

MINISTRY OF SCIENCE AND HIGHER EDUCATION
RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
higher education
NORTH CAUCASIAN FEDERAL UNIVERSITY

I APPROVE

Dean of the Faculty of Mathematics
and computer science named after
Professor N.I. Chervyakov,
Candidate of Physical and Mathemat-
ical Sciences, Associate Professor
Grobova T.A.

ASSESSMENT TOOLS FUND FOR DISCIPLINE

Engineering Mathematics / Инженерная математика

Direction of training	02.04.01 Mathematics and Computer Science
Directionality (profile)	Training Program for Electronic Information
Year of commencement of studies	2026
Form of study	full-time
It is implemented in semesters	1

Introduction

1. Purpose

The assessment tools fund is intended for conducting ongoing monitoring of academic performance and midterm assessment in the discipline "Engineering Mathematics / Инженерная математика" for full-time students majoring in 02.04.01 Mathematics and Computer Science.

2. FOS is an appendix to the program of the discipline "Engineering Mathematics / Инженерная математика".

3. Developer: Andrey Vladimirovich Gladkov, Associate Professor of the Department of Computational Mathematics and Cybernetics.

4. An examination of the organophosphorus compounds was carried out.

Members of the expert group:

Chairman:

Poddubnaya N.A. – Chairman of the Teaching and Methodological Committee of the Faculty of Mathematics and Computer Science named after Professor N.I. Chervyakov

Members of the commission:

Gladkov A.V. – member of the teaching and methodological committee of the Department of Computational Mathematics and Cybernetics;

Andrukhiv L.V. – member of the teaching and methodological committee of the Department of Mathematical Modeling;

Kopytkova L.B. – member of the teaching and methodological committee of the department of mathematical analysis, algebra and geometry.

Representative of the employer organization: Lapin V.G. – Head of the Automated Control System Department of the Stavropol Regional Clinical Consultative and Diagnostic Center.

Expert opinion: The FOS for the discipline " Engineering Mathematics / Инженерная математика " allows for assessing the level of development of competencies. Recommended for use in the educational process.

« 15 » April 2026

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

1. Description of the criteria for assessing competence at various stages of its development, description of assessment scales

Competence (ii), indicator (s)	Levels of development competence (s),			
	Minimum level not achieved (unsatisfactory) 2 points	Minimum level (satisfactorily) 3 points	Average level (Fine) 4 points	High level (excellent) 5 points
Competency: OPC-2. Able to create and explore new mathematical models in the natural sciences, improve and develop concepts, theories, and methods				
Learning outcomes for the discipline: <i>Indicator:</i> ID-1 _{OPK-2} Conducts research into new mathematical models in the natural sciences ID-1 _{OPK-2} Develops new and improves existing concepts, theories and methods	Unable to use fundamental knowledge in the field of numerical methods in future professional activities. Does not possess the skills to use numerical methods to solve professional problems.	Partially able to use fundamental knowledge in the field of numerical methods in future professional activities. Has minimal skills in using numerical methods to solve professional problems.	In general, he is able to use fundamental knowledge in the field of numerical methods in future professional activities. Has a good command of the skills of using numerical methods to solve professional problems.	Able to effectively use fundamental knowledge in the field of numerical methods in future professional activities. Has a high level of skills in using numerical methods to solve professional problems.
Competency: PC-1. Able to demonstrate fundamental knowledge of mathematical and natural sciences, programming, and information technology.				
Learning outcomes for the discipline: <i>Indicator:</i> ID-1 _{PC-1} In his professional activities, he demonstrates fundamental knowledge of mathematics and natural sciences. ID-2 _{PC-1} Solves problems of professional activity using programming and information technology tools	Does not know how to use knowledge of mathematical apparatus to solve professional problems. Does not know how to operate with knowledge of methods of mathematical modeling of physical processes Incapable of constructing rigorous logical proofs and calculations. Incapable of identifying the physical essence in applied problems. Has no experience with mathematical tools. Does not operate with knowledge of the syntax of modern programming	To a minimal extent, he uses knowledge of mathematical apparatus to solve professional problems. Operates to a minimal extent with knowledge of methods of mathematical modeling of physical processes To a minimal extent, he is capable of constructing rigorous logical proofs and calculations. To a minimal extent, he is able to highlight the physical essence in applied problems. Has minimal experience with mathematical tools. a minimal knowledge of the syntax of modern program-	In general, he is able to use knowledge of mathematical apparatus to solve professional problems. In general, he is able to operate with knowledge of methods of mathematical modeling of physical processes In general, he is capable of constructing rigorous logical proofs and calculations. In general, he is able to highlight the physical essence in applied problems.	Uses knowledge of mathematical apparatus to solve professional problems. Operates with knowledge of methods of mathematical modeling of physical processes Able to construct rigorous logical proofs and calculations. Able to highlight the physical essence in applied problems.

