

Документ подписан простой электронной подписью

Информация о владельце:

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Дата подписания: 22.10.2026 13:25:38

Уникальный программный ключ:

990bea3aeec48c23bd8699e48288f8d1960c600

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

I APPROVED BY

Acting director of the institute

advanced engineering

Ph.D. tech. Sciences, Associate Professor

A.A. Porokhnya

WORKING PROGRAM OF THE DISCIPLINE

"High-frequency electronic circuits/ High Frequency Electronic Circuit »

Direction of training	11.03.02 Infocommunication technologies and communication systems
Profile	Intelligent Data Processing in Infocommunication Systems and Networks
Year of commencement of studies	2026 g.
Form of study	full-time
Implemented in a semester	5

Developed by

Professor of the Department of Digital, Robotic Systems and Electronics at the Institute of Advanced Engineering

Candidate of Technical Sciences , Professor

Bazhenov A.V.

1. The purpose and objectives of mastering the discipline (module)

The purpose of mastering the discipline: developing students' professional competencies aimed at the application of microprocessor technology for the design, operation, and administration of information and communication equipment.

Objectives for mastering the discipline:

- systematization of fundamental knowledge on the general principles of operation of hardware, software and software-hardware of microprocessor technology.
- formation of a system of knowledge, skills and abilities for the creation and modernization of a switching subsystem using microprocessor technology;
- formation of ideas on the architecture and general principles of operation of hardware, software and software-hardware of microprocessor technology in infocommunications.

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

The course "High Frequency Electronic Circuits" is a compulsory course in curriculum B1.O.29. It is taught in the 5th semester.

3. List of planned learning outcomes for the discipline (module), correlated with the planned learning outcomes for the educational program

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
OPK-1. Capable of using the principles, laws, and methods of natural science and mathematics to solve engineering problems.	ID-1 OPK-1 understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulation, transmission and processing of information.	Understands the fundamental laws of nature and the basic physical and mathematical laws and methods of storing, transmitting, and processing information. Applies physical laws and mathematical methods to solve theoretical and applied problems. Uses knowledge of physics and mathematics to solve practical problems.
	ID-2 OPK-1 applies physical laws and mathematical methods to solve theoretical and applied problems.	Understands the fundamental laws of nature and the basic physical and mathematical laws and methods of storing, transmitting, and processing information. Applies physical laws and mathematical methods to solve theoretical and applied problems. Uses

		knowledge of physics and mathematics to solve practical problems.
	ID-3 OPK-1 uses knowledge of physics and mathematics to solve practical problems	Understands the fundamental laws of nature and the basic physical and mathematical laws and methods of storing, transmitting, and processing information. Applies physical laws and mathematical methods to solve theoretical and applied problems. Uses knowledge of physics and mathematics to solve practical problems.

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

Amount of classes: total: 6 credits, 216 academic hours.	OZFO, In academic hours
Contact work:	50.00
Lectures/including practical training	No
Laboratory work /including practical training	No
Practical classes /including practical training	50.00 / -
Independent work	112.00
Forms of control	
Exam	54.00
Credit	No
Credit with grade	No
Coursework	No

* The course (module) involves the use of e-learning and distance learning technologies (*unless otherwise established by the educational standard*)

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

No.			full-time education	
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	Section (topic) of the discipline and brief content	Developed competencies, indicators	Contact work of students with a teacher/of which in the form of practical training, hours			Independent work, hours	Forms of the current control academic performance
			Lectures	Practical classes	Laboratory work		
1	Topic 1. Electronic circuits and their place in modern information and communication systems. Levels of representation of a microprocessor system. Software model of a microprocessor. Microcontroller architecture. Typical microcontroller composition. Low-level programming. Practical Lesson 1: Exploring the Microcontroller Debug Board and Development Environment	ID-1 OPK1 ID-3 OPK-1		6		14	interview defense

