

Документ подписан простой электронной подписью
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Дата подписания: 22.10.2026 13:25:38
Уникальный программный ключ:
990bea3aecc48c23bd8699e48288f8d1960c600

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
Higher Education
"NORTH CAUCASUS FEDERAL UNIVERSITY"

APPROVED BY
Acting Director of the Institute
Advanced Engineering
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WORK PROGRAM OF THE DISCIPLINE
Advanced Language Programming C

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	2026
Form of study	Full-time
Implemented in a semester	2

Developed by
Senior Lecturer at the School of Digital,
Robotic Systems and Electronics of the
Institute of Advanced Engineering
Govorova S.V.

1. Purpose and objectives of mastering the discipline (module)

The purpose of the discipline "Advanced Language Programming C" is to form a future bachelor from a set of competencies. The study of the discipline ensures the implementation of the requirements of the Federal State Educational Standard of Higher Education in the direction 11.03.02 Infocommunication Technologies and Communication Systems.

Objectives of the discipline: to study the basics of programming in the environments of modern information systems: the creation of modular programs, elements of the theory of modular programming, object-oriented design and programming on the example of the C++ programming language.

2. Place of the discipline (module) in the structure of the educational program

The discipline "Advanced Language Programming C" belongs to the disciplines of the compulsory part.

3. List of planned learning outcomes in the discipline (module) correlated with the planned results of the development of the educational program

Code, formulation of competence	Indicator code, wording	Planned learning outcomes in the discipline (module), characterizing the stages of the formation of competencies, indicators
OPK-3. Able to apply methods of search, storage, processing, analysis and presentation of information from various sources and databases in the required format, while observing the basic requirements of information security	ID-3 _{OPK-3} solves data processing problems using computer technology.	solves the problem of data processing using computer technology, using the C++ language.
OPK-4. Able to understand the principles of modern information technologies and use them to solve problems of professional activity	ID-4 _{OPK-4} uses the capabilities of computer technology and software to solve problems of control and algorithmization of information processing processes.	uses the capabilities of computing and software to create applications, uses the C++ language to solve information processing problems
OPK-5. Able to develop algorithms and computer programs suitable for practical application	ID-2 _{OPK-5} reads the codes of software products written in the mastered programming languages and makes the necessary changes	reads codes, understands and makes required changes to the program code
	ID-3 _{OPK-5} develops original algorithms and computer programs suitable for practical use	develops original applications suitable for practical use

4. Scope of the academic discipline (module) and forms of control

Scope of classes: total: 4 ECTS 144 academic hours	OFO,
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	in acad. hours
Contact work:	32
Lectures/from them practical training	0 / -
Laboratory work/from them practical training	32 / -
Practical training/of which practical training	-
Independent work	112
Forms of control	-
Exam	-
Credit	Yes
Credit with a grade	-
Computational and graphic works	-
Term papers	-
Tests	-

5. The content of the discipline (module), structured by topics (sections) with an indication of the number of hours and types of classes

№	Section (topic) of the discipline and summary	Emerging competencies, indicators	Full-time				Form of current monitoring of progress
			Contact work of students with the teacher / of them in the form of practical training, hours			Independent work, hours	
			Lectures	Practical exercises	Laboratory work		
1.	Basic concepts of C and C++ General information about programs, lexemes, and the alphabet. Identifiers and function words. Constants: integer constants, real constants, enumerable constants, symbolic (literal constants). Operation signs. Unary operations. Binary operations: additive, multiplicative, shift, bit-by-bit, relation operations, logical operations, assignments	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		6	Interview
2.	Variables in C and C++. Primary and derived types. Memory classes. The scope (scope) of the identifier (name). 3. The visibility of the object and namespace. The lifespan of objects. Expressions and type conversions	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		6	Interview

3.	C and C++ operators and expressions. C++ language operators: Increment, Decrement, Sizeof, Negation, Shift, Relation, Bitwise, Boolean, Assignment, Conditional. Type Conversion	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
4.	Basic constructs of structured programming. Sequential statements. If and switch selection statements. Control transfer statements: goto unconditional transfer operator, return operator from the return function, loop or break switch exit operator, continue to the next iteration statement. Loop statements: loop with while precondition, loop with do postcondition, iterative for loop.	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
5.	Arrays in C and C++ One-dimensional arrays. Multidimensional arrays	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
6.	Pointers and references in C and C++. Dynamic arrays. Pointers and object addresses. Address arithmetic, pointer types and operations. Arrays and pointers. Pointer arrays, dynamic arrays. New and delete operators. Malloc and free functions	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
7.	User-defined types Renaming Types C++ Language Enumerations. Structure as a Type and Data Set	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
8.	Functions in C and C++. Definitions, descriptions, and function calls. Functions with a variable number of parameters. Recursive functions. Inline functions. Using arrays as function parameters. Function pointers. References. Overloading	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		6	Interview
9.	Classes in C++. Class concept. Definition of class methods. Method labels and optional arguments	ID-3 _{OPK-3} ID-4 _{OPK-4} ID-2 _{OPK-5} ID-3 _{OPK-5}		2		8	Interview

