

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
FEDERAL STATE AUTONOMOUS EDUCATIONAL
INSTITUTION OF HIGHER EDUCATION
"NORTH CAUCASUS FEDERAL UNIVERSITY"

SUGGESTIONS FOR TEACHING
for the performance of practical work
on the discipline "Principles of Communications" for students of the field of
study
11.03.02 Infocommunication Technologies and Communication Systems
"Intelligent Data Processing in Infocommunication Systems and Networks"

Stavropol 2026

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LABORATORY WORK No 1

Study of the nature of signal propagation in long communication lines

Objective: To study the basic regularities of electromagnetic signal propagation in long communication lines, to study the effect of load on the nature of signal propagation, to determine the wave impedance of the line.

Theoretical substantiation

A long line is a transmission line whose length is commensurate with or exceeds the wavelength of the transmitted signal. The main parameters of a long line are: linear impedance R_0 , linear inductance L_0 , linear capacitance C_0 and linear conductivity of insulation G_0 . The propagation of a signal in such a line is described by telegraph equations.

The key parameter is **wave impedance** $Z_{\text{в}} = \sqrt{(R_0 + j\omega L_0)/(G_0 + j\omega C_0)}$. In the matched load mode ($Z_{\text{н}} = Z_{\text{в}}$), all the energy of the incident wave is absorbed by the load, there is no reflected wave. With an unmatched load, a reflected wave occurs, which leads to signal distortion and the formation of standing waves.

Procedure for performing work

1. Get acquainted with the laboratory stand and measuring instruments.
2. Assemble a circuit to investigate the propagation of a pulse signal in a long line.
3. Set a pulse signal with an amplitude of 2 V, a duration of 0.1 μs , and a frequency of 50 kHz on the generator.
4. Connect the oscilloscope to the line input, synchronize via the external channel.
5. By changing the resistance of the load, observe the change in the shape of the reflected pulse.
6. Set the load at which the reflected pulse is minimal – this corresponds to the matching mode.
7. Measure the amount of load resistance in the matching mode – this is the wave resistance of the line.
8. Repeat the measurements on the harmonic signal by observing the standing waves.

9. Measure the standing wave ratio (SWR) for multiple load values.
10. Compare the obtained value of wave impedance with the nameplate value of the cable.

Control questions

1. What is a long line? Under what condition is a line considered long?
2. What parameters characterize a long line?
3. What is the wave resistance of a line and what does it depend on?
4. What is the load matching mode?
5. What is Reflection Coefficient and How Does It Relate to Load Resistance?
6. What is Standing Wave Ratio (SWR)?
7. How does the polarity of the reflected pulse change as the load resistance increases and decreases?
8. Why is there no reflected signal at the agreed load?
9. What practical problems are solved by line coordination?
10. How is the wave impedance of a line determined experimentally?

LABORATORY WORK No 2

Investigation of structural elements of symmetrical communication cables

Objective: To study the design of symmetrical communication cables, to study the electrical parameters of symmetrical circuits, to master the methods of measuring loop resistance, ohmic asymmetry, capacitance and transient attenuation.

Theoretical substantiation

A symmetrical cable consists of twisted pairs or fours of insulated conductors. The main electrical parameters are: loop resistance, ohmic asymmetry, insulation resistance, working capacity and transient attenuation between circuits.

Transient attenuation characterizes the degree of mutual influence between adjacent circuits and depends on the symmetry of the cable. To reduce mutual

influence, **symmetry** is used - a set of measures that includes crossing conductors and concentrated symmetry.

Procedure for performing work

1. Get acquainted with the design of a symmetrical cable (study the cross-section, marking of the conductors).
2. Assemble a circuit to measure the loop resistance. Measure the loop resistance of each pair.
3. Measure the resistance of each conductor separately.
4. Calculate the ohmic asymmetry of the circuit as the difference in the resistance of the conductors.
5. Measure the insulation resistance between the conductors and between the conductors and the shield.
6. Measure the working capacity of the chain.
7. Assemble a circuit to measure transient attenuation at the near and far ends.
8. Measure the transient attenuation between two adjacent pairs.
9. To evaluate the effect of twisting and symmetry on the value of transient attenuation.
10. Compare the obtained values with the standard values.

