

MINISTRY OF SCIENCE AND THE HIGHER EDUCATION  
RUSSIAN FEDERATION  
Federal state autonomous  
educational institution of the higher education  
"THE 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 Mathematical Sciences, Associate  
Professor  
Grobova T. A.

**ASSESSMENT TOOLS FUND FOR DISCIPLINE**

Digital Signal Processing / Цифровая обработка сигналов

|                                 |                                             |
|---------------------------------|---------------------------------------------|
| Direction of training           | 02.04.01 Mathematics and Computer Science   |
| Profile                         | Training Program for Electronic Information |
| Year of commencement of studies | <u>2026</u>                                 |
| Form of study                   | full-time                                   |
| Implemented in the 1st semester |                                             |

## Introduction

1. Purpose: The assessment toolkit is designed to provide a methodological basis for organizing and conducting ongoing assessments in the course "Digital Signal Processing / Цифровая обработка сигналов." Ongoing assessment in this course is a systematic method for assessing students' knowledge, skills, and abilities. The objectives of ongoing assessments are to obtain initial information on the progress and quality of competencies acquired, as well as to encourage regular, targeted student work. This work is intended to develop a certain level of competencies.

2. FOS is an appendix to the program of the discipline "Foreign Language in the Sphere of Professional Communication"

3. Developer: Department of Computational Mathematics and Cybernetics .

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

Members of the expert group:

Chairman

Babenko M. G., Head of the Department of Computational Mathematics and Cybernetics

Members of the commission:

Peleshenko V.S., Associate Professor of the Department of Computational Mathematics and Cybernetics

Peleshenko T. A., Associate Professor of the Department of Computational Mathematics and Cybernetics

Representative of the employer organization Kornienko S. A., head of the branch department FSUE "Main Radio Frequency Center" in the Southern and North Caucasian Federal Districts districts

Expert opinion: the fund of assessment tools corresponds to the educational program in the field of training 02.04.01 Mathematics and computer science profile " Training Program for Electronic Information » and is recommended for conducting ongoing monitoring of students' academic performance and midterm assessment.

