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Информация о владельце:
ФИО: Порохня Андрей Алексеевич
Должность: И.о. директора института перспективной инженерии
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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
Cand. Tech. Sci., Associate Professor
A.A. Porokhnya

WORK PROGRAM OF THE DISCIPLINE
"Information Theory and Coding"

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	5

Developed by
Professor at the School of Digital Sciences,
Robotics and Electronics
Institute of Advanced Engineering
Dr. Tech. Sci., Professor
V.P. Mochalov

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

The purpose of mastering the discipline is to form students' general professional competencies in the field of transmitting and receiving information using telecommunication devices.

Objectives of mastering the discipline:

1) Systematization of fundamental knowledge in the theory of signals, in the theory of noise immunity and coding, in the principles of building monochannel communication systems, the formation of skills to correctly use the knowledge gained in practice.

2) Acquisition of skills in modeling the main types of signals used in telecommunication systems, modulation and demodulation processes, coding and decoding, in the use of methods and methods to increase noise immunity in analog and discrete communication channels.

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

The discipline "Information Theory and Coding" belongs to the compulsory disciplines of Block 1 of the Discipline (modules).

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-4. Able to understand the principles of modern information technologies and use them to solve problems of professional activity	ID-1 OPK-4 uses information and communication technologies when searching for the necessary information.	Uses information and communication technologies when searching for the necessary information.
	ID-3 OPK-4 understands modern interactive software systems and basic methods of processing experimental data, including the use of standard software, general and special-purpose software packages.	Understands modern interactive software systems and basic methods of processing experimental data, including the use of standard software, general and special purpose software packages.
	ID-4 OPK-4 uses the capabilities of computer technology and software to solve problems of control and algorithmization of information processing processes.	It uses the capabilities of computer technology and software to solve problems of control and algorithmization of information processing processes.

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

Scope of classes: total: 5 EC 180 acad.h.	OFO, In acad. hours
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Contact work:	32.00/0
Lectures/from them practical training	0
Laboratory work/from them practical training	0
Practical training/of which practical training	32.00/0
Independent work	148.00
Forms of control	
Exam	-
Credit	Yes
Credit with a grade	-
Course work	no

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				Current Forms control Academic Performance
			Contact work of students with the teacher / of them in the form of practical training, hours			Independent work, hours	
			Lectures	Practical exercises	Laboratory work		
Semester 5							
1	General information about telecommunication facilities. Introduction to the theory of electrical communication. Information, messages, signals and interference. General principles of building communication systems. Interference and distortion in the communication channel. Characteristics of information transmission systems. Study of the characteristics of deterministic signals. Practical work 1. Study of the characteristics of signals essential for their transmission through communication channels	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
2	Mathematical models of signals and interference. Mathematical description of signals and interference. Frequency representation of signals. Mathematical representation of random signals and interference. Graphical and geometric representation of signals. Study of spectral analysis and synthesis of signals.	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview

	Study of correlation characteristics of signals. Study of statistical characteristics of narrowband stochastic processes. Practical Work 2. Study of Signal Characteristics in Their Vector Representation						
3	Analytical and discrete signal representation. Analytical representation of the signal. Discretization of signals in time. Study of Continuous Signal Sampling. Practical Work 3. Study of Discretization of Continuous Signals	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
4	Fundamentals of Modulation and Detection Theory Amplitude modulation. Amplitude detection. Frequency and phase modulation. Phase and frequency detection. Study of amplitude modulation and detection of AM signals. Study of frequency-modulated radio signals. Practical work 4. Study of spectral analysis and synthesis of periodic signals	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
5	Digital modulation (manipulation) and pulse modulation methods. Digital modulation (manipulation). Pulse modulation methods. Study of signals with digital modulation (manipulation). Practical work 5. Study of spectral analysis and signal synthesis based on the Fourier transform	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
6	Signal conversion in communication channels. Mathematical models of communication channels. Transmission of signals through communication channels. Mathematical models of communication channels. Study of communication channel models. Study of the probabilistic characteristics of a discrete communication channel in the presence of additive fluctuation interference. Practical work 6. Investigation of the properties of the Fourier transform	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
7	Fundamentals of the theory of noise immunity of message transmission systems.	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview

