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

Academy of Engineering

(name of the main educational unit (POU) - developer of the EP HE)

COURSE SYLLABUS

ALGEBRA AND GEOMETRY

(name of discipline/module)

Recommended by the Didactic Council for the Education Field of:

27.03.04 CONTROL IN TECHNICAL SYSTEMS

(code and name of the area of training/specialty)

The course instruction is implemented within the professional education programme of higher education:

DATA ENGINEERING AND SPACE SYSTEMS CONTROL

(name (profile/specialization) EP HE)

1. GOAL OF DISCIPLINE MASTERING

The discipline “Algebra and Geometry” is included in the bachelor’s program “Data Engineering and Space Systems Control” in the direction of 27.03.04 “Control in Technical Systems” and is studied in the 1st and 2nd semesters 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 analysis of the scope of their application in professional activities.

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

2. REQUIREMENTS FOR 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 formed in students when mastering the discipline (results of mastering the discipline)

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
GPC-1	Able to analyze professional tasks based on regulations, laws and methods in the field of natural sciences and mathematics	GPC-1.1 Has basic knowledge acquired 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 tasks of professional activity based on knowledge, specialized sections of mathematical and natural science disciplines (modules)	GPC -2.1 Proficient in 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 the skills of 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, professional thinking skills 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 DISCIPLINE IN THE STRUCTURE OF HE EP

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 educational program of higher education, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the discipline “Algebra and Geometry”.

Table 3.1. List of components of EP HE that contribute to achieving the planned results of mastering the discipline

Cipher	Name of competency	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
GPC -1	Able to analyze professional tasks based on regulations, laws and methods in the field of natural sciences and mathematics		Research work / Scientific research work; Technological Training; Undergraduate practice / Pre-graduate practice; 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 practice / Pre-graduate practice;
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 practice / Pre-graduate practice; 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;

** - elective disciplines/practices

4. SCOPE OF DISCIPLINE AND TYPES OF STUDY WORK

The total complexity 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 study.

Type of educational work	TOTAL,ac.ch.		Semester(s)	
			1	2
<i>Contact work, ac.ch.</i>	122		54	68
Lectures (LK)	52		18	34
Laboratory work (LR)	0		0	0
Practical/seminar sessions (SZ)	70		36	34
<i>Independent work of students, ac.ch.</i>	112		27	85
<i>Control (exam/test with assessment), academic degree.</i>	54		27	27
Total labor intensity of the discipline	ac.ch.	288	108	180
	credit units	8	3	5

5. CONTENT OF DISCIPLINE

Table 5.1. Contents of the discipline(module) by type of educational work

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational work*
Section 1	Principles of linear algebra and analytic geometry	1.1	Linear and affine spaces	LC, NW
		1.2	Linear dependence of vectors	LC, NW
		1.3	Rank of matrix and system of vectors	LC, NW
		1.4	Matrices and operations on them	LC, NW
		1.5	Action of a matrix on a vector	LC, NW
		1.6	Dot product and its matrix notation	LC, NW
		1.7	Degeneracy and non-degeneracy	LC, NW
		1.8	Permutations and their signs	LC, NW
		1.9	Multiplication (composition) of permutations	LC, NW
		1.10	Determinant, its geometric meaning	LC, NW
		1.11	Matrix trace	LC, NW
		1.12	Coordinate systems, vector and mixed product of vectors	LC, NW
		1.13	Equations of lines and planes	LC, NW
		1.14	Distance from a point to a straight line (plane)	LC, NW
		1.15	Angles between straight lines	LC, NW
		1.16	Orientation of a straight line (plane, space)	LC, NW
Section 2	Systems of linear equations	2.1	Matrix notation of a system of linear equations	LC, NW
		2.2	Gauss method for solving systems of linear equations	LC, NW
		2.3	Kronecker-Capelli theorem	LC, NW
		2.4	Non-degenerate systems	LC, NW
		2.5	Calculating the inverse matrix	LC, NW
		2.6	Cramer's formulas	LC, NW
		2.7	Homogeneous systems of linear equations	LC, NW
		2.8	Space of solutions of a system of linear equations	LC, NW
		2.9	Geometric meaning of systems of linear equations	LC, NW
		2.10	Sum and intersection of linear subspaces	LC, NW
		2.11	Mutual arrangement of affine subspaces	LC, NW
Section 3	Linear mappings and linear operators	3.1	Linear mappings and operations on them	LC, NW
		3.2	Linear transformation matrix	LC, NW
		3.3	Dependence of the transformation matrix on the choice of basis	LC, NW
		3.4	Canonical form of linear mapping	LC, NW
		3.5	Eigenvalues and eigenvectors of a linear operator	LC, NW
		3.6	Characteristic polynomial of the operator	LC, NW
		3.7	Diagonalizable Operators	LC, NW
		3.8	Linear operators in Euclidean space	LC, NW
		3.9	Orthogonal operator and its diagonalizability	LC, NW
		3.10	Symmetric operator and its diagonalizability	LC, NW
		3.11	Movements on a plane and in space	LC, NW
		3.12	Representation of movement as a composition of rotation and parallel translation	LC, NW
		3.13	Affine transformations of plane and space	LC, NW
		3.14	Representation of an affine transformation as a composition of homothety and motion	LC, NW
Section 4	Lines and surfaces of the second order	4.1	General second order equation and its reduction to canonical form	LC, NW
		4.2	Intersection of a second-order line and a straight line	LC, NW
		4.3	Tangent to a line of second order	LC, NW
		4.4	Classification of second order lines	LC, NW
		4.5	Second order surfaces	LC, NW

