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Информация о владельце:

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MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION

Federal State Autonomous Educational Institution

higher education

NORTH CAUCASIAN FEDERAL UNIVERSITY

I APPROVED BY

Acting director of the institute

advanced engineering

Ph.D. tech. Sci., Associate Professor

A.A. Porokhnya

WORKING PROGRAM FOR THE DISCIPLINE

"Digital Circuit and Logic Design"

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
Form of study	Full-time
Implemented in a semester	4

Developed by

Associate Professor of the Department of Digital,

robotic systems and electronics

Institute of Advanced Engineering

Ph.D. tech. Sci., Associate Professor

Nikulin V.I.

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

The objective of mastering the discipline : to develop students' professional competencies in the field of modern circuit design of analog and digital telecommunication devices.

Objectives of mastering the discipline :

- 1) Systematization of fundamental knowledge in the principles of construction and operation of typical (basic) analog and digital circuit devices.
- 2) Developing skills to correctly use acquired knowledge to select the right circuit design solutions when developing telecommunication devices and systems.
- 3) Acquisition of skills in designing analog and digital circuit devices;
- 4) Development of basic circuit design training necessary for successful mastery of professional disciplines, as well as for subsequent project activities.

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

The discipline Design of digital circuits and logic circuits/Digital Circuit and Logic Design refers to the disciplines of the compulsory part, Block 1, Discipline (modules) B1.0.21.

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. Able to represent a modern scientific picture of the world, identify the natural science essence of problems in their professional activities, determine solutions, and evaluate the effectiveness of the choices made.	ID-1 _{OPK-1} formulates the fundamental laws of nature and the basic physical mathematical principles and methods of accumulation, transmission and processing of information.	Calculates the parameters and characteristics of analog and digital information communications equipment, analyzes their quality indicators based on measurements, and uses specialized software for their design.
	ID-2 _{OPK-1} applies physical laws and mathematical methods to solve theoretical and applied problems in the field of infocommunications	applies physical laws and mathematical methods to solve theoretical and applied problems in the field of infocommunications, analyzes their qualitative indicators based on measurements, and uses specialized software for their design.

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
	ID-3 _{OPK-1} uses deep knowledge of physics and mathematics to solve practical problems in the field of infocommunications.	uses a deep knowledge of physics and mathematics to solve practical problems in the field of infocommunications, applies physical laws and mathematical methods to solve theoretical and applied problems in the field of infocommunications
OPK-2. Capable of implementing new principles and methods for researching modern information and communication systems and networks of various types for transmission, distribution, processing, and storage of information.	ID-1 _{OPK-2} defines the principles and methods of research of modern information and communication systems and evaluates their advantages and disadvantages	defines the principles and methods for studying modern information and communication systems and evaluates their advantages and disadvantages, ensures the implementation of the basic methods and means for conducting experimental studies of systems for the transmission, distribution, processing and storage of information
	ID-2 _{OPK-2} ensures the implementation of the basic methods and means for conducting experimental research into systems for transmitting, distributing, processing and storing information	ensures the implementation of the basic methods and means for conducting experimental research into systems for the transmission, distribution, processing and storage of information, defines the principles and methods for studying modern information and communication systems and evaluates their advantages and disadvantages

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
	ID-3 _{OPK-2} implements new principles and methods of processing and transmitting information in modern information and communication systems and networks	implements new principles and methods of processing and transmitting information in modern information and communication systems and networks, ensures the implementation of basic methods and means for conducting experimental research into systems for transmitting, distributing, processing and storing information
	ID-4 _{OPK-2} uses advanced domestic and foreign experience in the study of modern information and communication systems and/or their components	uses advanced domestic and foreign experience in the study of modern information and communication systems and/or their components, ensures the implementation of basic methods and means for conducting experimental research into systems for the transmission, distribution, processing and storage of information

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

Number of lessons: total: 3 z.e., 108 ac.h.	OFO, in academic hours
Contact work:	32.00
Lectures/including practical training	No
Laboratory work /including practical training	No
Practical classes /including practical training	32.00/32.00
Independent work	76.00
Forms of control	
Exam	-
Credit	Yes
Credit with grade	-
Coursework	No