2	Topic 2. Tools for developing software for high-frequency electronic circuits Purpose and classification of software development tools (IDEs). Composition of a typical IDE . Creating a flowchart of the algorithms for the operation of software products under development and software documentation in accordance with the Unified System of Software Development (ESPD) using an IDE . Organization of binary signal input/output. Practice 2: Programming Input/Output Procedures binary signals	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	interview
3	Topic 3. Analog-to-digital and digital-to-analog conversions. Devices, algorithms, and accuracy of analog-to-digital conversions. Comparison of analog quantities. Digital-to-analog converters. Generation of analog signals based on PWM Practical Lesson 3: Investigating the Peculiarities of Analog Signal Processing	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	interview

4	Topic 4. Timers and event processors. Timers and event processors and their implementation in microcontroller architectures. Time interval measurement. Real-time clock. Built-in timing functions. Generation of pulse sequences with specified durations and repetition periods. Counting of events associated with external signals and program results. Practice 4: Exploring the Peculiarities of Timer/Counter Programming	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	interview
5	Topic 5. Protocols for information interaction between the microprocessor and peripheral equipment of automated systems. Universal Synchronous-Asynchronous Receiver-Receiver (USART). Implementation of serial data exchange using USART . Programming RS -485 and RS -232 interface drivers based on the ModBus protocol . Development of drivers for data exchange using proprietary protocols. Practical lesson 5: Research of interfaces of infocommunication systems and networks	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	interview

6	Topic 6. Organization of the computing process in real-time systems. Organization of the computing process using dispatching. Organization of interrupt handling. Free RT OS real-time operating system. Organization of the computing process using an RTOS. Practical lesson 6: Study of the interrupt system of microprocessor devices	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	interview
7	Topic 7. Programmable logic circuits and digital signal processors. Specialized microprocessor devices. Programmable logic gate arrays (FPGAs). Digital signal processing algorithms and their implementation on digital signal processors (DSPs). Workshop 7: Exploring Programmable Logic Circuits	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		6		14	computer testing
8	Topic 8. Programmable Logic Controllers The purpose of programmable logic controllers. Overview of programmable logic controllers. General characteristics of PLC programming languages. Graphical PLC programming languages. Text-based PLC programming languages. Integrated environments. Practical lesson 8: PLC programming in the CoDeSys environment	ID-1 OPK1 ID-2 OPK-1 ID-3 OPK-1		8		14	computer testing
	EXAM					54.00	
	TOTAL FOR THE SEMESTER			50.00		166.00	

6. Fund of assessment tools for conducting ongoing monitoring of academic performance and midterm assessment of students in a discipline (module)

The Assessment Toolkit (AT) for ongoing performance monitoring and midterm assessment of students in the course (module) "High-Frequency Electronic Circuits" is based on a list of mastered competencies, indicating the stages of their development during the course (module) mastery. The AT provides objective monitoring of the achievement of planned learning outcomes. The AT includes:

- description of indicators and criteria for assessing competencies at various stages of their formation, description of assessment scales;
- methodological materials defining the procedures for assessing knowledge, skills, abilities and (or) work experience, characterizing the stages of competence development;
- standard test assignments and other materials necessary for assessing knowledge, skills and the level of mastery of the developed competencies in the process of mastering the discipline (module).

FOS is an appendix to this discipline (module) program.

7. Methodological guidelines for students on mastering the discipline

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

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

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

Laboratory work is carried out with the aim of consolidating the acquired information and acquiring skills in programming microprocessor systems.

Students' independent work is aimed at independent study of additional material, preparation for practical and laboratory classes, and completion of all types of independent work.

To successfully master the discipline, it is necessary complete all types of independent work using the recommended sources of information.

8. Educational, methodological and informational support of the discipline

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

8.1.1. List of main literature:

1. Bazhenov, A. V. Programming of embedded microprocessor systems: textbook / A. V. Bazhenov, N. Yu. Bratchenko, N. V. Grivennaya. - Stavropol: SKFU Publishing House, 2022. - 302 p., unlimited copies.