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational work*
Section 5	Algebraic structures on sets. Complex numbers	5.1	Group theory began	LC, NW
		5.2	Transformation groups	LC, NW
		5.3	Examples of Abelian groups	LC, NW
		5.4	Examples of non-Abelian groups: matrices, permutations	LC, NW
		5.5	Classification of Abelian finite groups	LC, NW
		5.6	Subgroups, normal divisors (normal subgroups), conjugation, cosets, factor groups	LC, NW
		5.7	Concepts of monomorphism, epimorphism, isomorphism	LC, NW
		5.8	Fields and rings	LC, NW
		5.9	Residue rings	LC, NW
		5.10	Complex number field	LC, NW
		5.11	Complex numbers and their applications in various topics of algebra, geometry and trigonometry	LC, NW
		5.12	Modulus and argument of a complex number	LC, NW
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, NW
		6.2	Greatest common divisor of two polynomials (integers)	LC, NW
		6.3	Euclid's algorithm	LC, NW
		6.4	Least common multiple	LC, NW
		6.5	Irreducible polynomial (prime number)	LC, NW
		6.6	Fundamental Theorem of Arithmetic	LC, NW
		6.7	Roots of a polynomial	LC, NW
		6.8	Multiple roots	LC, NW
		6.9	Derivative of a polynomial	LC, NW
		6.10	Taylor polynomial	LC, NW
		6.11	Algebraic and transcendental numbers	LC, NW
		6.12	Minimal polynomial of an algebraic number	LC, NW
		6.13	Algebraic integers	LC, NW
		6.14	Polynomials in several unknowns	LC, NW
		6.15	Lexicographic ordering of monomials	LC, NW
		6.16	Symmetric polynomials	LC, NW
		6.17	The main theorem of the theory of symmetric polynomials	LC, NW
6.18	Vieta formulas	LC, NW		

* - to be filled out only for full-time education: LC – lectures; LR – laboratory work; SZ – practical/seminar classes.

6. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Auditorium equipment	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; board (screen) and technical means of multimedia presentations.	

Audience type	Auditorium equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	
For independent work	An auditorium for independent work by students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to EIOS.	

* - the audience for independent work of students is MANDATORY!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF DISCIPLINE

Main literature:

1. Ilyin, V. A. Linear algebra and analytical geometry: textbook / V. A. Ilyin, G. D. Kim. - Moscow: Prospekt, 2015. - 400 p. - ISBN 978-5-392-16339-7
2. Beklemishev, D.V. Course of analytical geometry and linear algebra: textbook. — 13th ed., rev. / D.V. Beklemishev - St. Petersburg: Lan Publishing House, 2015. - 448 p.
3. Collection of problems in mathematics for colleges: textbook. manual for colleges: in 4 hours / Bolgov V. A., Demidovich B. P., Efimov A. V. [etc.]; total ed. Efimov A.V., Demidovich B.P. - 3rd ed., revised. - M.: Alliance, 2014. Part 1: Linear algebra and foundations of mathematical analysis. - 2014. - 478 p. - Reprint. reproduction ed. 1993 - ISBN 978-5-91872-051-6.¶
4. Beklemisheva L.A., Petrovich A.Yu., Chubarov I.A. Collection of problems on analytical geometry and linear algebra.M., Fizmatlit, 2004

Additional literature:

1. Aleksandrov 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; Analytic geometry ; Differential calculus of functions of one variable: a textbook for colleges / O. V. Manturov, N. N. Matveev. - Moscow: Higher School, 1986. - 480 p.

Resources of the information and telecommunications network "Internet":

1. EBS of RUDN University and third-party EBS, to which university students have access based on concluded agreements
 - Electronic library system of RUDN University - EBS RUDN University <http://lib.rudn.ru/MegaPro/Web>
 - EBS "University Library Online" <http://www.biblioclub.ru>
 - EBS Law <http://www.biblio-online.ru>
 - EBS "Student Consultant" www.studentlibrary.ru
 - EBS "Trinity Bridge"
2. Databases and search engines
 - electronic fund of legal and regulatory technical documentation <http://docs.cntd.ru/>
 - Yandex search engine <https://www.yandex.ru/>
 - search system Google <https://www.google.ru/>

- abstract database SCOPUS [http://www.elsevier.com/locate/scopus/](http://www.elsevier.com/locate/scopus)
Educational and methodological materials for students' independent work when mastering a discipline/module:*

1. A course of lectures on the discipline "Algebra and Geometry".

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

8. ASSESSMENT MATERIALS AND POINT-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCIES FOR A DISCIPLINE

Evaluation materials and point-rating system* for assessing the level of development of competencies (parts of competencies) based on the results of mastering the discipline "Algebra and Geometry" are presented in the Appendix to this Work Program of the discipline.

* - OM and BRS are formed on the basis of the requirements of the relevant local regulatory act of RUDN University.

DEVELOPER:

Assistant professor

Position,

Signature

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Alexandrovna

Last name I.O.

HEAD OF BUP:

Head of the department

Position

Signature

Razumny Yuri Nikolaevich

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HEAD OF OP VO:

Professor

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