

Документ подписан простой электронной подписью
Информация о владельце:
ФИО: Порохня Андрей Алексеевич
Должность: И.о. директора института перспективной инженерии
Дата подписания: 22.10.2026 13:25:38
Уникальный программный ключ:
990bea3aecc48c23bd8699e48288f8d1960c600

MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
Federal State Autonomous
Educational institution of higher education
"NORTH CAUCASUS FEDERAL UNIVERSITY"

APPROVED BY
Acting Director of the Institute
Advanced Engineering
A.A. Porokhnya

DISCIPLINE ASSESSMENT TOOLS FUND
"Complex Variable Function and Integral Transform"

Field of study	11.03.02 Infocommunication Technologies and Communication Systems
Profile	Intelligent Data Processing in Infocommunication Systems and Networks
Year of start of training	<u>2026</u>
Form of study	<u>Full-time</u>
Implemented in a semester	<u>3</u>

Introduction

1. Purpose: the fund of assessment tools for the discipline "Functions of a Complex Variable and Integral Transformation" is intended for an objective assessment of the level of competence formation.

2. FOS is an appendix to the program of the discipline "Functions of a complex variable and integral transformation"

3. Developer: Associate Professor of the Department of Mathematical Modeling Andrukhiv L.V.

4. An examination of the FOC was carried out.

Members of the expert group:

Chairman: N.Y. Bratchenko, Chairman of the CMT of the Institute of Advanced Engineering, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Members of the Commission:

V.P. Mochalov, Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

S.V. Melnikov, Senior Researcher of the Interdisciplinary Training and Research Center for Agricultural Technologies, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Representative of the employer's organization:

Mironov V.A., General Director of Orintex LLC.

Expert opinion: The FAT for the discipline allows you to assess the level of competence formation. Start approbation.

5. The validity period of the FAT is determined by the period of implementation of the educational program.

1. Description of indicators and assessment criteria at various stages of their formation, description of assessment scales

Competency(s), indicator(s))	Levels of competence formation			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Intermediate level (good) 4 points	High level (excellent) 5 points
UK-1				
ID-1 UK-1 identifies a problem situation, carries out its multifactorial analysis and diagnosis based on a systematic approach;	With difficulty identifies a problem situation, carries out its multifactorial analysis and diagnosis based on a systematic approach;	Poorly identifies a problem situation, carries out its multifactorial analysis and diagnosis based on a systematic approach;	Basically, correctly identifies a problem situation, carries out its multifactorial analysis and diagnosis based on a systematic approach; .	• Identifies a problem situation, carries out its multifactorial analysis and diagnosis based on a systematic approach;
ID-2 UK-1 searches, selects and systematizes information to determine alternative options for strategic solutions in a problem situation;	Has difficulty searching, selecting and systematizing information to determine alternative options for strategic solutions in a problem situation;	Demonstrates poor skills in systematizing information to identify alternative options for strategic solutions in a problem situation;	Possesses the skills to search, select and systematize information to determine alternative options for strategic solutions in a problem situation	Fully possesses the skills to search, select and systematize information to determine alternative options for strategic solutions in a problem situation
ID-3 UK-1 determines and assesses the risks of possible solutions to a problem situation, chooses the best option for its solution.	With difficulty identifies and assesses the risks of possible solutions to a problem situation, chooses the best option for its solution.	Demonstrates weak skills to identify and assess the risks of possible solutions to a problem situation, chooses the best option for its solution.	Sufficiently identifies and assesses the risks of possible solutions to a problem situation, chooses the best option for its solution	Fully identifies and assesses the risks of possible solutions to a problem situation, chooses the best option for its solution

Assessment of the level of competence in the discipline is carried out on the basis of the "Regulation on the current monitoring of progress and intermediate certification of students in educational programs of higher education - bachelor's programs, specialist programs, master's

programs - in the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" in the current edition.

ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Job Number	Correct answer	Content of the question	Competence
		Semester 3	
1.	2	Complex number $z = \sqrt{3} - i$. Then $ z =$	UK-1
2.	c)	Which function is analytic in C ?: a) $-2z + \bar{z}$ b) $z - 4 z $ c) $iz^2 - z$ d) $\operatorname{Re}\{z\} - \operatorname{Im}\{z\}$	UK-1
3.	b)	Is the fulfillment of the Cauchy-Riemann conditions at every point in the region of the complex plane sufficient for the analyticity of the function in this region? a) yes b) no c) not always	UK-1
4.	$-i\pi$	Calculate the integral $\int_L \bar{z} dz$, where L is the upper semicircle $ z = 1$, the direction of the traversal clockwise.	UK-1
5.	$\frac{1}{3}(1-i)$	Calculate Integral $\int_{-1}^i z^2 dz$	UK-1
6.	A function of a complex variable is the mapping of f of a complex numerical set D into a complex numerical set G .	Define the function of a complex variable.	UK-1
7.	If the function $w = f(z) = u(x, y) + iv(x, y)$ is defined in some neighborhood of the point	Formulate a differentiability criterion at a point.	UK-1

	$z = x + iy$, and at this point the real functions $u(x, y)$ $v(x, y)$ are differentiable, then for the differentiability of the function $w = f(z)$ at the point z , it is necessary and sufficient that at this point the equations hold: $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \quad \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}.$ These equations are called Cauchy-Riemann conditions		
8.	An unambiguous function $w = f(z)$ is called analytic at a point z , if it is differentiable at it and some of its surroundings.	Define the analytic function	UK-1
9.	$w = e^z = e^{x+iy} =$ $= e^x \cdot (\cos y + i \sin y)$ Hence $u(x, y) = e^x \cos y$ and $v(x, y) = e^x \sin y$.	To find out whether the analytical function? $w = e^z$	UK-1

$$\frac{\partial u}{\partial x} = e^x \cos y;$$

$$\frac{\partial u}{\partial y} = -e^x \sin y;$$

$$\frac{\partial v}{\partial x} = e^x \sin y;$$

$$\frac{\partial v}{\partial y} = e^x \cos y.$$

Therefore, $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y},$

$$\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}, \text{ the Cauchy-}$$

Riemann conditions are fulfilled for all points of the plane Oxy . Then the

function $w = e^z$ is analytic on the entire plane.

