**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

COMPLEX ANALYSIS

(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 "Complex Analysis" 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 the 4th semester of the 2nd year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 6 sections and 17 topics and is aimed at studying the methods and areas of application of the theory of functions of a complex variable.

The purpose of mastering the discipline is to develop the student's mathematical culture and prepare him for mastering other basic mathematical courses

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Complex Analysis" 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-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 "Complex Analysis" 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 "Complex Analysis".

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	Mathematical analysis; Space Flight Mechanics; Algebra and Geometry;	Research work / Scientific research work; Technological Training;

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
	methods in the field of natural sciences and mathematics	Physics;	Undergraduate Training; Research Work; Space Flight Mechanics;
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	Mathematical analysis; Space Flight Mechanics; Theoretical Mechanics; Algebra and Geometry; Theory of Probability and Mathematical Statistics; Differential equations;	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 "Complex Analysis" is "3" 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) 4
Contact work, academic hours	*51*		*51*
Lectures (LC)	17		17
Laboratory work (LW)	0		0
Practical/seminar classes (SC)	34		34
Independent work of students, academic hours	*57*		*57*
Control (exam/test with assessment), academic hours	*0*		*0*
General complexity of the discipline	**ac.h.**	**108**	108
	credit.ed.	**3**	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	Introduction	1.1	Definition of a complex number. Algebraic form of a complex number. Operations on complex numbers. Properties of operations.	LC, SC
		1.2	Geometric interpretation of a complex number. Trigonometric and exponential forms of a complex number. Extracting the root of a complex number.	LC, SC
Section 2	Functions of a complex variable	2.1	Sequences and series of complex numbers. Extended complex plane. Stereographic projection. Riemann sphere. Curves and regions on the complex plane.	LC, SC
		2.2	Continuous complex-valued functions of a real variable. Continuous functions of a complex variable. Exponential, trigonometric and hyperbolic functions.	LC, SC
Section 3	Differentiation and integration	3.1	Integration of functions of a complex variable. Definition of an integral. Properties of integrals. Estimates of integrals.	LC, SC
		3.2	Differentiation of functions of a complex variable. Definition of the derivative. Rules of differentiation.	LC, SC
		3.3	Cauchy-Riemann conditions. Differentiable functions at a point and in a domain. Necessary and sufficient conditions for differentiability of a function at a point.	LC, SC
		3.4	Geometric meaning of the derivative. Concept of conformality of mapping. Inverse function theorem. Multivalued functions "root" and logarithm. Cauchy integral theorem. Composite contour theorem.	LC, SC
		3.5	Antiderivative. Newton–Leibniz formula.	LC, SC
Section 4	Regular functions	4.1	Regular functions. Power series. Absolute and uniform convergence of power series. Abel's theorem. Integration and differentiation of power series.	LC, SC
		4.2	Cauchy integral formula. Properties of functions regular in a domain. Harmonic functions.	LC, SC
		4.3	Theorems on the mean. Sufficient conditions for the regularity of a function in a domain. Morera's theorem. Weierstrass's first and second theorems. Uniqueness theorem.	LC, SC
		4.4	Analytic continuation of regular functions. Isolated singular points of single-valued character.	LC, SC
Section 5	Laurent series	5.1	Expansion of a regular function into a Laurent series. Uniqueness of expansion. Study of singular points using Laurent series. Criteria for the existence of a removable singular point, pole, essential singular point. Behavior of a function in the neighborhood of an essential singular point. Theorems of Sokhotsky and Picard.	LC, SC
		5.2	Entire functions. Liouville's theorem. Fundamental theorem of algebra.	LC, SC
Section 6	Deduction Theory and Its Application	6.1	Residue theory and its application. The fundamental theorem of residue theory. Calculating integrals using residues.	LC, SC

Section number	Name of the discipline section	Section Contents (Topics)		Type of academic work*
		6.2	Integrals over a closed contour. Calculation of improper integrals of a real variable. Jordan's lemma	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.	
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. Sveshnikov, A.G. Theory of functions of a complex variable: textbook / A.G. Sveshnikov, A.N. Tikhonov. - 6th ed., stereotype. - Moscow: Fizmatlit, 2010. - 334 p.http://biblioclub.ru/index.php?page=book&id=75710
2. Malysheva, N.B. Functions of a complex variable: textbook / N.B. Malysheva, E.R. Rozendorn. - Moscow: Fizmatlit, 2010. - 168 p. -ISBN 978-5-9221-0977-2; Ditto [Electronic resource]. - URL: http://biblioclub.ru/index.php?page=book&id=68367
3. Popov, V.N. Applied issues of the theory of functions of a complex variable: a tutorial / V.N. Popov; Ministry of Education and Science of the Russian Federation, Federal State Autonomous Educational Institution of Higher Professional Education Northern (Arctic) Federal University named after M.V. Lomonosov. - Arkhangelsk: IPC NArFU, 2013. - 164 p.: ill. - Bibliography in the book.ISBN 978-5-261-00850-7 ; Ditto [Electronic resource]. - URL: http://biblioclub.ru/index.php?page=book&id=436400.
4. Khatskevich V.P. Theory of functions of a complex variable.http://web-local.rudn/ru/web-local/prep/prep_2071

5. Khatskevich V.P. Examples and exercises on the theory of functions of a complex variable.http://web-local.rudn/ru/web-local/prep/prep_2071

Further reading:

1. Tuganbaev, A.A. Functions of a complex variable: textbook / A.A. Tuganbaev. - 2nd ed., erased. - Moscow: Flinta Publishing House, 2017. - 48 p. -ISBN 978-5-9765-1406-5 ; Ditto [Electronic resource]. - URL: http://biblioclub.ru/index.php?page=book&id=115140

2. Minkova, R.M. Functions of a complex variable in examples and problems: a teaching aid / R.M. Minkova; Ministry of Education and Science of the Russian Federation, Ural Federal University named after the first President of Russia B.N. Yeltsin. - Ekaterinburg: Publishing House of the Ural University, 2014. - 57 p.: ill., table, diagram. -ISBN 978-5-7996-1216-0; Ditto [Electronic resource]. - URL: http://biblioclub.ru/index.php?page=book&id=275814

3. Aramanovich I.G., Lunts G.L., Elsgolts L.E. Functions of a complex variable.Operational calculus. Stability theory.-M.: NaUCa, 2010.

4. Leontiev T.A., Panferov V.S., Serov V.S. Problems in the theory of functions of a complex variable. - M.: Mir, 2015.

5. Shabunin M., Polovinkin E., Karpov M. Collection of problems on the theory of functions of a complex variable. - M.: UNIMEDIASTYLE, 2016.

6. Shabunin M.I., Sidorov Yu.V. Theory of functions of a complex variable.-M.: UNIMEDIASTYLE, 2014.

7. Collection of problems on the theory of analytic functions edited by Evgrafov M.A.-M.: NaUCa, 2012.

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 "Complex analysis".

* - 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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