**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

ALGEBRA AND GEOMETRY

(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 discipline "Algebra and Geometry" is included in the bachelor's program "Data Science and Space Systems" in the direction 27.03.04 "Control in Technical Systems" and is studied in semesters 1 and 2 of the 1st year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 6 sections and 76 topics and is aimed at studying the theoretical foundations of matrix algebra, the theory of linear spaces, systems of linear algebraic equations, linear operators, analytical geometry, vector algebra, lines and surfaces of the first and second order. Particular attention is paid to the analysis of methods for solving typical problems and the analysis of the area of their application in professional activities.

The purpose of mastering the discipline is to increase the level of mathematical literacy, the formation of fundamental knowledge and skills in applying methods for solving problems of linear algebra and analytical geometry, necessary for professional activity and mastering subsequent disciplines.

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Algebra and Geometry" 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-1	Able to analyze the tasks of professional activity based on provisions, laws and methods in the field of natural sciences and mathematics	GPC-1.1 Possesses basic knowledge obtained in the field of mathematical and (or) natural sciences; GPC-1.2 Knows how to use them in professional activities; GPC-1.3 Has the skills to select methods for solving problems of professional activity based on theoretical knowledge;
GPC-2	Able to formulate tasks of professional activity based on knowledge, specialized sections of mathematical and natural science disciplines (modules)	GPC-2.1 Has mastered mathematical methods, programming fundamentals and specialized programming systems for implementing algorithms for solving applied problems; GPC-2.2 Able to select and adapt mathematical methods and software to solve practical problems; GPC-2.3 Possesses skills in developing and implementing algorithms for solving applied problems in the field of professional activity;
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 "Algebra and Geometry" 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 "Algebra and Geometry".

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-1	Able to analyze the tasks of professional activity based on provisions, laws and methods in the field of natural sciences and mathematics		Research work / Scientific research work; Technological Training; Undergraduate Training; Research Work; Space Flight Mechanics; Complex analysis;
GPC-2	Able to formulate tasks of professional activity based on knowledge, specialized sections of mathematical and natural science disciplines (modules)		Space Flight Mechanics; Numerical Methods; Automatic Control Theory; Equations of mathematical physics; Analysis of Geoinformation Data; Research work / Scientific research work; Technological Training; Undergraduate Training; Research Work;
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities		Research work / Scientific research work; Technological Training; Undergraduate Training; Space Flight Mechanics; Theoretical Mechanics; Numerical Methods; Automatic Control Theory; Theory of Probability and Mathematical Statistics; Differential equations; Complex analysis; 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 "Algebra and Geometry" is "8" 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)	
			1	2
Contact work, academic hours	*122*		*54*	*68*
Lectures (LC)	52		18	34
Laboratory work (LW)	0		0	0
Practical/seminar classes (SC)	70		36	34
Independent work of students, academic hours	*112*		*27*	*85*
Control (exam/test with assessment), academic hours	*54*		*27*	*27*
General complexity of the discipline	**ac.h.**	**288**	*108*	*180*
	credit.ed.	**8**	*3*	*5*

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	Principles of Linear Algebra and Analytic Geometry	1.1	Linear and affine spaces	LC, SC
		1.2	Linear dependence of vectors	LC, SC
		1.3	Rank of a matrix and a system of vectors	LC, SC
		1.4	Matrices and actions on them	LC, SC
		1.5	Action of a matrix on a vector	LC, SC
		1.6	Dot product and its matrix notation	LC, SC
		1.7	Degeneracy and non-degeneracy	LC, SC
		1.8	Permutations and their signs	LC, SC
		1.9	Multiplication (composition) of permutations	LC, SC
		1.10	Determinant, its geometric meaning	LC, SC
		1.11	Trace of the Matrix	LC, SC
		1.12	Coordinate systems, vector and mixed product of vectors	LC, SC
		1.13	Equations of lines, planes	LC, SC
		1.14	Distance from a point to a line (plane)	LC, SC
		1.15	Angles between lines	LC, SC
		1.16	Orientation of a line (plane, space)	LC, SC
Section 2	Systems of linear equations	2.1	Matrix notation of a system of linear equations	LC, SC
		2.2	Gauss method for solving systems of linear equations	LC, SC
		2.3	Kronecker-Capelli theorem	LC, SC
		2.4	Non-degenerate systems	LC, SC
		2.5	Calculating the inverse of a matrix	LC, SC
		2.6	Cramer's formulas	LC, SC
		2.7	Homogeneous systems of linear equations	LC, SC
		2.8	The solution space of a system of linear equations	LC, SC
		2.9	Geometrical meaning of systems of linear equations	LC, SC
		2.10	Sum and intersection of linear subspaces	LC, SC
		2.11	Mutual arrangement of affine subspaces	LC, SC
Section 3	Linear mappings and linear operators	3.1	Linear mappings and operations on them	LC, SC
		3.2	Linear transformation matrix	LC, SC
		3.3	Dependence of the transformation matrix on the choice of basis	LC, SC
		3.4	Canonical form of a linear mapping	LC, SC
		3.5	Eigenvalues and eigenvectors of a linear operator	LC, SC
		3.6	Characteristic polynomial of the operator	LC, SC
		3.7	Diagonalizable operators	LC, SC
		3.8	Linear operators in Euclidean space	LC, SC
		3.9	Orthogonal operator and its diagonalizability	LC, SC
		3.10	Symmetric operator and its diagonalizability	LC, SC
		3.11	Movements on the plane and in space	LC, SC
		3.12	Representation of motion as a composition of rotation and parallel translation	LC, SC
		3.13	Affine transformations of the plane and space	LC, SC
		3.14	Representation of an affine transformation as a composition of a homothety and a motion	LC, SC
Section 4	Lines and surfaces of the second order	4.1	General equation of the second order and its reduction to canonical form	LC, SC
		4.2	Intersection of a second-order line and a straight line	LC, SC
		4.3	Tangent to a line of the second order	LC, SC
		4.4	Classification of second order lines	LC, SC
		4.5	Surfaces of the second order	LC, SC