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 ),<br>indicator (s)                                                                                                                                                                                                                                                                                                                                               | Levels of development competence ( s ),                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                   | The minimum level has not been reached (Unsatisfactory )<br>2 points                                                                                                                                                                                                                   | Minimum level (satisfactorily)<br>3 points                                                                                                                                                                                                                                                  | Intermediate level (Fine)<br>4 points                                                                                                                                                                                                                                                 | High level (excellent)<br>5 points                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b><i>UK-2 is capable of managing a project at all stages of its life cycle.</i></b>                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Learning outcomes for the discipline<br>ID-1UK-2 As part of project activities, it models technological processes for the creation and processing of materials, taking into account economic factors and in accordance with environmental and industrial safety requirements.<br>ID-2UK-2 Implements a new project into production and manages it at all stages of its life cycle | Does not know the basic mathematical and software methods of signal processing<br>Unable to apply knowledge in the field of mathematical and software methods of signal processing<br>Does not have a command of the mathematical and technical apparatus underlying signal processing | Has general knowledge of mathematical and software methods of signal processing<br>Able to apply knowledge in the field of mathematical and software methods of signal processing in practice<br>Has a command of the mathematical and technical apparatus that underlies signal processing | Knows a number of basic mathematical and software methods for signal processing<br>Able to apply knowledge in the field of mathematical and software methods of signal processing well<br>Has a good command of the mathematical and technical apparatus underlying signal processing | Knows a number of basic mathematical and software methods of signal processing and the features of their practical application<br>Able to effectively apply various knowledge in the field of mathematical and software methods of signal processing in practice<br>Has a good command of the mathematical and technical apparatus underlying signal processing and can interactively apply it depending on the specifics of the task at hand |
| <b><i>OPK-2 is capable of conducting methodological and expert work in the field of mathematics and computer science.</i></b>                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Learning outcomes for the course (module):<br>ID-1 OPK-2 Searches                                                                                                                                                                                                                                                                                                                 | Does not know the basic domestic and foreign terminology in the                                                                                                                                                                                                                        | Has general knowledge of communication using basic terminology in the field of                                                                                                                                                                                                              | Possesses knowledge in the field of communication                                                                                                                                                                                                                                     | Has extensive knowledge in the field of communicatio                                                                                                                                                                                                                                                                                                                                                                                          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p>for system software, understands the structure of the operating system, the purpose of the main parameters and components of the operating system; uses methods for installing system software, as well as the modes of its interaction with the operating system; selects methods for monitoring operating system components, as well as fault-tolerant configuration modes</p> <p><b>ID-2</b> <small>OPK-2</small> <b>Installs and uninstalls the</b> Windows operating system , deploys the Windows directory service , and configures server roles; installs and uninstalls system software, starts, stops, and configures Windows services , and uses a Windows -based software router ; diagnoses the causes of Windows operating system failures using system software</p> | <p>field of mathematical and software methods of signal processing<br/>Does not know how to logically correctly, reasonably and clearly formulate theoretical positions in the field of mathematical and software methods of signal processing<br/>Does not possess the skills to collect, process, analyze and systematize scientific and technical information on the research topic using the achievements of domestic and foreign science, engineering and technology</p> | <p>mathematical and software methods of signal processing<br/>Possesses basic skills in formulating theoretical principles in the field of mathematical and software methods of signal processing<br/>Possesses the skills to collect, process, analyze and systematize information using the achievements of science, technology and engineering</p> | <p>using basic terminology in the field of mathematical and software methods of signal processing<br/>Possesses good skills in the field of formulating theoretical positions in the field of mathematical and software methods of signal processing<br/>Possesses the skills to collect, process, analyze and systematize scientific and technical information on the research topic using the achievements of domestic and foreign science, engineering and technology</p> | <p>n using basic terminology in the field of mathematical and software methods of signal processing<br/>Possesses good skills in the field of formulating theoretical positions in the field of mathematical and software methods of signal processing, depending on the practical task at hand<br/>Possesses the skills to collect, process, analyze and systematize scientific and technical information on the research topic using the achievements of domestic and foreign science, engineering and technology with the use of modern means of searching, processing and disseminating information</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

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 midterm 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.

**The methodical materials defining procedures of assessing knowledge, abilities, skills and (or) experience of activity characterizing stages of formation of competences**

The procedure of holding **examination** is carried out according to the Provision on carrying out the current control of progress and intermediate certification of students for educational programs of the higher education – to programs of a bachelor degree, programs of a specialist program , programs of a magistracy - in SKFU, the Provision on carrying out the current control of progress and intermediate certification of students for educational programs of the higher education – to programs of a postgraduate study, programs of an internship - in SKFU

Join in the examination card: 2 questions and task.

For preparation under the ticket it is taken away: 40 minutes

By preparation for the answer the student is granted the right of use: program of discipline.

Flowing control of students it is carried out by the teachers conducting a practical training on discipline in the following forms:

Oral poll on occupation.

Colloquium.

Individual practical tasks.

The solution of practical tasks with use of computer means on occupations.

Solution of house individual practical tasks.

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**Questions for examination**

on discipline Mathematical and program methods of processing of signals

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1. Transfer functions and pulse characteristics of basic links of the first and second orders.
2. Vsepropuskayushchy LDS, LDS from linear FChH .
3. Synthesis of KIH-filters. Problem of synthesis of digital filters as problem of approximation. Method of window functions .
4. Synthesis of KIH-filters. Method of frequency selection.
5. Bystry transformation of Fourier. An algorithm with thinning on time.
6. Kikh -filtration on the basis of bystry transformation of Fourier.
7. Analog filters prototypes for synthesis of digital filters.
8. Methods of synthesis of BIH-filters. Method of invariance of the pulse characteristic. Method of bilinear z-transformation. Method of frequency transformation of digital filters.
9. Block diagrams of recursive LDS.
10. Block diagrams of nonrecursive LDS.
11. Types of digital images and their submission to MATLAB.
12. Color models and formats of graphic files.
13. Bitmap as logical massif, binarization methods.
14. Binarization methods, their merits and demerits.
15. Bitmaps and Boolean operations .

