SYLLABUS
Fall semester 2023-2024 academic year
Educational program "6B07111 Space technic and technology", "6B07110 Robotic systems", "6B05403 Mechanics"

ID and name of course	Independent work of the student (IWS)	Number of credits			General number of credits	Independent work of the student under the guidance of a teacher (IWST)
		Lectures (L)	Practical classes (PC)	Lab. classes (LC)		
28971 - Complex Analysis	6	1.7	3.3	0	6	7

ACADEMIC INFORMATION ABOUT THE COURSE				
Learning Format	**Cycle, component**	**Lecture types**	**Types of practical classes**	**Form and platform final control**
Offline	base	Problematic, analytical	Problematic, problem solving	Oral
Lecturer - (s)	Merey Sautbekova, senior-lecturer			
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ACADEMIC COURSE PRESENTATION		
Purpose of the course	**Expected Learning Outcomes (LO) *** Describe what is the result of studying the course the student will be able to:	**Indicators of LO achievement (ID)** As a result of studying the discipline, the student will be able to:
Purpose of the subject of functions of a complex variable consists of familiarization with fundamental methods complex analysis, these methods based on analysis of infinitesimal quantities and use of complex field properties numbers. When studying a subject are being considered I the following topics: Integral theory of Cauchy. Expansion in Taylor and	**LO 1.** Explain the essence of the basic mathematical concepts included in the course program "Theories of functions of a complex variable", their relationship, interdependence and mutual influence on the basis of demonstrative argumentation of the reasoning.	**ID 1.1** Understand the basic definitions and theorems of the course on the theory of functions of a complex variable;
		ID 1.2 Classify and apply theoretical results to clarify questions of existence and methods for finding input characteristics and operations on the basic concepts of the course;
		ID 1.3 Have practical skills in working with complex numbers: arithmetic operations on them, geometric interpretation, trigonometric and exponential notation.
	LO 2. Solve questions and problems of differentiation and integration of a function of a complex variable based on definitions and theorems	**ID** 2.1 Using the definitions of the basic elementary functions of a complex variable, build an elementary computational apparatus for working with them and find out the properties of these functions;
		ID 2.2 Apply the apparatus of the classical theory of functions of two variables to construct a table of derivatives of functions of a complex variable, clarify the properties of the operation of differentiation of these functions;
		ID 2.3 Understand the operation of integrating functions of a complex variable and its connection with second-order curvilinear integrals;

Laurent series, analytical continuation, theory of subtractions and their application to the calculation of integrals, as well as mastery of the basics geometric theories and their application to the in-depth study of basic elementary functions with complex variables and conformal mappings.		**ID** 2.4 Calculate closed loop integrals of analytic functions based on Cauchy's integral theorem and Cauchy's formula.
	LO 3. Master the basic tools for expanding analytic functions into Taylor and Laurent power series and analyze the behavior of a function in the vicinity of its singular point.	**ID** 3.1 Understand how the region of convergence of the classical power series and the Laurent series works based on proof tools;
		ID 3.2 Find the expansion of elementary functions into Taylor and Laurent power series in their domains of analyticity;
		ID 3.3 Classify singular points of analytic functions according to their type based on the Laurent series expansion in the neighborhood of the singular point and based on the behavior of the function.
	LO 4. Calculate residues of analytic functions with respect to their singular points and with respect to the point at infinity based on the definition and relevant theorems. Assess the applicability of the concept of "residue" on the basis of theorems to the calculation of integrals over closed loops and solve the problem of their calculation.	**ID** 4.1 Find deductions analytical functions with respect to their singular points and the point at infinity by expansion in a Laurent series and by passing to the limit for the poles;
		ID 4.2 Apply basic residue theorems when finding contour integrals of functions of a complex variable
		ID 4.3 Be able to correctly imagine the application of residues to the calculation of proper and improper integrals based on Jordan's lemmas.
Prerequisites	Mathematical analysis, Algebra, Geometry.	
Postrequisites	Differential equations, Methods of mathematical and theoretical physics.	
Learning Resources	**Literature:** main, additional. 1. Complex Analysis Lecture Notes, Dan Romik, 2020. 2. Complex Analysis by E. M. Stein and R. Shakarchi (Princeton University Press, 2003. 3. Complex Analysis, Ian Stewart, David Tall, Second Edition, (Cambridge University Press, 2018. 4. Complex Analysis, Joseph Bak, Donald J. Newman, Third Edition, Springer, 2010. 5. A first Course in Complex Analysis with Applications, Dennis G. Zill, Patrick D. Shanahan, 2003.	