Control questions

1. What types of balanced cables do you know?
2. What is a twist pitch and how does it affect the cable parameters?
3. What is loop resistance and how is it measured?
4. What is characterized by ohmic chain asymmetry?
5. What are the norms for ohmic asymmetry?
6. What is Transient Attenuation and Circuit Protection?
7. Why does symmetry reduce the mutual influence between circuits?
8. What is the difference between transient attenuation at the near and far ends?
9. What symmetry methods are used on high-frequency cables?
10. How does the design of a cable affect its electrical parameters?

LABORATORY WORK No 3

Coaxial Link Study

Objective: To study the design of a coaxial cable, to study the propagation of signals in a coaxial line, to study the effect of matching on signal losses and distortions.

Theoretical substantiation

A coaxial cable consists of a central conductor, a dielectric, an external conductor (shield) and a protective sheath. The main advantage is high protection from external interference and low losses at high frequencies.

The wave impedance of a coaxial line is determined by the ratio of diameters: $Z_B = \frac{138}{\sqrt{\epsilon}} \lg \frac{D}{d}$, where D is the inner diameter of the shield, d is the diameter of the central conductor, ϵ is the permittivity. The standard values of wave resistance are 50 Ohm (for power transmission) and 75 Ohm (for minimum loss).

Procedure for performing work

1. Study the design of a coaxial cable (consider the cross-section).
2. Measure geometric parameters: diameter of the central conductor, inner diameter of the shield.
3. Calculate the theoretical value of wave resistance.
4. Assemble a circuit for measuring wave impedance by the experimental method.
5. Connect the generator and oscilloscope to the line.
6. By changing the resistance of the load, achieve a minimum reflected signal.
7. Measure the load resistance in matching mode.
8. Investigate the dependence of attenuation on the frequency and length of the cable.
9. To study the dependence of attenuation on the type of dielectric.
10. Compare experimental and calculated values.

Control questions

1. What are the elements of a coaxial cable?

2. What are the advantages of coaxial cable over symmetrical cable?
3. How is the wave impedance of a coaxial line calculated?
4. What are the standard values of wave resistance that correspond to optimal conditions?
5. What does coaxial cable loss depend on?
6. What is the dielectric loss tangent?
7. How does the diameter of the central conductor affect attenuation?
8. Why choose a 50 ohm cable for high power transmission?
9. How does load matching affect line efficiency?
10. What types of coaxial cables are used in SCS?

LABORATORY WORK No 4

Calculation of Electromagnetic Wave Parameters in a Coaxial Cable

Objective: To master the method of calculating the parameters of electromagnetic waves in a coaxial cable, to study the dependence of parameters on the frequency and geometry of the cable.

Theoretical substantiation

In a coaxial cable, a transverse electromagnetic wave (TEM) propagates. The wavelength in the cable is Λ , where $\Lambda = \lambda / \sqrt{\epsilon\mu}$ λ is the wavelength in free space, ϵ and μ are the relative dielectric and magnetic constants.

The attenuation coefficient is the sum of the conductor losses α_R and the dielectric loss α . For copper conductors, α_R depends on the D/d ratio, reaching a minimum at D/d = 3.6. The dielectric loss increases in proportion to the frequency.

Procedure for performing work

1. Get a version of the assignment with the cable parameters from the teacher.
2. Calculate the wave impedance according to the specified geometric parameters.
3. Calculate the wavelength in the cable for given frequencies.
4. Calculate the attenuation coefficient in conductors for multiple frequencies.

5. Calculate the attenuation coefficient in a dielectric for the same frequencies.
6. Plot the dependence of total attenuation on frequency.
7. Determine the optimal D/d *D/d ratio* for minimum attenuation.
8. Calculate the maximum and permissible transmitted power.
9. To study the dependence of parameters on the type of dielectric.
10. Draw conclusions about the choice of the optimal cable design for the given conditions.

Control questions

1. What wave propagates in a coaxial cable?
2. How is the wavelength in a cable calculated?
3. What are the components of attenuation in a coaxial cable?
4. How does attenuation in conductors depend on frequency?
5. How does attenuation in a dielectric depend on frequency?
6. At what D/d *D/d ratio* is the minimum attenuation achieved?
7. Why choose a different ratio for power transmission?
8. What is the power limit of a coaxial cable?
9. How to choose a wave impedance for a specific application?
10. What dielectrics are used in coaxial cables and why?

LABORATORY WORK No 5

Study of a fiber-optic communication line

Objective: To study the principles of signal transmission over fiber-optic cable, to study attenuation and losses in optical fiber, to study methods for measuring FOCL parameters.

