics" is part of the bachelor's program "Data Science"and Space Systems" in the direction 27.03.04 "Control in Technical Systems" and is studied in 3, 4 semesters of the 2nd year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 13 sections and 43 topics and is aimed at studying the understanding of the goals and objectives of probability theory and their role and place in socio-economic research and engineering applications, modern trends in probability theory, methodological problems of probability theory; basic concepts of combinatorics, probability theory, fundamentals of the theory of random processes, basic concepts and problems of mathematical statistics, familiarization with the basic concepts of probability theory (event, probability, random variable, numerical characteristics of random variables, etc.), mastering the basic techniques for solving practical problems on the topics of the discipline, developing computer skills in scientific research, the possibilities of applying the mastered methods in solving specific engineering problems

The purpose of mastering the discipline is to study the basics of probability theory and mathematical statistics

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Probability Theory and Mathematical Statistics" is aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies developed in students while mastering the discipline (results of mastering the discipline)

Cipher	Competence	**Indicators of Competence Achievement** (within the framework of this discipline)
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	GPC-3.1 Knows the theoretical foundations and principles of mathematical modeling; GPC-3.2 Able to develop and use methods of mathematical modeling, information technologies to solve problems of applied mathematics; GPC-3.3 Possesses practical skills in solving problems of applied mathematics, methods of mathematical modeling, information technologies and the basics of their use in professional activities, skills of professional thinking and an arsenal of methods and approaches necessary for the adequate use of methods of modern mathematics in theoretical and applied problems;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL EDUCATIONAL EDUCATION

Discipline " Theory of Probability and Mathematical Statistics " refers to the mandatory part of block 1 “Disciplines (modules)” of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Theory of Probability and Mathematical Statistics ".

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	Mathematical analysis; Algebra and Geometry;	Research work / Scientific research work; Technological Training; Undergraduate Training; Space Flight Mechanics; Numerical Methods; Automatic Control Theory; Equations of mathematical physics; Optimal Control Methods; Analysis of Geoinformation Data;

* - filled in in accordance with the competency matrix and the SUP EP HE
** - elective disciplines/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF STUDY WORK

The total workload of the discipline “Theory of Probability and Mathematical Statistics” is “7” credit units.

Table 4.1. Types of educational work by periods of mastering the educational program of higher education for full-time education.

Type of academic work	**TOTAL,**ac.h.		**Semester(s)**	
			3	**4**
Contact work, academic hours	*123*		*72*	*51*
Lectures (LC)	53		36	17
Laboratory work (LW)	0		0	0
Practical/seminar classes (SC)	70		36	34
Independent work of students, academic hours	*75*		*54*	*21*
Control (exam/test with assessment), academic hours	*54*		*18*	*36*
General complexity of the discipline	**ac.h.**	***252***	*144*	*108*
	credit.ed.	*7*	*4*	*3*

5. CONTENT OF THE DISCIPLINE

Table 5.1. Contents of the discipline (module) by types of academic work

Section number	Name of the discipline section	Section Contents (Topics)		Type of academic work*
Section 1	Probability space	1.1	Space of elementary outcomes.	LC, SC
		1.2	Events, actions on them.	LC, SC
		1.3	Axiomatic definition of probability.	LC, SC
		1.4	Probability space	LC, SC
Section 2	Classical and geometric probabilities	2.1	Classical definition of probability	LC, SC
		2.2	Elements of Combinatorics	LC, SC
		2.3	Hypergeometric distribution	LC, SC
		2.4	Geometric definition of probability. The meeting problem. Buffon's problem (throwing a needle).	LC, SC
Section 3	Conditional Probability. Independence of Events. Formula of Total Probability and Bayes	3.1	Conditional probability. Formula for multiplying probabilities.	LC, SC
		3.2	Independence of events in pairs and in the aggregate. Bernstein's example of events independent in pairs but dependent in the aggregate	LC, SC
		3.3	Formula of total probability. Bayes' formula.	LC, SC
Section 4	Bernoulli diagram	4.1	Bernoulli diagram, Bernoulli formula.	LC, SC
		4.2	Poisson's theorem.	LC, SC
		4.3	Local Moivre-Laplace theorem. Integral Moivre-Laplace theorem.	LC, SC
		4.4	Bernoulli's theorem (the law of large numbers in Bernoulli's form). Polynomial scheme.	LC, SC
Section 5	Random variables and their distributions	5.1	Random variable. Distribution function and its properties.	LC, SC
		5.2	Discrete random variable. Distribution series. Binomial, Poisson, geometric distributions.	LC, SC
		5.3	Continuous random variable. Distribution density and its properties. Uniform, exponential, normal, gamma distributions.	LC, SC
		5.4	Function of a random variable (calculation of distributions of a function of a random variable for different cases).	LC, SC
Section 6	Multidimensional random variables and their properties	6.1	Multidimensional random variable (using 2-dimensional as an example). Joint distribution function and its properties.	LC, SC
		6.2	Discrete two-dimensional random variable.	LC, SC
		6.3	Continuous two-dimensional random variable. Joint distribution density and its properties.	LC, SC
		6.4	Multidimensional normal law.	LC, SC
		6.5	Conditional distributions of random variables. Independent random variables.	LC, SC
		6.6	Functions of a two-dimensional random variable (calculation of distributions). Convolution formula.	LC, SC
Section 7	Numerical characteristics of random variables	7.1	Mathematical expectation of a random variable, its properties.	LC, SC
		7.2	Variance of a random variable, its properties.	LC, SC
		7.3	Covariance and correlation coefficient of random variables, their properties. Covariance matrix.	LC, SC
		7.4	Higher order moments. Median, quantile, mode, entropy.	LC, SC
Section 8	Convergence of random variables	8.1	Convergence of random variables. Types of convergence. Chebyshev inequality. (Weak) law of large numbers for independent identically distributed random variables, its generalizations.	LC, SC

