

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution for Higher Education
«North-Caucasus Federal University»

APPROVED BY

Dean of FPE of NCFU

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ASSESSMENT TOOLS FOR THE DISCIPLINE (MODULE)
«Engineering Mathematics»

Field of study	<u>13.04.02 Electric Power Engineering and Electrical Engineering</u>
Specialization (Profile)	<u>Training Program of Electrical Engineering</u>
Year of commencement of studies	<u>2026</u>
Mode of study	<u>full-time</u>
Implemented in semester(s)	<u>1</u>

Foreword

1. Purpose: This assessment tools (AT) document is intended to assess the level of competency formation during ongoing progress control and intermediate assessment of students in the discipline "Engineering Mathematics".

2. The AT is an appendix to the syllabus of the discipline "Engineering Mathematics".

3. Developer: Maksim S. Demin, Candidate of Physical and Mathematical Sciences, Associate Professor at the Department of Automated Electric Power Systems and Power Supply.

4. The AT has undergone expert review.

Members of the expert group:

Chairperson: Yu. G. Kononov, Doctor of Technical Sciences, Professor, Head of the Department of Automated Electric Power Systems and Power Supply.

Committee members:

D.A. Kostyukov, Candidate of Technical Sciences, Associate Professor, Department of Automated Electric Power Systems and Power Supply.

A.V. Petrov, Candidate of Technical Sciences, Associate Professor, Department of Automated Electric Power Systems and Power Supply.

Representative of the employer organization:

S.A. Filippov, Candidate of Technical Sciences, Head of the Leninsky District Department of the Stavropol Interdistrict Branch of the PJSC «Stavropolenergosbyt».

Expert opinion: The AT is recommended for assessing the level of competency formation during ongoing progress control and intermediate assessment of students in the discipline "Engineering Mathematics".

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

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

Competency(ies), indicator(s)	Levels of competency formation			
	Minimum level not achieved (Unsatisfactory) – 2 points	Minimum level (Satisfactory) – 3 points	Medium level (Good) – 4 points	High level (Excellent) – 5 points
UC-1 Capable of conducting critical analysis of problem situations based on a systems approach and developing an action strategy				
Learning outcomes for the discipline (module): Indicator: ID-2 UC-1 analyses a problem situation and performs its decomposition into mathematical and computational tasks in electrical engineering contexts	Does not sufficiently decompose an engineering problem into mathematical variables, assumptions, equations and computational stages. Has difficulty selecting methods and interpreting results without substantial teacher assistance.	Has a general understanding of how to decompose engineering problems into mathematical variables, assumptions, equations and computational stages; solves typical tasks according to a model using teacher guidance.	Independently decomposes typical engineering problems, selects and applies appropriate mathematical methods of linear algebra, calculus, differential equations, Fourier analysis, numerical computation, optimization and statistics, and interprets results with minor inaccuracies.	Fully and independently decomposes complex or non-standard engineering problems, justifies method selection, performs calculations correctly, and evaluates assumptions, errors and applicability of results.

ASSESSMENT TOOLS FOR CHECKING THE LEVEL OF COMPETENCY FORMATION

Task No.	Correct Answer	Question Content	Competency
1.	1	Matrix multiplication AB is defined when: 1) the number of columns of A equals the number of rows of B 2) A and B have the same determinant 3) A and B are both diagonal 4) A and B have the same trace	UC-1
2.	1	A square matrix is nonsingular if: 1) its determinant is not zero 2) all its elements are positive 3) its trace equals zero 4) it has no eigenvalues	UC-1
3.	1	An eigenvector v of a matrix A satisfies: 1) $Av = \lambda v$ for some scalar λ 2) $Av = 0$ only 3) $A + v = \lambda$ 4) $\det(A) = v$	UC-1
4.	2	The Gaussian elimination method is mainly used to: 1) compute Fourier coefficients 2) solve systems of linear algebraic equations 3) calculate probability distributions 4) find complex residues	UC-1
5.	3	The Taylor series is used to: 1) classify random variables only 2) replace matrices with scalars 3) approximate functions near a point 4) determine the rank of a graph	UC-1
6.	4	For a first-order ordinary differential equation $y' = f(x,y)$, Euler's explicit method uses: 1) $y_{n+1} = y_n / h$ 2) $y_{n+1} = y_n - f(x_n, y_n)$ 3) $y_{n+1} = f(x_n, y_n)$ 4) $y_{n+1} = y_n + hf(x_n, y_n)$	UC-1

Task No.	Correct Answer	Question Content	Competency
7.	1	A system of linear differential equations is usually written in vector form as: 1) $x' = Ax + b$ 2) $\det(A) = 0$ 3) $x + y = 0$ only 4) $F = ma$ only	UC-1
8.	2	The complex impedance of an inductor in sinusoidal steady-state analysis is: 1) R 2) $j\omega L$ 3) $1/(j\omega C)$ 4) 0	UC-1
9.	3	The complex impedance of a capacitor is: 1) $j\omega L$ 2) ωC 3) $1/(j\omega C)$ 4) $C\omega^2$	UC-1
10.	1	Fourier analysis represents a signal in terms of: 1) frequency components 2) only decimal digits 3) only random variables 4) only matrix determinants	UC-1
11.	2	The FFT is: 1) a probability distribution 2) an efficient algorithm for computing the DFT 3) a type of differential equation 4) a matrix norm	UC-1
12.	1	Numerical integration by the trapezoidal rule approximates the area under a curve by: 1) trapezoids 2) circles 3) eigenvectors 4) random samples only	UC-1
13.	4	The stability of a numerical method for ODEs is related to: 1) font size in the program 2) the name of the variable only 3) the number of plots 4) the behavior of errors during computation	UC-1
14.	1	Gradient descent updates the current point mainly in the direction: 1) opposite to the gradient 2) parallel to the x-axis only 3) of increasing determinant 4) of a random eigenvector	UC-1