Theoretical substantiation

An optical fiber consists of a core and a cladding with different refractive indices ($n_1 > n_2$). Signal transmission is based on the phenomenon of **total internal reflection**: at angles of incidence greater than the limiting angle, the beam does not go beyond the interface of the media.

The main parameters of FOCL are: attenuation (dB/km), dispersion, numerical aperture. Attenuation consists of absorption and scattering losses. Insertion loss attenuation measurement is a standard method for testing optical lines.

Procedure for performing work

1. Study the design of optical fiber and cable.
2. Get acquainted with the laboratory model and measuring equipment.
3. Prepare the optical fiber for measurement (end cleaning).
4. Measure the power of the optical radiation source.
5. Measure the output power of a short piece of fiber (reference).
6. Measure the output power of a long stretch of fiber.
7. Calculate attenuation using the insertion loss method.
8. Measure the loss at the connectors.
9. Evaluate the contribution of various factors to the overall attenuation.
10. Compare the obtained values with the passport data.

Control questions

1. What is the principle of signal transmission over optical fiber?
2. What is total internal reflection?
3. What types of optical fibers are there?
4. What is Numerical Aperture?
5. What does attenuation in optical fiber consist of?
6. What transparency windows are used in FOCL?
7. What is dispersion and how does it affect signal transmission?
8. How is optical fiber attenuation measured?
9. What are the advantages of FOCL over copper cables?
10. What types of connectors are used in fiber-optic communication lines?

LABORATORY WORK No 6

Study of SCS design technology on the nanoCAD platform

Objective: To study the capabilities of the nanoCAD platform for the design of structured cabling systems, to master the basic tools for creating a structured cabling project.

Theoretical substantiation

Structured cabling system (SCS) is a hierarchical cabling system of a building, divided into subsystems: workplace, horizontal, trunk and administrative. SCS design requires taking into account many parameters: cable lengths, laying margins, number of ports, compliance with standards.

nanoCAD SCS is a specialized software for SCS design, which allows you to automate the calculation of cable routes, generation of specifications and cable logs, as well as checking the design for compliance with the standards.

Procedure for performing work

1. Get acquainted with the nanoCAD SCS interface.
2. Create a new project.
3. Connect the architectural subbase (floor plan).
4. Define rooms and floors.
5. To create a system of cable channels.
6. Arrange workplaces and telecommunications equipment.
7. Configure workplace configurations.
8. Create horizontal subsystem connections.
9. Generate reports (specification, cable log).
10. Check the project for errors.

Control questions

1. What is a structured cabling system?
2. What subsystems does SCS include?
3. What are the advantages of using nanoCAD SCS?
4. What is an architectural foundation and how does it connect?
5. How are rooms and floors defined in a project?
6. What is a workplace configuration?
7. How are connections created in a horizontal subsystem?
8. What reports can be generated in nanoCAD SCS?
9. What checks are performed for a SCS project?
10. What standards regulate the design of SCS?

SCS design in the nanoCAD SCS environment

Objective: To master the practical skills of designing a structured cabling system in the nanoCAD SCS environment, to perform a full design cycle for a given object.

Theoretical substantiation

SCS design includes several stages: object analysis, topology selection, calculation of the number of workplaces, route design, calculation of cable lengths taking into account stocks, selection of equipment and materials. nanoCAD SCS allows you to automate most of these operations, ensuring the correctness of calculations and compliance with standards.

Particular attention is paid to the backbone subsystem, which may include connections between buildings. In nanoCAD SCS, this task is solved through the "Long-distance connections" tool with the creation of the "Output" and "Input" ATMs.

Procedure for performing work

1. Get a design assignment (site plan, requirements).
2. Create a new project in nanoCAD SCS.
3. Download the architectural framework.
4. Define floors and rooms.
5. Design a cable duct system.
6. Arrange workplaces according to the task.
7. Assemble telecommunication cabinets.
8. Create horizontal subsystem connections.
9. Create connections of the main subsystem (if necessary, between buildings).
10. Perform a project check and generate reporting documentation.

Control questions

1. What are the stages of SCS design?
2. How is the cable length calculated in a horizontal subsystem?
3. What stocks are taken into account when calculating cable lengths?
4. How is the backbone subsystem designed?

5. How are long-distance connections between buildings implemented in nanoCAD SCS?
6. What are the SDRs used to mark the transitions between floors?
7. How is the correctness of the SCS design checked?
8. What reports are generated when the design is complete?
9. What are the requirements for telecommunication cabinets?
10. How is the project compliance with the standards?