	Immunity of the discrete message transmission system: signal reception as a statistical problem, criteria for optimal signal reception, optimal reception of discrete signals, immunity for coherent reception of binary signals, incoherent reception of discrete signals. Immunity of the continuous message transmission system: optimal reception of continuous signals, optimal linear filtering of signals, potential immunity of continuous message transmission. Study of optimal signal reception. Study of potential noise immunity in coherent and incoherent reception. Practical Work 7. Study of Correlation Characteristics of Signals						
8	Fundamentals of the theory of information transfer. Information characteristics of the message source. Discrete channel bandwidth. Discrete message compression methods. Continuous channel bandwidth. Study of the bandwidth of communication channels. Practical work 8. Study of amplitude modulation and detection of AM signals	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		2.00		12.00	Interview
9	Fundamentals of noise-resistant coding. Introduction to Corrective Codes. Linear Block Codes. Hamming Codes. Cyclic Codes. Study of noise-resistant codes. Practical work 9. Study of frequency-modulated radio signals	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		4.00		12.00	Interview
10	Adaptive interference suppression devices. Fundamentals of Adaptive Interference Suppression. Adaptive notch and high-pass filters. Adaptive prediction devices, tracking filters, and storage devices. Filter research. Practical work 10. Study of discrete signals and their characteristics	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		4.00		12.00	Interview
11	Methods of receiving signals in difficult conditions. Reception of signals in channels with fading. Methods of combating signal fading. Methods of combating intersymbol interference. Reception of discrete messages in channels with spectrum-concentrated and impulse interference. Compensation of interference and distortion in the channel.	OPK-4 ID-1 OPK-4 ID-3 OPK-4 ID-4 OPK-4		4.00		14.00	Interview

	Investigation of methods for receiving signals that increase the signal-to-noise ratio. Practical work 11. Research on broadband noise-like signals						
12	Principles of multichannel communication and information distribution. Methods of Common Channel Resource Allocation. Frequency Channel Separation. Time Channel Separation. Code Channel Separation. Study of the principles of multichannel communication. Practical work 12. Study of numerical characteristics and laws of probability distribution of stochastic processes	OPK-4 ID-1 _{OPK-4} ID-3 _{OPK-4} ID-4 _{OPK-4}		4.00		14.00	Interview
	TOTAL for the 5th semester			32.00		148.00	
	TOTAL			32.00		148.00	

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

The Assessment Tools Fund (OSF) for current monitoring of progress and intermediate certification of students in the discipline (module) "Information Theory and Coding" is based on the list of mastered competencies 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 work is carried out in order to consolidate the acquired information, to acquire the skills of 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 laboratory work, as well as performing 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:

Akulininichev Yu.P. Theory of Electrical Communication: Electronic Resource: Textbook / A.S. Bergardt / Yu.P. Akulinichev. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2015. - 193 p. - The book is in the basic version of the EBS IPRbooks.

Akulininichev Yu.P. Theory of Electrical Communication. Laboratory Practicum Elektronnyi resurs / Akulinichev Yu.P. - Moscow: TUSUR, 2012. - 123 p.

Akulininichev Yu.P. Teoriya elektricheskogo svyazi Elektronnyi resurs [Theory of Electrical Communication: Elektronnyi resurs] / Akulinichev Yu.P.: a manual for conducting practical classes and independent work of students. - Moscow: TUSUR, 2012. - 202 p.

Akulininichev Yu.P. Theory of Electrical Communication Elektronnyi resurs: uchebno-metodicheskoe posobie [Theory of Electrical Communication: Electronic Resource: Textbook]. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2015. - 124 p. - The book is in the basic version of the EBS IPRbooks.

Grigoriev V.A. Theory of Electrical Communication Elektronnyi resurs: Sbornik zadach [Theory of Electrical Communication: Elektronnyi resurs: Sbornik zadach [Theory of Electrical Communication: Collection of Problems]. – St. Petersburg: ITMO University, 2012. - 78 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 2227-8397

Pashintsev V. P., Lyakhov A. V. General Theory of Communication: Textbook (Laboratory Practice) / Pashintsev V. P., Lyakhov A. V. – Stavropol: NCFU Publishing House, 2015. – 629 p.