Academic course policy	The academic policy of the course is determined by the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University . Documents are available on the main page of IS Univer . **Integration of science and education.** The research work of students, undergraduates and doctoral students is a deepening of the educational process. It is organized directly at the departments, laboratories, scientific and design departments of the university, in student scientific and technical associations. Independent work of students at all levels of education is aimed at developing research skills and competencies based on obtaining new knowledge using modern research and information technologies. A research university teacher integrates the results of scientific activities into the topics of lectures and seminars (practical) classes, laboratory classes and into the tasks of the IWST, IWS, which are reflected in the syllabus and are responsible for the relevance of the topics of training sessions and assignments. **Attendance.** The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course. Failure to meet deadlines results in loss of points. **Academic honesty.** Practical/laboratory classes, IWS develop the student's independence, critical thinking, and creativity. Plagiarism, forgery, the use of cheat sheets, cheating at all stages of completing tasks are unacceptable. Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by the "Rules for the final control" , "Instructions for the final control of the autumn / spring semester of the current academic year" , "Regulations on checking students' text documents for borrowings". Documents are available on the main page of IS Univer . **Basic principles of inclusive education.** The educational environment of the university is conceived as a safe place where there is always support and equal attitude from the teacher to all students and students to each other, regardless of gender, race / ethnicity, religious beliefs, socio-economic status, physical health of the student, etc. All people need the support and friendship of peers and fellow students. For all students, progress is more about what they can do than what they can't. Diversity enhances all aspects of life. All students, especially those with disabilities, can receive counseling assistance by phone / e- mail merey.sautbekova@gmail.com or via video link in Zoom. **Integration MOOC (massive open online course).** In the case of integrating MOOC into the course, all students need to register for MOOC. The deadlines for passing MOOC modules must be strictly observed in accordance with the course study schedule.

	ATTENTION! The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course, as well as in the MOOC. Failure to meet deadlines results in loss of points.

INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT

Score-rating letter system of assessment of accounting for educational achievements				**Assessment Methods**
Grade	**Digital equivalent points**	**points, % content**	**Assessment according to the traditional system**	**Criteria-based assessment** is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment. **Formative assessment is** a type of assessment that is carried out in the course of daily learning activities. It is the current measure of progress. Provides an operational relationship between the student and the teacher. It allows you to determine the capabilities of the student, identify difficulties, help achieve the best results, timely correct the educational process for the teacher. The performance of tasks, the activity of work in the classroom during lectures, seminars, practical exercises (discussions, quizzes, debates, round tables, laboratory work, etc.) are evaluated. Acquired knowledge and competencies are assessed. **Summative assessment** - type of assessment, which is carried out upon completion of the study of the section in accordance with the program of the course. Conducted 3-4 times per semester when performing IWS. This is the assessment of mastering the expected learning outcomes in relation to the descriptors. Allows you to
A	4.0 _	95-100	Great	
A-	3.67	90-94		
B+	3.33	85-89	Fine	

				determine and fix the level of mastering the course for a certain period. Learning outcomes are evaluated.
B	3.0	80-84		**Formative and summative assessment** / **Points**
B-	2.67	75-79		
C+	2.33	70-74		Work in practical classes / 18
C	2.0	65-69	Satisfactorily	Independent work / 42
C-	1.67	60-64		
D+	1.33	55-59	Unsatisfactory	Final control (exam) / 40
D	1.0	50-54		TOTAL / 100

Calendar (schedule) for the implementation of the content of the course. Methods of teaching and learning.