LABORATORY WORK No 8

Improving SCS reliability using redundancy and STP protocol

Objective: To study the methods of improving the reliability of SCS, to master the configuration of the spanning tree protocol (STP/RSTP) for redundancy of communication channels.

Theoretical substantiation

However, the presence of multiple paths between switches can lead to looping and a "broadcast storm". Spanning **Tree Protocol (STP)** and its improved version **RSTP** automatically block redundant paths, creating a logical tree topology, and activate a backup path if the primary path fails.

Configuring STP includes selecting a root bridge, defining port roles, and configuring security mechanisms (for example, restricted_role to protect against unauthorized connection of root switches).

Procedure for performing work

1. Assemble a network diagram with two switches and two cables between them.
2. Enable STP on the switches.
3. Determine the current version of the protocol.
4. Configure the priority for the root switch selection.
5. Assign edge ports.
6. Check the status of ports and their roles.
7. Determine which port is blocked.
8. Ping between computers and track losses.

9. Disconnect the main cable and check how quickly the connection is restored.
10. Switch the protocol version from RSTP to STP and compare the recovery time.

Control questions

1. Why do we need the STP protocol in SCS?
2. What is a broadcast storm?
3. What is the difference between RSTP and STP?
4. How is a root switch selected?
5. What are the port roles in STP?
6. What is an edge port?
7. How do I check the status of STP on a switch?
8. What happens when the primary link fails?
9. What defense mechanisms exist in STP?
10. How does redundancy increase the reliability of SCS?

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SUGGESTIONS FOR TEACHING

on the organization and conduct of independent work on the discipline
"Principles of Communications" for students of the field of study
11.03.02 Infocommunication Technologies and Communication Systems
"Intelligent Data Processing in Infocommunication Systems and Networks"

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INTRODUCTION

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

The purpose of mastering the discipline: the formation of students' professional competencies aimed at the use of measuring instruments to assess the qualitative and quantitative indicators of the work of information and communication equipment.

Objectives of mastering the discipline:

1. Systematization of fundamental knowledge on the theory of electrical circuits and methods for measuring the parameters of electrical signals.
2. Formation of a system of knowledge, skills and abilities to conduct all types of measurements, organization and implementation of measures for metrological support of information and communication equipment;
3. Formation of ideas for monitoring the compliance of developed projects and technical documentation with the requirements imposed by national standards and regulatory documents, international recommendations and technical regulations in the field of information and communication networks and systems.

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

The discipline Structured Cabling Systems refers to the disciplines of the part formed by the participants of educational relations and belongs to the module "Infocommunication Systems and Networks".

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
PC-1. It is capable of developing switching subsystems and network platforms, data transmission networks, transport networks and radio access networks, satellite communication systems	ID-1PK-1 understands and is guided by the principles of construction and operation of communication networks, including their constituent subsystems, and signaling protocols, standards for the quality of data, voice and video transmission used in communication networks, in the legislation of the Russian Federation in the field of communications.	Understands and navigates the principles of construction and operation of structured cabling systems
	ID-2PC-1 analyzes statistical parameters of traffic, develops solutions for operational reconfiguration of the network, changing the parameters of the switching subsystem, network platforms, for the use of equipment of new technologies; changing and adjusting the parameters of the switching subsystem, transport networks and data transmission networks, for organizing new and expanding existing communication directions.	Develops solutions for the prompt reconfiguration of structured cabling systems (SCS), parameters of the switching subsystem, transport networks and data transmission networks, for the organization of new and expansion of existing information and communication networks based on SCS technology
	ID-4PC-1 develops schemes for the organization of communication and integration of new network elements, builds and expands the switching	Designs structured cabling systems with the ability to implement plans to expand existing equipment, network