10.	Stages and models of the software life cycle. Modern programming technologies. The concept of the software life cycle. Goals and structure of modern models of the software software life cycle. The content of individual stages of the software program development. Standardization of the software software life cycle	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
11.	International standards that serve as the basis for the development of software products. GOST Unified System of Program Documentation. ISO 15504 (SPICE) Standard. ISO 9000 Quality Management System. CMM Standard.	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
12.	Assessment of the quality of software facilities. Features of software development and maintenance for working groups and paraprogramming. Quality indicators of software systems. Methods for determining quality indicators. Methods for assessing the quality of software facilities according to GOST 28 195-89. Quality management of software systems. Reliability of software systems. Characteristics of software errors and their causes	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
13.	Software testing. Planning of testing and debugging of SF. Principles and methods of testing. Design of test data sets. Testing of modules. Testing of software complexes. Criteria for testing completeness. Debugging of programs. Processing of test and debugging results.	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
14.	Data processing algorithms The concept of a data processing algorithm. Characteristics of an algorithm class. Main classes of algorithms. Basic algorithms for data processing	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
15.	Recursion and recursive algorithms. Basic concepts. Analysis of the labor intensity of recursive algorithms. Recursive functions and procedures. Search algorithms with returns and their recursive implementation	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview

16.	Search algorithms in linear structures. Linear search algorithm. Binary search algorithm	ID-3 OPK-3 ID-4 OPK-4 ID-2 OPK-5 ID-3 OPK-5		2		8	Interview
	TOTAL for the 2nd semester			32.00		112.00	
	TOTAL			32.00		112.00	

6. Fund of assessment tools for current monitoring of progress and intermediate certification of students in the discipline (module)

The Assessment Tools Fund (CSF) for current monitoring of progress and intermediate certification of students in the discipline (module) "Advanced Language Programming C" is based on the list of competencies to be mastered with an indication of the stages of their formation in the process of mastering the discipline (module).

- description of indicators and criteria for assessing competencies at various stages of their formation, description of assessment scales;
- methodological materials that determine the procedures for assessing knowledge, skills, and (or) experience of activity, characterizing the stages of competence formation;
- standard control tasks and other materials necessary to assess knowledge, skills and the level of mastery of the formed competencies in the process of mastering the discipline (module).

The FAT is an appendix to this program of the discipline (module).

7. Methodical instructions for students on the development of the discipline

Starting work, each student should take into account the following provisions.

The discipline (module) is built on a thematic principle, each topic is a logically complete section.

The lecture material is devoted to the consideration of the key, basic provisions of the courses and the explanation of educational tasks submitted for independent work of students.

Practical classes are conducted in order to consolidate the learned information, to acquire skills for its application in solving practical problems in the relevant subject area.

Independent work of students is aimed at independent study of additional material, preparation for practical classes, as well as the performance of all types of independent work.

For the successful development of the discipline, it is necessary to perform all types of independent work, using the recommended sources of information.

8. Educational, methodological and information support of the discipline

8.1. List of basic and additional literature necessary for mastering the discipline (module)

8.1.1. List of basic literature:

1. Tyulpinova N. V. Algoritmizatsiya i programmirovaniye Elektronnyy resurs: Uchebnoe posobie [Algorithmization and programming Elektronnyy resurs: Uchebnoe posobie]. - Saratov : Vuzovskoe obrazovanie, 2019. - 200 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 978-5-4487-0470-3, unlimited copies

2. Bederdinova O. I Osnovy algoritizatsii i strukturnogo programmirovaniye Elektronnyy resurs [Fundamentals of algorithmization and structural programming] / Bederdinova O. I. : textbook. - Arkhangelsk: NArFU, 2017. - 88 p. - ISBN 978-5-261-01227-6, unlimited copies

3. Zabihullin, F. Z. Strukturnoe programmirovaniye na S++ Elektronnyy resurs [Structural programming in C++] / Zabihullin F. Z. : textbook. - Ufa : BSPU named after M. Akmulla, 2019. - 45 p. - ISBN 978-5-907176-11-9, unlimited copies