Section number	Name of the discipline section	Section Contents (Topics)		Type of academic work*
Section 9	Central Limit Theorem	9.1	Central limit theorem for independent identically distributed random variables.	LC, SC
Section 10	Introduction to Mathematical Statistics and Parameter Estimation Theory	10.1	Basic concepts of mathematical statistics	LC, SC
		10.2	Estimates of unknown parameters, properties of estimates. Basic methods of point estimation	LC, SC
		10.3	Interval estimation.	LC, SC
Section 11	Testing statistical hypotheses	11.1	The concept of statistical hypothesis. Errors of the first and second kind. Statistical criterion. Criterion power.	LC, SC
		11.2	Algorithm for testing statistical hypothesis. Neyman-Pearson lemma. Criteria for testing parametric hypotheses. Chi-square goodness-of-fit test for testing hypothesis about the type of distribution of random variable.	LC, SC
		11.3	Student's criterion, Fisher's criterion, Kolmogorov-Smirnov criterion. Criterion based on the sample correlation coefficient.	LC, SC
		11.4	Rank tests. Wilcoxon test. Spearman's rank correlation coefficient. Tests for independence of two random variables.	LC, SC
Section 12	Applications of Mathematical Statistics	12.1	Regression analysis. Regression models. Least squares method. Gauss-Markov scheme.	LC, SC
		12.2	Simple linear regression. Method of statistical tests. Concept of experimental design.	LC, SC
Section 13	Random processes	13.1	The concept of a random process. Classification and main characteristics of random processes	LC, SC
		13.2	Stationary random processes. Linear and nonlinear transformations, differentiation and integration of random processes.	LC, SC
		13.3	Stationary white noise. The concept of a Markov random process. Discrete and continuous Markov processes. Markov chain.	LC, SC

* - filled in only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means for multimedia presentations.	
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
For independent work	A classroom for independent work of students (can be used for conducting seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

* - the audience for independent work of students MUST be indicated!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. V.E. Gmurman. Guide to solving problems in probability theory and mathematical statistics: Textbook for applied bachelor's degree. - 11th ed., revised and enlarged. - M.: Yurait, 2014. - 404 p.

2. Zaryadov I.S., Kozyrev D.V., Milovanova T.A., Razumchik R.V. “Collection of problems in probability theory and mathematical statistics”: a textbook.Moscow: RUDN, 2014. – 140 pp.: ill.

3. Bocharov P.P., Pechinkin A.V. Probability Theory and Mathematical Statistics. - M.: Fizmatlit.2005.

4. Pismennyi D.T. Lecture notes on probability theory, mathematical statistics and random processes. – 7th ed. – M.: Iris-press, 2015.

5. Kibzun A.I., Goryainova E.R., Naumov A.V. Probability Theory and Mathematical Statistics: Basic Course with Examples and Problems. — M.: Fizmatlit, 2007.

6. Kochetkov E.S., Smerchinskaya S.O. Probability Theory in Problems and Exercises. – 2nd ed. – M.: FORUM, 2017

Further reading:

1. Bocharov P.P., Pechinkin A.V. Probability Theory and Mathematical Statistics. – M.: Fizmatlit.2005

2. V. Feller, Introduction to Probability Theory and Its Applications, vol. 1,2. - M.: Librokom, 2010

3. Ventzel E.S., Ovcharov Probability Theory and Its Engineering Applications. — M.: Knorus, 2010.

4. Ivchenko G.I., Medvedev Yu.I. Mathematical statistics. - M.: Higher school, 1992

5. Pugachev V.S. Probability Theory and Mathematical Statistics - M.: Nauka, 1979

Resources of the information and telecommunications network "Internet":

1. RUDN University EBS and third-party EBSs to which university students have access on the basis of concluded agreements

- Electronic library system of RUDN - ELS RUDNhttp://lib.rudn.ru/MegaPro/Web
- Electronic library system "University library online"http://www.biblioclub.ru
- EBS Yuraithttp://www.biblio-online.ru
- Electronic Library System "Student Consultant" www.studentlibrary.ru
- Electronic library system "Troitsky Bridge"

2. Databases and search engines

- electronic fund of legal and normative-technical documentationhttp://docs.cntd.ru/
- Yandex search enginehttps://www.yandex.ru/

- search engineGoogle https://www.google.ru/
- abstract databaseSCOPUS http://www.elsevierscience.ru/products/scopus/

Educational and methodological materials for independent work of students in mastering a discipline/module:*

1. Lecture course on the subject "Probability Theory and Mathematical Statistics".

* - all educational and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

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