Code, formulation of competence	Indicator code, wording	Planned learning outcomes in the discipline (module), characterizing the stages of the formation of competencies, indicators
	subsystem and network platforms; performs work on switching equipment, deploys equipment for service platforms, equipment for new technologies on the network, fulfills plans for the expansion of existing equipment of network platforms and new technologies.	platforms and new technologies.
PC-3. Able to carry out calculations on the design of networks, structures and means of info-communications in accordance with the terms of reference using both standard methods, techniques and design automation tools, and independently created original programs	ID-1PK-3 understands regulatory, regulatory, technical, organizational and methodological documents that regulate the design preparation, implementation and operation of communication systems (telecommunication systems), the construction of facilities and communication lines.	Understands and applies in practice international and national standards, regulatory documentation for the design of structured cabling systems
	ID-3PK-3 calculates the parameters and characteristics of the network and infocommunication facilities, analyzes their qualitative indicators based on statistics and radio measurements, and uses specialized design software.	Calculates the parameters of structured cabling systems, including the use of specialized software.
	ID-4PK-3 identifies and analyzes the advantages and disadvantages of design solutions, assesses the risks associated with the implementation of the project.	Identifies and analyzes the advantages and disadvantages of structured cabling design options
	ID-5PK-3 collects initial data for the design of the network and infocommunication facilities, determination of the optimal configuration and topology of the transport network; develops technical solutions for the implementation of the communication system (telecommunication system) and its components.	Collects initial data for the design of structured cabling systems and their components.
PC-5. Ability to carry out installation, configuration, adjustment, testing of equipment, development of operating modes, control of design parameters of operation and testing of communication equipment, ensuring compliance of technical parameters of information and communication	ID-1PK-5 understands the current industry standards that determine the requirements for the parameters of the operation of equipment, channels and paths; methods for checking the technical condition of equipment, paths and transmission channels.	Understands and complies with standards, technical regulations and industry regulations that define the requirements for the design of structured cabling systems
	ID-2PK-5 complies with the technologies for setting up, adjusting and testing communication (telecommunications) equipment, operating rules and methods of using measuring and testing equipment.	Complies with the technologies for the installation and configuration of structured cabling equipment
	ID-5PC-5 selects and uses the appropriate test and measurement equipment, uses the equipment software when setting it up.	Selects and uses test and measurement equipment for the installation and configuration of

Code, formulation of competence	Indicator code, wording	Planned learning outcomes in the discipline (module), characterizing the stages of the formation of competencies, indicators
systems and/or their components with established operational and technical standards		structured cabling systems
PC-8. Capable of performing routine maintenance on network devices and software of the information and communication system	ID-1PK-8 complies with the instructions for the installation and operation of the administered network devices and software; the regulations for preventive maintenance on the administered information and communication system.	Complies with the instructions for installation, operation and maintenance of the information and communication system, as well as the regulations for preventive maintenance
	ID-2PC-8 installs operating systems of network devices; monitors administered network devices; uses standard data recovery procedures, works with archiving servers and operating system management tools; draws up a backup schedule for the operating systems of network devices; disassembles and assembles administered network devices.	Carries out the installation and basic configuration of network equipment, monitors the condition of the cable system, applies standard procedures for diagnostics and restoration of performance, participates in the assembly and disassembly of elements
	ID-3PC-8 uses modern means of monitoring the performance of the administered network; it uses regulatory and technical documentation in the field of information and communication technologies to solve problems.	Uses modern means of testing and controlling the parameters of structured cabling systems, applies regulatory and technical documentation and standards in design and operation
	ID-4PC-8 performs work on rebooting the operating systems of network devices, planning the schedule for copying the software of the network infocommunication system, restoring parameters using archiving servers and management tools of specialized operating systems of network equipment.	Performs work to restore the operability of information and communication systems, participates in the planning of routine maintenance, including backup and restoration of network infrastructure configurations
	ID-5PK-8 carries out routine maintenance of equipment in accordance with the manufacturer's recommendations.	Carries out routine and preventive maintenance of information and communication systems in accordance with the technical requirements and recommendations of equipment manufacturers.

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

Scope of classes: total: 3 EC 108 academic hours.	OFO, In acad. hours
Contact work:	46.00/0
Lectures/from them practical training	0
Laboratory work/from them practical training	0
Practical training/of which practical training	46.00/0
Independent work	62.00
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

5.1. Thematic plan of the discipline (module)

№	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 6							
1	Introduction to structured cabling systems. Structured cabling system as a part of an infocommunication network. Main types of SCS communication lines. Structured cabling system of a building. Fundamentals of electrodynamics of communication lines. Basic Provisions of Electrodynamics of Guiding Systems. Characteristics of the Electromagnetic Field. Electromagnetic Processes in Conductors and Dielectrics. Surface Effect. Guided Electromagnetic Waves. Initial Principles of Calculation of Guiding Systems. Study of the nature of signal propagation in long communication lines Practical Work No1 Investigation of the nature of signal	PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5		6		8	Interview