	languages (for example, Python , C++). Does not operate with knowledge of basic algorithms and data structures. Incapable of developing algorithms to solve practical problems. Incapable of writing, testing, and debugging software code. Incapable of selecting IT tools for a specific problem. Does not have professional-level programming skills. Does not have experience working in specialized development environments. Does not have methods of computer modeling and data analysis.	ming languages (e.g. Python , C++). to a minimal degree with knowledge of basic algorithms and data structures. To a minimal extent, he is capable of developing algorithms for solving practical problems. To a minimal extent, he is able to write, test and debug software code. To a minimal extent, he is able to select IT tools for a specific problem. at least professional-level programming skills. minimal experience working in specialized development environments. To a minimal extent, it has computer modeling and data analysis methods.	In general, he has experience working with mathematical tools. In general, he operates with knowledge of the syntax of modern programming languages (for example, Python , C++). Operates with knowledge of basic algorithms and data structures. Able to develop algorithms to solve practical problems. Able to write, test and debug software code. Able to select IT tools for a specific problem. Possesses professional-level programming skills. Has experience working in specialized development environments. Possesses methods of computer modeling and data analysis.	Has experience working with mathematical tools. Operates with knowledge of the syntax of modern programming languages (for example, Python , C++). Operates with knowledge of basic algorithms and data structures. Able to develop algorithms to solve practical problems. Able to write, test and debug software code. Able to select IT tools for a specific problem. Possesses professional-level programming skills. Has experience working in specialized development environments. Possesses methods of computer modeling and data analysis.
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The assessment of the level of development of competence in the discipline is carried out on the basis of the "Regulations on the current monitoring of academic performance and mid-term assessment of students in higher education programs - bachelor's degree programs , specialist programs , master's degree programs - at the federal state autonomous educational institution of higher education " North Caucasus Federal University" in the current version.

ASSESSMENT TOOLS FOR CHECKING THE LEVEL OF DEVELOPMENT COMPETENCIES

Task number	Correct answer	Contents of the question	Competence										
		Semester 1											
1.		Types of errors.	OPK-2 PC-1										
2.	2)	Given approximate values $x = 5.253$ and $y = 7.1834$, all digits of which are correct in the strict sense. The maximum absolute error of the sum of these numbers in the strict sense is 1) $\Delta x=0.0005$ 2) $\Delta x=0.005$ 3) $\Delta x=0.05$ 4) $\Delta x=0.5$	OPK-2 PC-1										
3.	1)	The function $y = f(x)$ is given by the table: <table><tr><td>x</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y</td><td>0</td><td>0.6</td><td>1.1</td></tr></table> The value of the function $f(x)$ at the point $x=1.5$, using quadratic interpolation, is: 1) 0.3125 2) 0.125 3) 0.45 4) 0.1375 5) 0.75	x	1	2	3	y	0	0.6	1.1	OPK-2 PC-1		
x	1	2	3										
y	0	0.6	1.1										
4.	3)	Make a table of divided differences for the following values of x and y : <table><tr><td>x</td><td>0</td><td>1</td><td>4</td><td>8</td></tr><tr><td>y</td><td>10</td><td>20</td><td>80</td><td>1080</td></tr></table> The values of the first order divided differences are: 1) 10; 30; 100 2) 10; 40; 150 3) 10; 20; 250 4) 10; 20; 200	x	0	1	4	8	y	10	20	80	1080	OPK-2 PC-1
x	0	1	4	8									
y	10	20	80	1080									
5.	2)	Make a table of divided differences for the following values of x and y : <table><tr><td>x</td><td>0</td><td>1</td><td>3</td><td>5</td></tr><tr><td>y</td><td>5</td><td>10</td><td>20</td><td>30</td></tr></table> The values of the first order divided differences are: 1) 3; 4; 5 2) 5; 5; 5 3) 3; 3; 3 4) 1; 3; 5	x	0	1	3	5	y	5	10	20	30	OPK-2 PC-1
x	0	1	3	5									
y	5	10	20	30									
6.	4)	Make a table of finite differences for the following values of x and y : <table><tr><td>x</td><td>0</td><td>1</td><td>3</td><td>5</td></tr><tr><td>y</td><td>5</td><td>10</td><td>20</td><td>30</td></tr></table> The values of the first order finite differences are: 1) 5; 10; 20 2) 5; 10; 30 3) 5; 20; 30 4) 5; 10; 10	x	0	1	3	5	y	5	10	20	30	OPK-2 PC-1
x	0	1	3	5									
y	5	10	20	30									
7.	3)	Given approximate values $x = 2.35$ and $y = 7.1834$, all digits of which are true in the broad sense, the maximum absolute error of the difference between these numbers in the broad sense is 1) $\Delta x=0.001$ 2) $\Delta x=0.01$ 3) $\Delta x=0.1$ 4) $\Delta x=0.000$	OPK-2 PC-1										
8.		Best approximation methods. Root-mean-square approximation method.	OPK-2 PC-1										
9.		Best approximation methods. Finding an approximating func-	OPK-2										