Task No.	Correct Answer	Question Content	Competency
15.	3	Lagrange multipliers are used for optimization problems with: 1) no objective function 2) no variables 3) equality constraints 4) only complex numbers	UC-1
16.	2	The expected value of a random variable describes its: 1) maximum possible value 2) average or mean value 3) determinant 4) frequency spectrum	UC-1
17.	1	Variance measures: 1) dispersion around the mean 2) matrix symmetry 3) complex phase only 4) the length of a textbook	UC-1
18.	4	Regression analysis is primarily used to: 1) compute determinants only 2) draw circuit symbols 3) translate text 4) model relationships between variables	UC-1
19.	2	The condition number of a matrix characterizes: 1) the number of rows only 2) sensitivity of the solution to perturbations 3) the number of complex roots 4) the probability of an event	UC-1
20.	1	A diagonalizable matrix can be represented as: 1) $A = PDP^{-1}$ 2) $A = A + I$ only 3) $A = 0$ always 4) $A = xy$	UC-1
21.	3	The modulus of a complex number $z = a + jb$ is: 1) $a + b$ 2) $a - b$ 3) $\sqrt{a^2 + b^2}$ 4) ab	UC-1
22.	2	In electrical engineering, phasors are used to represent: 1) static loads only 2) sinusoidal quantities by complex numbers 3) probability tables only 4) integer sequences	UC-1

Task No.	Correct Answer	Question Content	Competency
23.	1	A local minimum of a differentiable function without constraints generally satisfies: 1) gradient equals zero 2) determinant equals one 3) probability equals one 4) frequency equals zero	UC-1
24.	4	The normal distribution is defined by the parameters: 1) only frequency and phase 2) rank and determinant 3) slope and intercept only 4) mean and standard deviation	UC-1
25.	2	A numerical method is consistent if: 1) its matrix is diagonal 2) its local truncation error tends to zero as the step tends to zero 3) it never uses arithmetic operations 4) it applies only to integers	UC-1
26.	1	The rank of a matrix is the dimension of: 1) its column space 2) the complex plane 3) the time domain 4) a probability sample only	UC-1
27.	3	The Fourier transform of a derivative is associated with multiplication by: 1) zero 2) the determinant 3) $j\omega$ in the frequency domain 4) a random number	UC-1
28.	2	The least-squares method minimizes: 1) the sum of variables 2) the sum of squared residuals 3) the largest eigenvalue only 4) the number of equations	UC-1
29.	1	The Newton method for nonlinear equations uses: 1) derivatives or Jacobians 2) only random guessing 3) Fourier coefficients only 4) Lagrange multipliers only	UC-1
30.	4	A probability density function must satisfy: 1) determinant less than zero 2) all values are integers 3) only one nonzero value 4) nonnegativity and total integral equal to one	UC-1

Task No.	Correct Answer	Question Content	Competency
31.	2	The scalar product of two vectors is commonly used to determine: 1) a histogram 2) angle and projection relations 3) a random sample size only 4) a Fourier transform	UC-1
32.	1	A homogeneous linear system $Ax = 0$ always has: 1) the zero solution 2) no solution 3) exactly two solutions 4) only complex solutions	UC-1
33.	3	The main advantage of numerical methods in engineering mathematics is that they: 1) avoid mathematical models 2) eliminate measurement errors completely 3) provide approximate solutions when analytical solutions are difficult 4) replace all experiments	UC-1
34.	1	A constraint in an optimization problem describes: 1) a condition that feasible solutions must satisfy 2) the final exam score only 3) a random histogram 4) a matrix transpose	UC-1
35.	4	Statistical estimation is used to: 1) diagonalize all matrices 2) compute only exact roots 3) remove all noise deterministically 4) infer population parameters from sample data	UC-1

2. Description of the grading scale

Within the framework of the rating system, student performance in each discipline is assessed during ongoing progress control and intermediate assessment. The rating system for assessing student knowledge is based on the use of a set of control measures (checkpoints) for testing the material covered, optimally located throughout the entire time interval of studying the discipline. The principles of the rating system for assessing student knowledge are based on the provisions described in the "Regulations on the organization of the educational process based on the rating system for assessing student knowledge" at North Caucasus Federal University.

The rating assessment system is not provided for students studying in master's degree programs, or for students studying in bachelor's degree programs by correspondence or part-time (evening) forms of study.

3. Criteria for assessing competencies

The grade "Excellent" is awarded to a student who has deeply and firmly mastered the program material, presents it exhaustively, consistently, clearly, and logically coherently, is able to closely link theory with practice, handles tasks, questions, and other types of knowledge application with ease, and does not struggle to answer when assignments are modified.

The grade "Good" is awarded to a student who has a solid command of the material, presents it competently and substantively without making significant inaccuracies in answering questions, correctly applies theoretical principles to practical questions and tasks, and possesses the necessary skills and techniques for their execution.

The grade "Satisfactory" is awarded to a student who has knowledge of only the basic material but has not mastered its details, makes inaccuracies, insufficiently correct formulations, and violates logical sequence in presenting the program material.

The grade "Unsatisfactory" is awarded to a student who does not know a significant part of the program material and makes substantial errors.