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

No.	Section (topic) of the discipline and brief content	Developed competencies, indicators	Full-time education				Forms of the current control academic performance
			Contact work of students with a teacher/of which in the form of practical training, hours			Independent work, hours	
			Lectures	Practical classes	Laboratory work		
4th semester							
1	Logic elements and their applications. Transistor logic elements . Logic elements: inverters; repeaters and buffers. Basic logic elements: AND, NAND, OR, NOR gates. Exclusive OR gate. Combined logic elements. Schmitt triggers. Transistor logic elements. Practical lesson #1 Research of basic logic elements.	OPK-1 ID-1 _{OPK-1} ID-2 _{OPK-1} ID-3 _{OPK-1} OPK-2 ID-3 _{OPK-2} ID-4 _{OPK-2} ID-5 _{OPK-2}		4.00/4.00		10:00	interview
2	Combination circuits. Decoders and encoders. Multiplexers and code comparators. Adders. Code converters. Monostable multivibrators and generators. Research of combinational digital devices: adders. Research of combinational digital devices: encoders and decoders. Practical lesson #2 Research of combinational digital devices: multiplexers and demultiplexers.	OPK-2 ID-3 _{OPK-2} ID-4 _{OPK-2} ID-5 _{OPK-}		4.00/4.00		10:00	interview
3	Triggers and their application schemes. Basics of trigger construction and classification. Operating principles of typical triggers. Basic trigger connection diagrams. Practical lesson #3 Manchester code encoder on flip-flops. Research of triggers.	OPK-2 ID-3 _{OPK-2} ID-4 _{OPK-2} ID-5 _{OPK-}		4.00/4.00		108.00	interview
4	Registers and schemes of their application. General information about registers. Parallel registers triggered by edges. Parallel registers triggered by levels. Using parallel registers in computers. Practical lesson #4 Shift registers and their application circuits. Research of registers.			4.00/4.00		2:00 PM	interview

5	Counters and their application diagrams. General information about counters. Asynchronous counters. Synchronous counters with asynchronous carry. Applications of synchronous counters with asynchronous carry. Synchronous counters and their applications. Practical lesson #5 Research of counters.	OPK-2 ID-1 _{OPK-2} ID-2 _{OPK-2} ID-3 _{OPK-2} ID-4 _{OPK-2}		4.00/4.00		2:00 PM	interview
6	Memory: permanent and operational. General information about memory. General information about read-only memory devices (ROM). ROM as a universal combinational microcircuit. Microprogrammed automata on ROM. General information about random access memory devices (RAM). RAM for temporary storage of information. RAM as an information buffer. Practical lesson #6 Study of working and permanent memory.	OPK-1 ID-1 _{OPK-1} ID-2 _{OPK-1} ID-3 _{OPK-1} OPK-2 ID-3 _{OPK-2} ID-4 _{OPK-2} ID-5 _{OPK-2}		4.00/4.00		2:00 PM	interview
7	Digital-to-analog and analog-to-digital converters. General information, classification, and parameters of analog-to-digital converters (ADCs). Parallel and serial-parallel ADCs. 3. Serial and integrating ADCs. General information, classification, and parameters of digital-to-analog converters (DACs). Serial DACs. Parallel DACs. Practical lesson #7 Research of digital-to-analog and analog-to-digital converters.	OPK-1 ID-1 _{OPK-1} ID-2 _{OPK-1} ID-3 _{OPK-1} OPK-2 ID-3 _{OPK-2} ID-4 _{OPK-2} ID-5 _{OPK-2}		8.00/8.00		2:00 PM	interview
TOTAL for 4th semester				32.00 /32.00		76.00	

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) " Design of Digital Circuits and Logic 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 examination of key, basic provisions of the course and an explanation of the educational assignments assigned to students for independent work.

Practical work is carried out with the aim of consolidating the acquired information and acquiring skills for its application in solving practical problems in the relevant subject area.

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

To successfully master the course, it is necessary to 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:

Galochkin V.A. Circuitry of Analog and Digital Devices Electronic resource: study guide / V.A. Galochkin; ed. S.N. Eliseev. - Samara: Volga Region State University of Telecommunications and Informatics, 2016. - 441 p. - The book is in the basic version of the IPRbooks electronic library system. - ISBN 978-5-904029-51-7.

Galochkin V.A. Circuit Design of Telecommunication Devices. Part 2. Circuit Design of Digital Electronic Devices Electronic resource: Textbook / V.A. Galochkin; ed. S.N. Eliseev. - Samara: Volga Region State University of Telecommunications and Informatics, 2016. - 280 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397.

Novikov Yu.V. Introduction to Digital Circuit Engineering Electronic resource: textbook / Yu.V. Novikov. - Introduction to Digital Circuit Engineering, 2019-12-01. - Moscow: Internet University of Information Technologies (INTUIT), 2016. - 392 p. - The book is in the basic version of the IPRbooks electronic library system. - ISBN 5-94774-600-X.

Bastrakova M.I. Circuitry of Telecommunication Devices: Workshop / M.I. Bastrakova, V.V. Pavlov; Volga State Technological University. - Yoshkar-Ola: Perm State Technical University, 2019. - 52 p.: schematic, ill. - <http://biblioclub.ru/>. - Bibliography in the book - ISBN 978-5-8158-2073-9

Galochkin, V.A. Circuit Design of Telecommunication Devices. Guidelines for Laboratory Work. Part 1. Circuit Design of Analog Electronic Devices. Electronic resource: Textbook / V.A. Galochkin. - Samara: Volga Region State University of Telecommunications and Informatics, 2016. - 402 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397

Durkin V.V. Circuitry of Analog Electronic Devices. Electronic resource / Durkin V.V., Tyrykin S.V., Belorutsky R.Yu.: teaching aid. - Novosibirsk: NSTU, 2019. - 88 p. - ISBN 978-5-7782-3937-1

8.1.2. List of additional literature:

Belous I.A. Circuitry of Telecommunication Devices. Electronic resource / Belous I.A.: study guide. - Vladivostok: VSUES, 2018. - 56 p. - ISBN 978-5-9736-0516-2.