2. Novikov, Yu. V.; Fundamentals of microprocessor technology: a tutorial / Yu. V. Novikov, P. K. Skorobogatov. - Fundamentals of microprocessor technology, 2022-07-28. - Electronic data. (1 file). - Moscow: Internet University of Information Technology (INTUIT), IPR Media, 2020. - 405 p. - electronic. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 978-5-4497-0677-5, unlimited copies

3. Vodovozov, AM Microcontrollers for automation systems [Electronic resource]: a tutorial / AM Vodovozov. - Electronic text data. - M.: In-fra-Engineering, 2016. - 164 p. - 978-5-9729-0138-8. - Access mode: <http://www.iprbookshop.ru/51727.html>

4. Fundamentals of programming microprocessor controllers in digital process control systems [Electronic resource]: a tutorial / V. S. Kudryashov, A. V. Ivanov, M. V. Alekseev [et al.]. - Electronic text data. - Voronezh: Voronezh State University of Engineering Technologies, 2014. - 144 p. - 978-5-00032-054-9. - Access mode: <http://www.iprbookshop.ru/47437.html>

5. Shegal, A. A. Application of the Multisim software package for designing devices on microcontrollers [Electronic resource]: laboratory practical training / A. A. Shegal; edited by V. I. Ievlev. - Electronic text data. - Ekaterinburg: Ural Federal University, EBS ASV, 2014. - 116 p. - 978-5-7996-1117-0. - Access mode: <http://www.iprbookshop.ru/65968.html>

8.1.2. List of additional literature:

1. Aliyev, M. T.; Microprocessors and microprocessor control systems. 8-bit processors of the AVR family: laboratory practical training / M. T. Aliyev, T. S. Bukanova; Volga Region State Technological University. - Yoshkar-Ola: Perm State Technical University, 2016. - 64 p.: diagram, table, ill. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-8158-1775-3, unlimited copies

2. Bezuglov, D. A. Digital devices and microprocessors: a textbook / D. A. Bezuglov, I. V. Kalienko. - 2nd ed. - Rostov n / D: Phoenix, 2008. - 468 p.: ill. - (Higher education). - Bibliography: pp. 464-465. - ISBN 978-5-222-13917-2

3. Khartov, V. Ya. AVR microcontrollers: a practical guide for beginners: a tutorial / V. Ya. Khartov. - M.: MSTU, 2007. - 240 p.: ill. - App.: pp. 231-238. - Bibliography: p. 239. - ISBN 978-5-7038-3051-2

4. Melnikov, E. V.; Fundamentals of microprocessor technology: laboratory practical training / E. V. Melnikov. - Fundamentals of microprocessor technology, 2026-09-20. - Electronic data (1 file). - Samara: Samara State Technical University, EBS ASV, 2020. - 47 p. - electronic. - The book is in the premium version of the EBS IPR BOOKS. - ISBN 2227-8397, unlimited copies

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

1. Guidelines for laboratory work in the discipline "Microprocessor technology in infocommunications": Field of study 11.03.02 "Infocommunication technologies and communication systems". Graduate qualification - bachelor / Comp. A.V. Bazhenov. - Electronic resource. - Stavropol: SKFU, 2024. Unlimited copies.

2. Guidelines for independent work in the discipline "Microprocessor technology in infocommunications": Field of study 11.03.02 "Infocommunication technologies and communication systems". Graduate qualification – bachelor / Comp. A.V. Bazhenov. – Electronic resource. – Stavropol: SKFU, 2024, unlimited copies.

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

1. <http://biblioclub.ru/> University library online
2. <http://www.filosof.historic.ru/> - Electronic library on philosophy
3. <http://ihtik.lib.ru/> - Electronic full-text library Ihtik.
4. <http://www.philosophy.ru/library> – Electronic library of the Institute of Philosophy of the Russian Academy of Sciences
5. <http://www.rsl.ru> – Russian State Library.
6. <http://www.philosophy.ru/lib/> - Philosophical portal

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

Lectures are delivered using computers and multimedia presentations. During seminars and practical classes, students present presentations they prepared during their independent work hours.