	propagation in long communication lines						
2	Electrical communication lines. Classification of electrical communication cables. Structural elements of symmetrical communication cables. Marking of symmetrical communication cables. Structural elements of coaxial communication cables. Marking and types of coaxial communication cables. Electrical cables for digital subscriber lines. The problem of electromagnetic compatibility in communication lines. Basic definitions and methods for studying mutual influences. Influences in homogeneous symmetrical communication lines. Influence between circuits of symmetrical cable communication lines. Effects in the construction lengths of the cable. Methods for increasing noise immunity Investigation of structural elements of symmetrical communication cables Coaxial Link Study Calculation of Parameters of Electromagnetic Waves in a Coaxial Cable Practical Work No2 Investigation of structural elements of symmetrical communication cables	PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5		6		8	Interview
3	Optical communication lines. Physical Foundations of Signal Transmission via Optical Cables. Fiber Fiber. Single-Mode and Multimode Fibers. Radial Analysis of Radiation Propagation in an Optical Fiber. Wave Analysis of Radiation Propagation in an Optical Fiber. Characteristics of Optical Lines and Their Measurement. Causes of Signal Attenuation in an Optical Cable. Dispersion. Main Dependencies of Optical Fiber Characteristics.Devices and Methods for Measuring FOCL Parameters. Study of a fiber-optic communication line Practical Work No3 Coaxial Link Study	PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5		6		8	Interview
4	Components of FOCL. Fiber-optic components of a structured cabling system. Component composition of the fiber-optic part of a structured cabling	PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1		6		8	Interview

	<p>system. Fiber-optic cables of external laying. Intra-facility cables. Optical fiber connectors. Integral connectors (splices). Connectors (connectors and adapters). Fiber-optic distribution devices. Technologies for terminating fiber optics with connectors</p> <p>Practical Work No4 Calculation of electromagnetic parameters waves in a coaxial cable</p>	<p>PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5</p>					
5	<p>Design of structured cabling systems. Hierarchy in a cabling system. Selection of a cable type for horizontal subsystems. Selection of a cable type for vertical subsystems. Standards for SCS implementation. Components of structured cabling systems. SCS switching equipment. Switching and hardware cables. Horizontal subsystem. SCS computer-aided design systems. NanoCAD platform. CAD nanoCAD SCS. Documentation of design results. Research of SCS design technology on the nano CAD platform SCS design in the nanoCAD SCS environment</p> <p>Practical Work No5 Study of fiber-optic Communication Lines</p>	<p>PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5</p>		6		10	Interview
6	<p>Improving the reliability and performance of SCS. Improving SCS reliability. Redundancy of transport lines. Increasing SCS reliability due to active elements. Increasing SCS performance. Aggregation of SCS lines. Splitting the horizontal subsystem of SCS into several virtual networks. Study of the technology for adjusting the active elements of SCS</p> <p>Practical Work No6 Study of SCS design technology on the nanoCAD platform</p>	<p>PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5</p>		8		10	Interview
7	<p>Installation and operation of SCS. Cable laying. Cabling inside the building. Laying cables between buildings. Electrical grounding of SCS elements. Operation of structured cabling systems. Ensuring safety during installation works.</p>	<p>PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3</p>		8		10	Interview

	Commissioning of SCS. Periodic maintenance and modernization of SCS Practical Work No7 SCS design in the nanoCAD SCS environment	ID-4PK-3 ID-5PK-3 PP-8 ID-1PC-5 ID-2PK-5 ID-3PK-5 ID-4PK-5 ID-5PK-5					
	TOTAL for the semester			46.00		62.00	
	TOTAL			46.00		62.00	

1. GENERAL CHARACTERISTICS OF INDEPENDENT WORK

All types of independent work in the discipline "Structured Cable Systems" are given in the table "Technological map of independent work". The basis of students' independent work in the discipline is the taking notes of lectures and recommended sources, preparation for computer testing of knowledge, preparation and preparation for the defense of reports on laboratory work, the performance of multi-level individual tasks in the course of laboratory work. For each type of independent work, certain forms of reporting are provided, which students present to the teacher during laboratory classes or during individual consultation hours.