8.1.2. List of additional literature:

Akulininichev Yu.P., Bergardt A.S. Theory and Technique of Information Transmission: Textbook. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2012. - 209 p.: ill., tab., schemes. - <http://biblioclub.ru/>. - ISBN 978-5-4332-0035-7

Akulininichev Yu.P., Bergardt A.S. Theory and Technique of Information Transmission Electronic resource: Textbook. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, El Content, 2012. - 210 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 978-5-4332-0035-7

Akulininichev Yu.P. General Theory of Communication: Electronic Resource: Textbook / A.S. Bergardt / Yu.P. Akulinichev. - Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2015. - 193 p. - The book is in the basic version of the EBS IPRbooks.

Bikkenin R.R. Theory of Electric Communication: Textbook. Manual for Higher Educational Institutions / R. R. Bikkenin, M. N. Chesnokov. - Moscow: Academy, 2010. - Grif: Rek. UMO. - Refs.: p. 323-324. - ISBN 978-5-7695-6510-6

Vasyukov V.N. General Theory of Communication Elektronnyi resurs [General Theory of Communication: Elektronnyi resurs] / Vasyukov V.N.: textbook. - Novosibirsk: NSTU, 2017. - 580 p. - ISBN 978-5-7782-3010-1

Veligosha A.V. General Theory of Communication: Textbook / A.V. Veligosha; Ministry of Education and Science of the Russian Federation; Federal State Autonomous Educational Institution of Higher Professional Education "North Caucasus Federal University". - Stavropol: NCFU, 2014. - 240 p.: ill. - <http://biblioclub.ru/>. - Refs.: p. 231

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

Lecture notes on the academic discipline "Theory of Electrical Communications" / For bachelors of training 11.03.02 "Infocommunication technologies and communication systems" / electronic resource, 2023.

Guidelines for the Performance of Laboratory Work in the Academic Discipline "Theory of Electrical Communication": Direction of training "Intelligent Data Processing in Infocommunication Systems and Networks": [Electronic resource]. – Stavropol: NCFU, 2023.

Guidelines for Independent Work in the Academic Discipline "Theory of Electrical Communications" / For Bachelors of the Direction of Training 11.03.02 "Infocommunication Technologies and Communication Systems" / Electronic resource, 2023.

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

http://books.ifmo.ru/book/823/teoriya_elektricheskoy_svyazi._konspekt_lekciy.htm - V.A. Grigoriev, O.I. Lagutenko, O.A. Pavlov, Yu.A. Raspaev, V.G. Starodubtsev, I.A. Khvorov. Theory of Electrical Communication. Lecture Notes.

<http://siblec.ru/> - Bank of lectures.

<https://openedu.ru/course/spbstu/gtcom/>

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 to demonstrate presentation multimedia materials. In the course of laboratory work, students perform research on mathematical and circuit models of signals and communication channels using software for computer modeling and industrial laboratory installations.

Information reference systems:

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

1.	http://siblec.ru/ - Bank of lectures.
2.	https://openedu.ru/course/spbstu/gtcom/

Software:

1	Viola Workstation 10
2	Alt Workstation K
3	Viola "Server"
4	Office software package - P7-Office
5	NI Multisim Education or Electronics Workbench.
6	PTC Mathcad
7	Airen test control program

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

Lectures	The classroom for lecture-type classes is equipped with specialized furniture and technical teaching aids that serve to present educational information to a large audience: a laptop, a projector. Educational and visual aids in the form of thematic presentations corresponding to the work programs of disciplines.
Practical exercises	A classroom equipped with equipment and technical teaching aids for the presentation of educational information: - magnetic marker board 1-element 120x240; - Epson short-throw multimedia projector with wall mounting; - 15 workstations consisting of: computer – Lenovo Idea Centre all-in-one PC ((i5-3330s-2.7 / RAM 4Gb / Hdd 1Tb; video card 615M / DVD / keyboard / mouse. Connection to the Internet, access to the corporate 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
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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 Education 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.