4. Konova, E. A. Algoritmy i programmy [Algorithms and programs]. Language C++ Elektronnyy resurs / Konova E. A., Pollak G. A. : uchebnoe posobie dlya vpo. - 5th ed., ster. - St. Petersburg: Lan, 2020. - 384 p. - APPROVED BY the UMO on education in the field of applied informatics as a textbook for students studying in the field of "Applied Informatics". - ISBN 978-5-8114-5431-0, unlimited copies

Beleva, L.F. Programming in the C++ language Elektronnyi resurs: uchebnoe posobie [Elektronnyi resurs: uchebnoe posobie]. - Saratov : IPR Media, 2018. - 81 p. - The book is in the basic version of the EBS IPRbooks. - ISBN 978-5-4486-0253-5, unlimited copies

8.1.2. List of additional literature:

1. Belotserkovskaya I. E. Algoritmatizatsiya [Algorithmization]. Introduction to the C++ programming language / I.E. Belotserkovskaya; N.V. Galina; L.Yu. - 2nd ed., ispr. - Moscow: National Open University "INTUIT", 2016. - 197 p., unlimited copies

2. Sedgwick R. Algoritmy na S++ [Algorithms in C++]. - 2nd ed., ispr. - Moscow: National Open University "INTUIT", 2016. - 1773 p., unlimited copies

3. Lubasheva T.V., Zhelezko B.A. Osnovy algoritmatizatsii i programmirovaniye: uchebnoe posobie [Fundamentals of algorithmization and programming: a textbook]. - Minsk: RIPO, 2016. - 378 p.: ill. - <http://biblioclub.ru/>. - Bibliogr. in the book. - ISBN 978-985-503-625-9, unlimited copies

4. Zotkin, S. P. Programming in the language of the high level S/S++ Elektronnyi resurs / Zotkin S. P. : lecture notes. - 3rd ed. - Moscow: MISI – MGSU, 2018. - 140 p. - ISBN 978-5-7264-1810-0, unlimited copies

5. Kashirskaya, E. N. Procedural'noe programmirovaniye: Praktikum Elektronnyi resurs [Procedural programming: Practicum Elektronnyi resurs] / Kashirskaya E. N. - Moscow: RTU MIREA, 2020. - 75 p., unlimited copies

6. Bazhenova I.Y. Introduction to Programming Elektronnyi resurs : uchebnoe posobie [Introduction to Programming Elektronnyi resurs: uchebnoe posobie]. - Introduction to Programming, 2020-07-28. - Moscow, Saratov: Internet University of Information Technologies (INTUIT), University Education, 2017. - 327 p. - The book is in the basic version of the IPRbooks EBS. - ISBN 978-5-4487-0073-6, unlimited copies

8.2. List of educational and methodological support for students' independent work in the discipline (module)

Programming in a High-Level Language: Guidelines and Variants of Tasks for 1st Year Students of the Direction of Training 09.03.01 Informatics and Computer Engineering. S. P. Zotkin. - Moscow : Moscow State University of Civil Engineering, IPR Media, EBS ASV, 2016. - 89 p. - The book is in the basic version of the EBS IPRbooks. - ISBN 978-5-7264-1277-1

8.3. List of resources of the information and telecommunication network "Internet" necessary for mastering the discipline (module)

www.biblioclub.ru - Electronic Library System "University Library Online"

www.eLibrary.ru - Scientific Electronic Library

www.iprbookshop.ru - IPRbooks Electronic Library System

9. List of information technologies used in the implementation of the educational process in the discipline (module), including a list of software and information reference systems

When giving lectures, computer equipment is used, demonstrations of presentation multimedia materials are used. In laboratory work, students present reports on laboratory work, prepared by them during the hours of independent work. When implementing disciplines using e-learning and DLT, the material can be placed both in the NCFU learning management system and in the information and library system used at the university.

Information reference systems:

Information and reference and information and legal systems used in the study of the discipline:

1	http://biblioclub.ru/index.php?page=book&id=234146
2	http://biblioclub.ru/index.php?page=book&id=89300

Software:

1.	Basic package of Microsoft Office programs (Word, Excel, PowerPoint). Microsoft Office Standard 2013: Contract No 01-ea/13 dated 25.02.2013, Microsoft Office Licensing https://support.microsoft.com/ru-ru/lifecycle/search/16674 Life cycle start date 09.01.2013;
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2.	Office 2013 Service Pack 1 Lifecycle Start Date 2/25/2014, Mainstream Support End Date 4/10/2018; Additional End of Support End of Support Date 4/11/2023
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10. Description of the material and technical base necessary for the implementation of the educational process in the discipline (module)