Table 1 - Technological map of the student's independent work

Codes we implement them competencies , indicator a(s)	Type of student activity	Assessment Tools and Technologies	Number of hours, including		
			SRS	Contact work with teacher	Total
Semester 6					
PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-5 ID-1PC-5 ID-2PK-5 ID-5PK-5	Preparation for practical work	Report on practical Work	20.00	14.00	34.00
PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3 ID-4PK-3 ID-5PK-3 PP-5 ID-1PC-5 ID-2PK-5 ID-5PK-5	Self-study References	Interview	20.00	14.00	34.00
PC-1 ID-1PK-1 ID-2PK-1 ID-4PK-1 PC-3 ID-1PK-3 ID-3PK-3	Abstract on the issues element designs structured systems	Interview	22.00	18.00	40.00

ID-4PK-3, ID-5, PK-3, PK-5, ID- 1PK-5, ID- 2, PK-5 ID-5PK-5					
Total for the 6th semester			62.00	46.00	108.00
Total			62.00	46.00	108.00

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

Reference citations:

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2. Guiding Telecommunication Systems: A Textbook / V.A. Andreev, E.L. Portnov, L.N. Kochanovsky, Vol.1, Theory of Transmission and Influence. - [7th ed., revised and supplemented]. - Moscow: Hot Line - Telecom, 2011. - 424 p.: ill. - Vulture: Rek. GOU HPO MTUCI. - Refs.: p. 412-416. - ISBN 978-5-9912-0092-9, 15 copies.

Further reading:

1. Sklyarov O.K. Fiber-Optic Networks and Communication Systems / O. K. Sklyarov. — Electron. Tekstovye dannye. — M.: SOLON-PRESS, 2009. — 266 c. — 5-98003-147-2. — Mode of access: <http://www.iprbookshop.ru/8660.html>, unlimited copies.

2. Semenov A.B., Portnov E.L., Zubilevich A.L. Structured Cable Systems: Textbook. Electron. Text Data. Moscow: Moscow Technical University of Communications and Informatics, 2010. — 103 c. — 2227-8397. — Mode of access: <http://www.iprbookshop.ru/63363.html>, unlimited copies.

3. Semenov A.B. Design and Calculation of Structured Cable Systems and Their Components [Elektronnyi resurs] / A.B. Semenov. – Electron. tekstovye dannye. – Saratov: Profobrazovaniye, 2008. – 416 p. – 978-5-4488-0120-4. – Rezhim dostupa: <http://www.iprbookshop.ru/63954.html> - 7 copies.

The system of assessment of knowledge, skills, and abilities that characterize the stages of competence formation

Within the framework of the rating system established at the university, the performance of students in the discipline is assessed during current control and intermediate certification.

Current control is carried out at each training session, as well as during the established control points (CT), the time of which and the types of reporting on them are given in Table 2. Checking the readiness for laboratory work is carried out in the form of an interview at the beginning of each practical work

Table 2 - Rating assessment of the student's knowledge

No p/n	Type of student activity	Deadlines Performance	Quantity points
Semester 6			
1	Preparation for practical works and presentation of reports (Topics 1,2)	4	12

2	Preparation for practical Works and Defense of Reports (Topics 3,4)	8	15
3	Preparation for practical Papers and Presentation of Reports (Topics 5)	12	13
4	Preparation for practical works and presentation of reports (Topics 6, 7)	16	15
	Total for the 6th semester:		55
	Total:		55

The maximum possible score for the entire current control is set at **55**. The current control measure is considered passed if the student received at least 60% of the maximum score established for this control. The rating score given to the student for the current control measure passed by the student within the time limits established by the schedule of control measures is determined as follows:

<i>Level of completion of the control task</i>	<i>Rating score (in % of the maximum score for the control task)</i>
<i>Excellent</i>	<i>100</i>
<i>Good</i>	<i>80</i>
<i>Satisfactory</i>	<i>60</i>
<i>Unsatisfactory</i>	<i>0</i>

Intermediate certification in the discipline "Structured Cabling Systems" is carried out in the form **of a test with a grade**

The test procedure with assessment is not carried out as a separate control measure, the assessment of the student's knowledge takes place based on the results of the current control.

In the case of a test with a grade, a scale is used to convert the rating score in the discipline into a grade according to a 5-point system

Scale for converting the rating score in the discipline into a grade according to a 5-point system

<i>Rating score in the discipline</i>	<i>Score on a 5-point system</i>
<i>88-100</i>	<i>Excellent</i>
<i>72-87</i>	<i>Good</i>
<i>53-71</i>	<i>Satisfactory</i>
<i><53</i>	<i>Unsatisfactory</i>

2. METHODOICAL RECOMMENDATIONS FOR THE STUDY OF THEORETICAL MATERIAL

Comprehensive study of the academic discipline offered to students involves mastering the materials of lectures, textbooks, programs, creative work of students in the course of practical classes, as well as systematic performance of tasks for independent work.

