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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

COMPLEX ANALYSIS

(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 “Complex analysis” 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 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 FOR 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 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 -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 "Complex analysis" 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 “Complex Analysis”.

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	Mathematical analysis; Space Flight Mechanics; Algebra and Geometry; Physics;	Research work / Scientific research work; Technological Training; Undergraduate practice / Pre-graduate practice;

Cipher	Name of competency	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
			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 practice / Pre-graduate practice; Space Flight Mechanics; Numerical Methods; Automatic Control Theory; Equations of mathematical physics; Optimal Control Methods; Analysis of Geoinformation Data;

* - to be filled out in accordance with the competency matrix and SUP EP VO

** - elective disciplines/practices

4. SCOPE OF DISCIPLINE AND TYPES OF STUDY WORK

The total labor intensity of the “Complex analysis” discipline is “5” 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)
			4
<i>Contact work, ac.ch.</i>	68		68
Lectures (LC)	34		34
Laboratory work (LR)	0		0
Practical/seminar sessions (SZ)	34		34
<i>Independent work of students, ac.ch.</i>	85		85
<i>Control (exam/test with assessment), academic degree.</i>	27		27
Total labor intensity of the discipline	ac.ch.	180	180
	credit units	5	5

5. CONTENT OF DISCIPLINE

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

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational 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, NW
		1.2	Geometric interpretation of a complex number. Trigonometric and exponential forms of complex numbers. Extracting the root of a complex number.	LC, NW
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, NW
		2.2	Continuous complex-valued functions of a real variable. Continuous functions of a complex variable. Exponential, trigonometric and hyperbolic functions.	LC, NW
Section 3	Differentiation and integration	3.1	Integration of functions of a complex variable. Definition of integral. Properties of integrals. Integral estimates.	LC, NW
		3.2	Differentiation of functions of a complex variable. Definition of derivative. Rules of differentiation.	LC, NW
		3.3	Cauchy-Riemann conditions. Differentiable functions at a point and in a region. Necessary and sufficient conditions for differentiability of a function at a point.	LC, NW
		3.4	Geometric meaning of derivative. The concept of mapping conformality. Inverse function theorem. Multivalued functions "root" and logarithm. Cauchy's integral theorem. Composite contour theorem.	LC, NW
		3.5	Antiderivative. Newton–Leibniz formula.	LC, NW
Section 4	Regular features	4.1	Regular features. Power series. Absolute and uniform convergence of power series. Abel's theorem. Integration and differentiation of power series.	LC, NW
		4.2	Integral Cauchy formula. Properties of domain-regular functions. Harmonic functions.	LC, NW
		4.3	Theorems about mean values. Sufficient conditions for the regularity of a function in a domain. Maurer's theorem. Weierstrass's first and second theorems. Uniqueness theorem.	LC, NW
		4.4	Analytical continuation of regular functions. Isolated singular points of unambiguous nature.	LC, NW
Section 5	Laurent series	5.1	Expansion of a regular function into a Laurent series. Uniqueness of decomposition. Study of singular points using Laurent series. Criteria for the existence of a removable singular point, pole, or essentially singular point. The behavior of a function in a neighborhood of an essentially singular point. Theorems of Sokhotsky and Picard.	LC, NW
		5.2	Whole functions. Liouville's theorem. Fundamental theorem of algebra.	LC, NW
Section 6	Residue theory and its application	6.1	Residue theory and its application. The main theorem of residue theory. Calculation of integrals using residues.	LC, NW

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational work*
		6.2	Integrals over a closed loop. Calculation of improper integrals of a real variable. Jordan's Lemma	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.	
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. 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. Rosendorn. - Moscow: Fizmatlit, 2010. - 168 p. - ISBN 978-5-9221-0977-2; The same [Electronic resource]. - URL: <http://biblioclub.ru/index.php?page=book&id=68367>
3. Popov, V.N. Applied questions of the theory of functions of a complex variable: textbook / 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; The same [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

Additional literature:

1. Tuganbaev, A.A. Functions of a complex variable: textbook / A.A. Tuganbaev. - 2nd ed., revised. - Moscow: Flinta Publishing House, 2017. - 48 p. - ISBN 978-5-9765-1406-5; The same [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: educational manual / R.M. Minkova; Ministry of Education and Science of the Russian Federation, Ural Federal University. the first President of Russia B.N. Yeltsin. - Ekaterinburg: Ural University Publishing House, 2014. - 57 p. : ill., table, diagrams. - ISBN 978-5-7996-1216-0; The same [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. Theory of stability. - M.: Nauka, 2010.

4. Leontiev T.A., Panferov V.S., Serov V.S. Problems on 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, ed. Evgrafova M.A. - M.: Nauka, 2012.

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.elsevierscience.ru/products/scopus/>

Educational and methodological materials for students' independent work when mastering a discipline/module:*

1. A course of lectures on the discipline "Complex Analysis".

* - 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 "Complex analysis" is 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.

DEVELOPERS:

Assistant professor

Position

Signature

Saltykova Olga
Alexandrovna

Last name I.O.

Assistant professor

Position

Signature

Samokhin Alexander
Sergeevich

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HEAD OF BUP:

Head of the department

Position

Signature

Razumny Yuri Nikolaevich

Last name I.O.

HEAD OF OP VO:

Professor

Position

Signature

Razumny Yuri Nikolaevich

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