Section number	Name of the discipline section		Section Contents (Topics)	Type of academic work*
Section 5	Algebraic structures on sets. Complex numbers	5.1	The beginning of group theory	LC, SC
		5.2	Transformation groups	LC, SC
		5.3	Examples of Abelian groups	LC, SC
		5.4	Examples of non-abelian groups: matrices, permutations	LC, SC
		5.5	Classification of Abelian finite groups	LC, SC
		5.6	Subgroups, normal divisors (normal subgroups), conjugation, cosets, factor groups	LC, SC
		5.7	Concepts of monomorphism, epimorphism, isomorphism	LC, SC
		5.8	Fields and rings	LC, SC
		5.9	Deduction rings	LC, SC
		5.10	Field of complex numbers	LC, SC
		5.11	Complex numbers and their application in various questions of algebra, geometry and trigonometry	LC, SC
		5.12	The modulus and argument of a complex number	LC, SC
Section 6	Polynomials and algebraic numbers	6.1	Division with remainder in the ring of polynomials with one unknown and the ring of integers	LC, SC
		6.2	Greatest common divisor of two polynomials (integers)	LC, SC
		6.3	Euclid's algorithm	LC, SC
		6.4	Least common multiple	LC, SC
		6.5	Irreducible polynomial (prime number)	LC, SC
		6.6	The fundamental theorem of arithmetic	LC, SC
		6.7	Roots of a polynomial	LC, SC
		6.8	Multiple roots	LC, SC
		6.9	Derivative of a polynomial	LC, SC
		6.10	Taylor polynomial	LC, SC
		6.11	Algebraic and transcendental numbers	LC, SC
		6.12	Minimal polynomial of an algebraic number	LC, SC
		6.13	Algebraic integers	LC, SC
		6.14	Polynomials in several unknowns	LC, SC
		6.15	Lexicographic ordering of monomials	LC, SC
		6.16	Symmetric polynomials	LC, SC
		6.17	The fundamental theorem of the theory of symmetric polynomials	LC, SC
		6.18	Vieta's formulas	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,	

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
	ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	
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. Ilyin, V. A. Linear algebra and analytic geometry: textbook / V. A. Ilyin, G. D. Kim. - Moscow: Prospect, 2015. - 400 p. -ISBN 978-5-392-16339-7

2. Beklemishev, D.V. Course of analytical geometry and linear algebra: textbook. - 13th ed., corrected / D.V. Beklemishev - St. Petersburg: Lan Publishing House, 2015. - 448 p.

3. Collection of problems in mathematics for higher education institutions: a textbook for higher education institutions: in 4 parts / Bolgov V. A., Demidovich B. P., Efimov A. V. [et al.]; general editors Efimov A. V., Demidovich B. P. - 3rd ed., corrected. - Moscow: Alliance, 2014. Part 1: Linear algebra and foundations of mathematical analysis. - 2014. - 478 p. - Reprint. reproduction of the 1993 edition. -ISBN 978-5-91872-051-6.¶

4. Beklemisheva L.A., Petrovich A.Yu., Chubarov I.A. Collection of problems in analytical geometry and linear algebra.M., Fizmatlit, 2004

Further reading:

1. Aleksandrov P.S., Lectures on Analytical Geometry: textbook / P.S. Aleksandrov - M., Nauka, 1968. - 912 p.

2. Manturov, O. V. Course of higher mathematics: linear algebra; analytical geometry; differential calculus of functions of one variable: textbook for technical universities / O. V. Manturov, N. N. Matveev. - Moscow: Higher School, 1986. - 480 p.

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. A course of lectures on the subject "Algebra and Geometry".

      * - 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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