		tion as a linear function (linear regression).	PC-1
10.		Best-Approximation Methods. Finding an Approximating Function in the Form of a Square Trinomial (Quadratic Regression)	OPK-2 PC-1
11.		Lagrange interpolation formula.	OPK-2 PC-1
12.		first interpolation formula.	OPK-2 PC-1
13.		second interpolation formula.	OPK-2 PC-1
14.		Newton's interpolation formula with divided differences.	OPK-2 PC-1
		Semester 6	OPK-2 PC-1
15.	2)	The Chebyshev polynomials $T_n(x)$ of degree n are defined by the formula. $T_n(x) = \frac{1}{2} \left[\left(x + \sqrt{x^2 - 1} \right)^n + \left(x - \sqrt{x^2 - 1} \right)^n \right] \quad (-1 \leq x \leq 1),$ $n = 0, 1, 2, \dots$.) Specify the value of n at which $T_n(x) = x$ 1) 0 2) 1 3) 2 4) 3	OPK-2 PC-1
16.	1)	The Chebyshev polynomials $T_n(x)$ of degree n are defined by the formula. $T_n(x) = \frac{1}{2} \left[\left(x + \sqrt{x^2 - 1} \right)^n + \left(x - \sqrt{x^2 - 1} \right)^n \right] \quad (-1 \leq x \leq 1), \quad n = 0, 1, 2, \dots$ Specify the value of n at which $T_n(x) = 1$ 1) 0 2) 1 3) 2 4) 3	OPK-2 PC-1
17.	3)	In numerical integration the formula $\int_{-1}^1 \phi(\xi) d\xi = \sum_{i=1}^n \phi(\xi_i) w_i + R_g$ is 1) The quadrature formula of trapezoids 2) Quadrature formula of rectangles 3) Gauss's quadrature formula 4) Simpson's quadrature formula	OPK-2 PC-1
18.	4)	The methods of approximate solution of differential equations, depending on the form of presentation of the solution, do not include 1) Analytical methods 2) Graphical methods 3) Numerical methods 4) Recursive methods	OPK-2 PC-1
19.	Cauchy	Finding any particular solution to a differential equation of the form $y = \phi(x, C_0)$ that satisfies the initial conditions $y(x_0) = y_0$, is called problem ####.	OPK-2 PC-1
20.	1)	The formula $L_n(x) = \sum_{i=0}^n y_i \prod_{j \neq i} \frac{(x - x_j)}{(x_i - x_j)}$ is used 1) To calculate the Lagrange interpolation polynomial 2) To calculate Newton's interpolation polynomial	OPK-2 PC-1

		3) To calculate the Chebyshev interpolation polynomial 4) To calculate the Hermite interpolation polynomial	
21.	half division	The idea of the ### method is to construct a sequence of nested segments, at the ends of which the function takes values of different signs	OPK-2 PC-1
22.	2)	When solving systems of linear algebraic equations, the iterative process and its convergence depend on the choice of the initial vector 1) depends 2) does not depend 3) It depends, but not always	OPK-2 PC-1
23.		Solution of a system of linear equations . Exact methods. Gauss method .	OPK-2 PC-1
24.		Solution of a system of linear equations . Simple iteration method.	OPK-2 PC-1
25.		Solution of a system of linear equations . Seidel method.	OPK-2 PC-1
26.		Solution of a system of linear equations . Sufficient conditions for the convergence of the simple iteration method and the Seidel method.	OPK-2 PC-1
27.		Solution of a nonlinear equation . Machine algorithm for root separation .	OPK-2 PC-1
28.		Solution of a nonlinear equation . The bisection method.	OPK-2 PC-1
29.		Solution of a nonlinear equation . Chord method.	OPK-2 PC-1
30.		Solution of a nonlinear equation . Newton's method.	OPK-2 PC-1
31.		Solution of a nonlinear equation . Secant method.	OPK-2 PC-1
32.		Solving a nonlinear equation . Simple iteration method	OPK-2 PC-1

2. Description of the rating scale

Under the rating system, student performance in each discipline is assessed through ongoing assessments and midterm assessments. The rating system for assessing student knowledge is based on a set of assessment activities (checkpoints) optimally spaced throughout the course. The principles of the rating system for assessing student knowledge are based on the requirements described in the Regulation on the Organization of the Educational Process Based on the Rating System for Assessing Student Knowledge at North Caucasus Federal University.

3. Competency assessment criteria

The grade " **excellent** " is given to a student if he

- Able to effectively use fundamental knowledge in the field of numerical methods in future professional activities.
- Has a high level of skills in using numerical methods to solve professional problems.

The grade " **good** " is given to a student in the case when the student

- In general, he is able to use fundamental knowledge in the field of numerical methods in future professional activities.
- Has a good command of the skills of using numerical methods to solve professional problems.

a grade of " **satisfactory** " if he/she

- Partially able to use fundamental knowledge in the field of numerical methods in future profes-

sional activities.

- Has minimal skills in using numerical methods to solve professional problems.

*The grade " **unsatisfactory** " is given if it*

- Unable to use fundamental knowledge in the field of numerical methods in future professional activities.
- Does not possess the skills to use numerical methods to solve professional problems.