Kravets A.V. Textbook for the course "Circuitry of analog electronic devices": textbook / A.V. Kravets. - Rostov-on-Don|Taganrog: Publishing House of the Southern Federal University, 2018. - 185 p.: ill. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN.

Linets G.I. Circuitry of Telecommunication Devices: textbook: / G.I. Linets, A.V. Veligosha; North-Caucasian Federal University, Part 1, Analog Circuitry. - Stavropol: SKFU, 2015. - 198 p.

Loskutov E.D. Circuit Design of Analog Electronic Devices Electronic resource: Textbook / E.D. Loskutov. - Saratov: University Education, 2016. - 264 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397.

Mikushin A.V. Digital circuit design Electronic resource: monograph / V.I. Sedinin / A.V. Mikushin. - Novosibirsk: Siberian State University of Telecommunications and Informatics, 2016. - 319 p. - The book is in the basic version of the IPRbooks electronic library system. - ISBN 978-5-91434-036-7.

A teaching aid for the subject Circuitry of Telecommunication Devices Electronic resource / compiled by: V.V. Logvinov, O.V. Matveeva. - Moscow: Moscow Technical University of Communications and Informatics, 2016. - 46 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397.

Chervyakov N.I. Digital circuit design: Tutorial / N.I. Chervyakov, A.I. Galushkin; North-Caucasian fed. - Stavropol: SKFU, 2015. - 198 p.

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

Lecture notes for the course "Circuitry of Telecommunication Devices." Part 1. Analog Circuitry / For bachelors in the 11.03.02 "Infocommunication Technologies and Communication Systems" program / electronic resource, 2023.

Lecture notes for the course "Circuitry of Telecommunication Devices." Part 2. Digital Circuitry / For bachelors in the 11.03.02 "Infocommunication Technologies and Communication Systems" program / electronic resource, 2023.

Guidelines for laboratory work in the academic discipline "Circuitry of Telecommunication Devices." Part 1. Analog Circuitry / For bachelor's degree students in the 11.03.02 "Infocommunication Technologies and Communication Systems" program / electronic resource, 2023.

Guidelines for laboratory work in the academic discipline "Circuitry of Telecommunication Devices." Part 2. Digital Circuitry / For bachelor's degree students in the 11.03.02 "Infocommunication Technologies and Communication Systems" program / electronic resource, 2023.

Guidelines for independent work on the academic discipline "Circuitry of telecommunication devices" / For bachelors of the training program 11.03.02 "Infocommunication technologies and communication systems" / electronic resource, 2023.

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

To help radio amateurs: info@mic-ron.ru / Circuit Engineering Magazine - <http://mic-ron.ru/knigi/740.html>

National Open University INTUIT / Hardware. - https://intuit.ru/studies/courses?service=0&option_id=37&service_path=1

Digital microcircuits, transistors / Website. - <https://www.microshemca.ru/>

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

During practical classes, students conduct research on analog and digital circuit devices using computer modeling software and industrial laboratory setups.

Information reference systems:

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

1.	To help radio amateurs: info@mic-ron.ru / Circuit Engineering Magazine - http://mic-ron.ru/knigi/740.html
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2.	National Open University INTUIT / Hardware. - https://intuit.ru/studies/courses?service=0&option_id=37&service_path=1
3.	Digital microcircuits, transistors / Website. - https://www.microshemca.ru/

Software:

1.	NI LabView Teaching Only.
2.	NI Multisim Education or Electronics Workbench.
3.	PTC Mathcad
4.	Test control program "Ayren"

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

Practical classes	A classroom equipped with equipment and technical teaching aids for presenting educational information: - interdisciplinary laboratory platform with the NI ELVIS II + Circuit Design software package – 10 pcs. (with the "Fundamentals of Radio Engineering and Telecommunications" laboratory complex, the "Fundamentals of Digital Engineering and FPGA Programming" laboratory module); - 12 workstations consisting of: PC Dell Intel Core i3-3240 3.4GHz/4096Mb/500Gb/DVD-RW/keyboard/mouse, monitor DELL E2014H. Connection to the Internet, access to the university's corporate network.
Independent work	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.
Practical training	It is carried out in the structural divisions of the university and (or) in organizations operating in the profile of the relevant educational program, including its structural division

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 Use 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 Russia 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 that provide services for video conferencing, online meetings and distance learning, 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.