Lectures	Classroom for training sessions, equipped with multimedia equipment and technical teaching aids.
Practical exercises	The classroom for laboratory-type classes is equipped with specialized furniture and technical teaching aids that serve to present educational information: computers, a projector, an interactive whiteboard. There is a connection to the Internet, access to the educational network of the university.
Independent work	Room for independent work of students, equipped with computer equipment with the ability to connect to the Internet and the ability to access the electronic information and educational environment of the university
Practical training	It is carried out in the structural divisions of the university and (or) in organizations that carry out activities in the profile of the relevant educational program, including its structural subdivision

11. Features of mastering the discipline (module) by persons with disabilities

Students with disabilities are provided with special textbooks, teaching aids and didactic materials, special technical teaching aids for collective and individual use, the services of an assistant (assistant) who provides students with the necessary technical assistance, as well as the services of sign language interpreters and typhlo-sign interpreters.

The development of a discipline (module) by students with disabilities can be organized together with other students, as well as in separate groups.

The development of a discipline (module) by students with disabilities is carried out taking into account the characteristics of psychophysical development, individual capabilities and health status.

In order to ensure the accessibility of higher education under the educational program by persons with disabilities when mastering the discipline (module), the following is ensured:

1) for visually impaired persons:

- the presence of an assistant who provides the student with the necessary technical assistance, taking into account individual characteristics (helps to take a workplace, move, read and complete the task, including by writing down by dictation),

- written tasks, as well as instructions on the procedure for their implementation, are drawn up in enlarged font,

- special textbooks, teaching aids and didactic materials (with large print or audio files),

- individual uniform lighting of at least 300 lux,

- if necessary, the student is provided with a magnifying device to complete the task;

2) for persons with hearing disabilities:

- the presence of an assistant who provides the student with the necessary technical assistance, taking into account individual characteristics (helps to take a workplace, move, read and complete the task, including by writing down by dictation),

- the availability of sound-amplifying equipment for collective use is ensured, if necessary, the student is provided with sound-amplifying equipment for individual use;

- is provided with appropriate sound means of reproducing information;

3) for persons with disabilities with musculoskeletal disorders (including those with severe disorders of the motor functions of the upper extremities or the absence of upper limbs):

- written tasks are performed on a computer with specialized software or dictated to an assistant;

- At the request of the student, tasks can be performed orally.

12. Features of the implementation of the discipline using distance educational technologies and e-learning

According to Part 1 of Article 16 of the Federal Law of December 29, 2012 No 273-FZ "On Education in the Russian Federation", *e-learning* is understood as the organization of educational activities with the use of information contained in databases and used in the implementation of educational programs and information technologies, technical means, as well as information and telecommunication networks that ensure the transmission of this information through communication lines, the interaction of students and teachers. Distance *educational technologies* are understood as educational technologies implemented mainly with the use of information and telecommunication networks with indirect (at a distance) interaction between students and teachers.

The discipline can be implemented using distance learning technologies and e-learning in whole or in part. The components of the discipline's teaching materials (the discipline's work program, assessment and methodological materials, forms of certification), implemented using distance learning technologies and e-learning, contain an indication of their use.

When organizing educational activities with the use of distance educational technologies and e-learning, asynchronous and synchronous ways of interacting with participants in educational relations through the information and telecommunication network "Internet" may be provided.

When using distance learning technologies and e-learning, the schedule for the discipline indicates: ways of interaction between participants in educational relations through the information and telecommunication network "Internet" (videoconferencing, ET - electronic testing); links to the electronic information and educational environment of NCFU, to educational platforms and resources of other organizations to which open access is provided through the information and telecommunication network "Internet"; for synchronous learning - the time of online classes and teachers; for asynchronous learning - the authors of online courses.

When organizing interim certification using distance learning technologies and e-learning, the Methodological Recommendations for the Use of Technical Means That Ensure the Objectivity of Results in the Conduct of Interim and State Final Certification in Educational Programs of Higher Education - Bachelor's Degree Programs, Specialist Programs and Master's Degree Programs with the Use of Distance Educational Technologies (Letter of the Ministry of Education and Science of Russia dated 07.12.2020 No MN-19/1573-AN "On the Direction of Methodological Recommendations") are used.

The implementation of the discipline using e-learning and distance learning technologies is carried out using the electronic information and educational environment of NCFU, to which students have access through the information and telecommunication network "Internet", or using the resources of other organizations, including platforms that provide services for video conferences, online meetings and distance learning (MTS-Link), as well as using the capabilities of social networks for communication between students and teachers.

Educational and methodological support of the discipline implemented with the use of e-learning and distance educational technologies includes a work program, teaching aids or a course of lectures presented in electronic form, guidelines for the implementation of various types of educational activities of students provided for by the discipline, and other educational materials posted in the information and educational environment of NCFU.