Information reference systems:

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

- 1 <http://catalog.ncfu.ru/catalog/ncfu> – Official website of the Scientific Library of the North Caucasus Federal University.
- 2 <http://www.consultant.ru> – Official website of Consultant Plus
- 3 <https://www.mnr.gov.ru> – Official website of the Ministry of Natural Resources and Environment of the Russian Federation
- 4 Information and legal portal "Garant" - <http://www.garant.ru/>

Software:

- 1 Alt Workstation 10

- 2 Alt Workstation K
- 3 Alt "Server"
- 4 Office suite - P7-Office

10. Description of the material and technical base necessary for the implementation of the educational process in the discipline (module)

Lecture classes	1	A classroom for conducting classes, equipped with multimedia equipment and technical teaching aids.
Practical lesson	1	A classroom for conducting training sessions, equipped with computer equipment, software development environments, and debug boards with samples of various types of microcontrollers.
Independent work	1	A room for independent student work equipped with computers and the ability to connect to the Internet and access the university's electronic information and educational environment.

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 (helper) who provides students with the necessary technical assistance, as well as the services of sign language interpreters and tactile sign language interpreters.

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

The acquisition 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 accessibility of higher education under the educational program for individuals with disabilities, the following is provided when mastering a discipline (module):

1) for persons with visual impairments:

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

- written assignments, as well as instructions on how to complete them, are written in large print,

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

- individual uniform illumination of at least 300 lux,

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

2) for persons with hearing impairments:

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

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

- is provided with appropriate sound means for reproducing information;

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

- written assignments are completed on a computer with specialized software or dictated to an assistant;

- at the student's request, assignments can be completed orally.

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

According to Part 1 of Article 16 of Federal Law No. 273-FZ of December 29, 2012, "On Education in the Russian Federation," e-learning is defined as the organization of educational activities using information contained in databases and used in the implementation of educational programs, as well as information technologies, technical means, and information and telecommunications networks that facilitate the transmission of said information over communication lines, as well as interaction between students and teaching staff. Distance learning technologies are educational technologies implemented primarily using information and telecommunications networks through indirect (remote) interaction between students and teaching staff.

The course may be delivered using distance learning technologies and e-learning, in whole or in part. The components of the course's teaching and methodological kit (the course curriculum, assessment and methodological materials, and assessment forms) implemented using distance learning technologies and e-learning contain instructions for their use.

When organizing educational activities using distance learning technologies and e-learning, asynchronous and synchronous methods of interaction between participants in educational relations may be provided through the Internet information and telecommunications network.

When using distance learning technologies and e-learning, the curriculum for the discipline shall indicate: methods of interaction between participants in educational relations via the Internet (videoconferencing, electronic testing); links to the SKFU electronic information and educational environment, to educational platforms and resources of other organizations that are openly accessible via the Internet; for synchronous learning - the time of online classes and teachers; for asynchronous learning - the authors of online courses.

When organizing midterm assessments using distance learning technologies and e-learning, the Methodological Recommendations for the Application of Technical Means Ensuring the Objectivity of Results during Midterm and State Final Assessments for Higher Education Programs—Bachelor's Degree Programs, Specialist Programs, and Master's Degree Programs Using Distance Learning Technologies—are used (Letter of the Ministry of Education and Science of the Russian Federation dated December 7, 2020, No. MN-19/1573-AN "On the Submission of Methodological Recommendations").

The implementation of the course using e-learning and distance learning technologies is carried out using the electronic information and educational environment of SKFU, to which students have access via the information and telecommunications network "Internet", or using the resources of other organizations, including platforms providing services for video conferencing, online meetings and distance learning (MTS-Link), as well as using the capabilities of social networks for communication between students and teachers.

The educational and methodological support for a discipline implemented using e-learning and distance learning technologies includes a work program, educational and methodological manuals or a course of lectures, methodological instructions for the implementation of various types of educational activities of students provided for by the discipline, and other educational and methodological materials posted in the information and educational environment of SKFU, presented in electronic form.