10.	$\int_L f(z) dz = \int_L u dx - v dy + i \int_L v dx + u dy.$ или $\int_L f(z) dz = \int_L (u + iv)(dx + i dy)$	What formula is used to calculate the integral of a one-to-one function of a complex variable z along the curve L ?	UK-1
11.	The integral of the analytic function in a singly connected region over any closed loop lying inside this region is equal to zero: $\oint_L f(z) dz = 0.$	Formulate an integral Cauchy theorem for a singly connected domain?	UK-1
12.	If the function $f(z)$ is analytic in a closed singly connected region D and at its boundary L, then for any point z_0 lying inside L, the integral Cauchy formula is valid $f(z_0) = \frac{1}{2\pi i} \cdot \oint_{L^+} \frac{f(z) dz}{z - z_0}$, where the contour	Write down Cauchy's integral formula	UK-1

	integration L is done in the positive direction (i.e. counterclockwise)		
13.	Expression of the form $\sum_{n=1}^{\infty} z_n = z_1 + z_2 + \dots + z_n + \dots,$ where $z_n = x_n + iy_n$ are complex numbers, is called a numerical complex series (a row in a complex domain).	Formulate a definition of a number series with complex terms	UK-1
14.	$c_n = 3^n$, then $R = \frac{1}{\lim_{n \rightarrow \infty} \sqrt[n]{ c_n }} = \frac{1}{3}$ and $z - 1 < \frac{1}{3}$ is the circle of convergence of the series.	Find the radius and convergence region of a series $\sum_{n=0}^{\infty} 3^n (z - 1)^n$	UK-1
15.	Any analytic function in a ring $r < z - z_0 < R$ $(0 \leq r < R \leq \infty)$ $f(z)$ can be decomposed in a row in this ring in the only way	Formulate Laurent's decomposition of a function into a series.	UK-1

	$f(z) = \sum_{n=-\infty}^{+\infty} c_n (z - z_0)^n,$		
16.	A point z_0 is called the order (k or multiplicity k) zero of the analytic function $f(z)$ if the conditions are met $f(z_0) = 0, f'(z_0) = 0, \dots, f^{(k-1)}(z_0) = 0, f^{(k)}(z_0) \neq 0$. If $k = 1$, then z_0 is called prime zero.	What is called the order zero of the k function $f(z)$?	UK-1
17.	A point $z_0 \in \overline{C}$ is called an isolated singular point of a function $f(z)$ if there exists a neighborhood of that point at which $f(z)$ it is analytic at all points except z_0 point . At the point itself, the z_0 function $f(z)$ is either undefined or is not analytic.	Define an isolated singular point of an analytic function.	UK-1

18.	An isolated singular point of a z_0 function $f(z)$ is called (i) <i>a removable point</i>, if there is a finite point $\lim_{z \rightarrow z_0} f(z) = A \neq \infty$; (ii) <i>a pole</i>, if there is a $\lim_{z \rightarrow z_0} f(z) = \infty$; (III) <i>is essentially a singular point</i> if $f(z)$ it has neither a finite nor an infinite limit at $z \rightarrow z_0$.	Which isolated singular point is called an avoidable point, a pole, an essentially-singular point?	UK-1
19.	<i>The subtraction</i> of an analytic function $f(z)$ at a finite isolated singular point z_0 is a complex number denoted by $\text{Res}_{z_0} f(z)$, and defined by equality $\text{Res}_{z_0} f(z) = \frac{1}{2\pi i} \oint_{\gamma} f(z) dz$	Define a deduction at a finite isolated singular point	UK-1
20.	Let the function $f(z)$ be analytic everywhere in a closed region $\bar{D}$ except	Formulate Cauchy's Theorem on Deductions	UK-1

	for a finite number of isolated singular points $z_k, k = 1, 2, \dots, N$ lying inside the region D. Then $\int_{\gamma^+} f(z) dz = 2\pi i \sum_{k=1}^N \text{Res} f(z_k)$, where γ^+ is the boundary of the area D, passing in the positive direction.		
21.	1+i	Perform the division $\frac{1+3i}{2+i}$.	UK-1
22.	$x^2 - y^2$	For the function $w = z^2$, write the real part.	UK-1
23.	$2xy$	For the function $w = z^2$, write an imaginary part.	UK-1
24.	1	Complex number $z = i$. Then $ z =$	UK-1
25.	90	A complex number $z = i$. Find its argument value, give the answer in degrees.	UK-1

2. Description of the rating scale

Students' progress in each discipline is assessed during current control and intermediate certification.

3. Criteria for assessing competencies*

A grade "passed" is given to a student if he is able to search, critically analyze and synthesize information, apply a systematic approach to solving problems.

The grade "not passed" is given to a student if he/she, when formulating and solving a problem in his/her professional activity, relying on

knowledge in the field of the theory of the function of a complex variable, makes mistakes that do not allow to establish the level of competence formation.