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 field of study/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)

2026

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Algebra and Geometry" is part of the "Data Science and Space Systems" bachelor's program in the 27.03.04 "Control in Technical Systems" program and is studied in semesters 1 and 2 of the first year. The course is offered by the Department of Mechanics and Control Processes. It consists of 6 sections and 28 topics and focuses on the theoretical foundations of matrix algebra, the theory of linear spaces, systems of linear algebraic equations, linear operators, analytic geometry, vector algebra, and first- and second-order lines and surfaces. Particular attention is paid to the analysis of methods for solving typical problems and their application in professional activities.

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

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Algebra and Geometry" 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 Competency Achievement** (within 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 Able 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 objectives for professional activity based on knowledge of specialized sections of mathematical and natural science disciplines (modules)	GPC-2.1 Has a command of 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 INSTITUTION

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, practical training*	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 objectives for professional activity based on knowledge of 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 accordance with the competency matrix and the SUP EP HE
** - elective courses/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF EDUCATIONAL 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,**academic hours		**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*
Total complexity of the discipline	**academic hours**	***288***	*108*	*180*
	credit	***8***	*3*	*5*

5. CONTENT OF THE DISCIPLINE

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

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
Section 1	Principles of Linear Algebra	1.1	Linear spaces and vector systems	Linear and affine spaces. Linear dependence of vectors. Rank of a matrix and a system of vectors.	LC, SC
		1.2	Matrices and operations on them	Matrices and operations on them. Matrix action on a vector. The dot product and its matrix notation. Singularity and non-singularity of matrices.	LC, SC
		1.3	Permutations and determinants	Permutations and their signs. Multiplication of permutations. The determinant and its geometric meaning. The trace of a matrix.	LC, SC
		1.4	Vector algebra	Coordinate systems. Scalar, vector, and mixed product of vectors.	LC, SC
		1.5	Lines and planes in space	Equations of lines and planes. Distance from a point to a line and to a plane. Angles between lines.	LC, SC
		1.6	Orientation	Orientation of a line, plane, space.	LC, SC
Section 2	Systems of linear equations	2.1	Basic concepts and solution methods	Matrix representation of a system of linear equations. Gauss's method for solving systems of linear equations. Kronecker-Capelli theorem.	LC, SC
		2.2	Non-degenerate systems	Non-degenerate systems. Calculating the inverse matrix. Cramer's formulas.	LC, SC
		2.3	Homogeneous systems	Homogeneous systems of linear equations. Solution space of a system of linear equations.	LC, SC
		2.4	Geometric interpretation	The geometric meaning of systems of linear equations. Mutual arrangement of affine subspaces.	LC, SC
		2.5	Linear subspaces	Sum and intersection of linear subspaces.	LC, SC
Section 3	Linear mappings and linear operators	3.1	Linear mappings and their matrices	Linear mappings and operations on them. Linear transformation matrix. Dependence of the transformation matrix on the choice of basis.	LC, SC
		3.2	Eigenvalues and eigenvectors	Eigenvalues and eigenvectors of a linear operator. Characteristic polynomial of the operator. Diagonalizable operators.	LC, SC
		3.3	Linear operators in Euclidean space	Linear operators in Euclidean space. Orthogonal operator and its diagonalizability. Symmetric operator and its diagonalizability.	LC, SC
		3.4	Movements of plane and space	Motion on a plane and in space. Representation of motion as a composition of rotation and parallel translation.	LC, SC
		3.5	Affine transformations	Affine transformations of the plane and space. Representation of an affine transformation as a composition of a homothety and a mo-	LC, SC

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
				tion.	
		3.6	Canonical view	Canonical form of a linear mapping	LC, SC
Section 4	Lines and surfaces of the second order	4.1	Second-order lines	The general second-order equation and its reduction to canonical form. The intersection of a second-order curve and a straight line. The tangent to a second-order curve. Classification of second-order curves.	LC, SC
		4.2	Quadric surfaces	Ellipsoids, hyperboloids, paraboloids, cones, cylinders. Canonical equations and geometric properties.	LC, SC
Section 5	Algebraic structures on sets. Complex numbers	5.1	Groups	Principles of group theory. Transformation groups. Examples of Abelian groups. Examples of non-Abelian groups: matrices, permutations. Classification of finite Abelian groups. Subgroups, normal divisors, conjugation, cosets, quotient groups.	LC, SC
		5.2	Group homomorphisms. Rings and fields	Concepts of monomorphism, epimorphism, and isomorphism. Fields and rings. Residue rings.	LC, SC
		5.3	Complex numbers	Field of complex numbers. The modulus and argument of a complex number.	LC, SC
		5.4	Applications of complex numbers	Complex numbers and their application in various questions of algebra, geometry and trigonometry.	LC, SC
Section 6	Polynomials and algebraic numbers	6.1	Division and divisibility of polynomials	Division with remainder in the ring of polynomials in one unknown and the ring of integers. The greatest common divisor of two polynomials and integers. The Euclidean algorithm. The least common multiple.	LC, SC
		6.2	Irreducible polynomials and the fundamental theorem of arithmetic	Irreducible polynomial and prime number. Fundamental theorem of arithmetic.	LC, SC
		6.3	Roots of a polynomial	Roots of a polynomial. Multiple roots. Derivative of a polynomial. Taylor polynomial. Vieta's formulas.	LC, SC
		6.4	Algebraic numbers	Algebraic and transcendental numbers. Minimal polynomial of an algebraic number. Algebraic integers.	LC, SC
		6.5	Polynomials in several variables	Polynomials in several unknowns. Lexicographic ordering of monomials. Symmetric polynomials. The fundamental theorem of the theory of symmetric polynomials.	LC, SC

* - to be completed 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 for the discipline

Audience type	Equipment of the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	A lecture hall equipped with specialized furniture, a whiteboard (screen), and multimedia presentation equipment.	Projector
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.	No
For independent work	A classroom for independent student work (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	No

* - the classroom 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 technical universities: a textbook for technical universities: 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. Moscow, Fizmatlit, 2004

Further reading:

1. Alexandrov P.S., Lectures on Analytical Geometry: textbook / P.S. Alexandrov - 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: Vysshaya shkola, 1986. - 480 p.

Resources of the information and telecommunications network "Internet":

1. RUDN University Electronic Library System and third-party electronic library systems to which university students have access based on concluded agreements

- Electronic library system of RUDN - ELS RUDN http://lib.rudn.ru/MegaPro/Web

- Electronic Library System "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://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 regulatory 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/

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

1. Lecture course on the subject "Algebra and Geometry".

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

DEVELOPER:

Associate Professor		Saltykova Olga Alexandrovna
Position, DEPARTMENT	*Signature*	*Surname I.O.*

HEAD OF THE DEPARTMENT:

Head of Department		Razumny Yuri Nikolaevich
Position of the DEPARTMENT	*Signature*	*Surname I.O.*

HEAD OF THE EP HE:

Professor		Razumny Yuri Nikolaevich
Position, DEPARTMENT	*Signature*	*Surname I.O.*