16. Marking bitmap component, connectivity.
17. Calculation of signs of objects on bitmaps.
18. Operations of dilatation and erosion.
19. Allocation of borders of binary objects, bwmmorph function.
20. Transformations of brightness and contrast of grayscale images.
21. Logarithmic and histograms transformations .
22. Linear spatial filtration, concepts of correlation and convolution.
23. Nonlinear spatial filtration .
24. Two-dimensional discrete transformation of Fourier.
25. Two-dimensional theorem of a parcel.
26. Creation of frequency filters on corresponding to them spatial.

To be  
able, to  
own

1. The description of LDS in a time domain. Pulse characteristic, convolution formula. Convolution matrix.
2. Differential equation of LDS. Recursive and Nonrecursive LDS. Criteria of stability .
3. Z-transformation. Definition. Ratio of z-and p-plane. Properties of z-transformation. Z-transformations of the standard sequences.
4. Return z-transformation. Ways of calculation of the return z-transformation: decomposition in power series, use of the table of correspondence, decomposition on partial fractions, calculation of planimetric integrals.
5. The description of linear discrete systems in the Z-area. Transfer function. Interrelation of transfer function and differential equation. Stability of linear discrete systems.
6. The description of the linear discrete systems (LDS) in frequency area. Properties of frequency characteristics of LDS.
7. Kinds of representation of transfer functions for KIH-and BIH-systems.

Evaluation criteria:

The mark is "perfectly" put down to the student if he showed deep and strong digestion of program material; the full, consecutive, competent and logically stated answers at modification of a task; freely copes with objectives, correctly proves their solution, possession of versatile skills and methods of performance practical tasks.

The mark is "well" put down to the student if he showed knowledge of program material, his competent statement, without essential inaccuracies in the answer to a question; correct use of theoretical knowledge.

The mark is "well" put down to the student if he showed digestion of the main material; at the answer inaccuracies, insufficiently correct formulations are allowed; violation of the sequence in a statement of program material.

The mark is "unsatisfactorily" put down to the student if he showed not knowledge of program material; at the answer there are mistakes.

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## **Questions to a colloquium**

on discipline Mathematical and program methods of processing of signals

1. Creation of frequency filters on corresponding to them spatial.
2. Bystry transformation of Fourier. An algorithm with thinning on time.
3. Kikh -filtration on the basis of bystry transformation of Fourier.
4. Analog filters prototypes for synthesis of digital filters.
5. Methods of synthesis of BIH-filters. Method of invariance of the pulse characteristic. Method of bilinear z-transformation. Method of frequency transformation of digital filters.
6. Block diagrams of recursive LDS.
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8. Types of digital images and their submission to MATLAB.
9. Color models and formats of graphic files.
10. Bitmap as logical massif, binarization methods.
11. Binarization methods, their merits and demerits.
12. Bitmaps and Boolean operations .
13. Marking bitmap component, connectivity.
14. Calculation of signs of objects on bitmaps.
15. Operations of dilatation and erosion.
16. Allocation of borders of binary objects, bwmorph function.
17. Transformations of brightness and contrast of grayscale images.
18. Logarithmic and histograms transformations .
19. Linear spatial filtration, concepts of correlation and convolution.
20. Nonlinear spatial filtration .
21. Two-dimensional discrete transformation of Fourier.
22. Two-dimensional theorem of a parcel.

Evaluation criteria:

The mark is "perfectly" put down to the student if he performed work in full, in reasonings and justification there are no inaccuracies and mistakes.

The mark is "well" put down to the student if he executed correctly 80-90% of a task.

The mark is "well" put down to the student if he shows the correct algorithm of actions when performing not less than 60% of tasks, but makes computing mistakes or defects.

The mark is "unsatisfactorily" put down to the student if made the essential mistakes which showed that the student has no obligatory abilities on this subject.