Week	Name of Topic	Count of hours	Maximal Score
	Module 1. Elementary functions of a complex variable		
1	L1. Complex numbers and operations on them	2	2
	PC 1. Complex numbers and operations on them. Geometric images on the complex plane.	1	8
2	**L2**. Functions of a complex variable. Limit of a function of a complex variable at a point. Continuity and properties of continuous functions. The concept of elementary functions of a complex variable.	1	
	PC 2. Elementary functions of a complex variable	2	2
	IWST 1. Consultations on the implementation of **IWS** -1	1	8
	Module 2. Differentiation and integration of a function of a complex variable.		
3	**L3**. Differentiation of a function of a complex variable. Cauchy-Riemann conditions. The concept of an analytic function and its simplest properties.	2	2
	PC 3. Differentiation of a function of a complex variable. Analytical functions.	1	8
	IWS 1 Elementary functions of a complex variable and their properties		5
4	**L4**. Geometric meaning of the derivative of a function of a complex variable. The concept of conformal mapping	2	2
	PC 4. Geometric meaning of the derivative of a function of a complex variable	1	8
5	**L5.** Integral of a function of a complex variable.	2	2
	PC 5. Integrating functions of a complex variable	1	8
6	**L6**. Cauchy's integral theorem and its consequences. Cauchy's integral formula and its consequences. Cauchy type integral and its properties	2	2
	PC 6. Integral theorem and Cauchy formula	1	8
	IWST-2. Colloquium and test 1		25
	Module 3. Complex functional series. Power series		
7	**L7**. Complex power series. Abel's theorem. Radius and circle of convergence.	2	2
	PC 7. Convergence region of power series.	1	8
RK1			**100**
8	**L8**. Taylor's theorem on the decomposability of an analytic function in a power series. Analytical continuation of a function.	2	1
	PC 8. Expansion of analytic functions into Taylor power series.	1	7
	IWST 3. Consultation on the implementation of IWS-2		
9	**L9**. Laurent series and its region of convergence. Expansion of an analytic function into a Laurent series. Classification of isolated singular points of a unique analytic function.	1	
	PC 9. Expansion of an analytic function of a complex variable into Laurent power series.	2	2
	IWS-2 Taylor and Laurent power series		6

10	**L10.** Behavior of an analytic function in the neighborhood of an isolated singular point (removable, pole, essentially singular). Weierstrass Sochocki theorem**.**	2	1
	PC 10. Behavior of an analytic function in a neighborhood of a point isolated by itself and in a neighborhood of a point at infinity	1	7
	IWST 4. Colloquium and test 2		15
Module 4. Deductions and their applications			
11	**L11**. Residue of an analytic function at an isolated singular point and its calculation. The main theorem about residues.	2	1
	PC 11. Deductions and their calculation. The main theorem about residues..	1	7
12	**L12**. Subtraction of an analytic function with respect to an infinitely distant singular point and its properties. Application of residue theory to the calculation of integrals	2	1
	PC 12. Subtraction of an analytic function with respect to an infinitely distant singular point and its properties. Application of residue theory to the calculation of integrals.	1	7
13	**L13**. Application of the theory of residues to the calculation of proper and improper integrals. Jordan Lemmas.	2	1
	PC 13. Application of the theory of residues to the calculation of definite and improper integrals.	1	7
	IWST 5. Colloquium and test 3.		15
14	**L14**. Logarithmic residue and its calculation. Theorem on counting the number of zeros of an analytic function. Conformal mappings	2	1
	PC 14. Conformal mappings. Linear functions.	1	7
15	**L15**. Conformal mappings. Riemann's theorem and the principle of one-to-one correspondence of boundaries.	2	1
	PC 15. Conformal mappings. Fractional linear functions	1	7
	IWST 6. Consultation on preparing for exam questions		
RK2			**100**
Final control (exam)			**100**
TOTAL for discipline			**100**

Dean _____U. S. Abdybekov

Lecturer _____ M. Sautbekova