During the lectures, the main issues within the framework of the topics under consideration are revealed, emphasis is placed on the most complex and interesting provisions of the studied material, which should be taken into account by students. Lecture materials are the basis for preparing students for practical classes.

Work with lecture notes

Review the notes immediately after classes. Mark the material in the lecture notes that is difficult to understand. Try to find answers to difficult questions using the proposed literature. If you could not understand the material on your own, formulate questions and contact the teacher for help at the current consultation or at the next lecture.

Every week, set aside time to review the material covered, checking your knowledge, skills and abilities on control questions and tests.

3. METHODOICAL RECOMMENDATIONS Software TAKING NOTES OF PRIMARY SOURCES

The study and analysis of literary sources is a mandatory type of independent work of students. The study of literature on the chosen topic has the task of tracing the nature of the formulation and solution of a certain problem by various authors, the argumentation of their conclusions and generalizations, to analyze and systematize the material obtained on the basis of their own comprehension in order to clarify the current state of the issue.

The study of the selected material must necessarily go with the simultaneous keeping of notes of what has been read and one's comments. The record can be both in the form of a synopsis and extracts, as well as a card index of statements, theses, ideas, methods, which in the future will facilitate the classification and systematization of the received material. Such notes are the best way to accumulate and primary processing of material, one of the obligatory forms of organization of mental work.

The plan is convenient to use when preparing for an oral presentation on the chosen topic. Each point of the plan should reveal one of the aspects of the chosen topic, and the entire plan should cover it in its entirety.

Theses imply a concise presentation of the main points of the text in the form of a statement or negation. They are a more advanced form of notes and provide the basis for discussion.

Note-taking is the process of mental processing and written fixation of information, in the form of a brief summary of the main content, meaning of a text. The result of note-taking is a record that allows the note-taker to immediately or after a certain period of time with the necessary completeness to restore the information received. Synopsis in Latin means "review". In essence, it should be compiled as a review containing the main ideas of the text without details and secondary details.

1. Orient themselves in the general composition of the text (be able to identify the introduction,

the main part, conclusion).

2. To see the logical and semantic outline of the message, to understand the system of presentation of information by the author as a whole, as well as the course of development of each individual thought.
3. To identify the "key" thoughts, i.e. the main semantic milestones on which the entire content of the text is "strung".
4. Identify detailed information.
5. Formulate the main information concisely, without transferring everything to the letter completely and verbatim.

Any scientific text contains information of 2 types: basic and auxiliary. The main information is the information that is most essential for revealing the content of the topic or issue. It includes: definitions of scientific concepts, formulations of laws, theoretical principles, etc. The purpose of auxiliary information is to help the reader better assimilate the proposed material. This type of information includes various kinds of comments. The main one is written down as fully as possible, the auxiliary one, as a rule, is omitted. The content of note-taking is the processing of basic information in order to generalize and reduce it. To generalize means to present it in a more general, schematic form, in the form of theses, conclusions, individual headings, presentation of the main results, etc. Such key words and phrases are called key words. Key words and phrases carry the main semantic and emotional load of the text content.

The choice of keywords is the first stage of semantic convolution, semantic compression of the material.

Important requirements for the outline are the clarity and visibility of the notes and their arrangement that would make it possible to understand the logical connections and hierarchy of concepts.

In terms of form, notes are divided into formalized and graphic.

1. Formalized (all records are entered into pre-prepared tables).

This is convenient, firstly, when taking notes of materials, when the list of characteristics of the described objects or phenomena is more or less constant, second, when preparing a single synopsis for several sources. Especially if there is a need to compare individual data. A variety of formalized synopsis is a record made in the form of answers to pre-prepared questions that provide exhaustive characteristics of similar objects or phenomena.

2. Graphic (the elements of the note-taking work are arranged in such a way that the hierarchy of concepts and the relationship between them are visible).

For each work, there may be not one, but several graphic notes, reflecting the book as a whole and its individual parts. Keeping a graphic note is the most perfect way to depict the internal structure of the book, and this process itself helps to assimilate its content.

The following main **types of notes can be distinguished: planned, textual, summary, thematic.**

Planned – it is easy to get with the help of a pre-made plan of the work, each question of the plan is answered by a certain part of the synopsis:

- a) question-and-answer (the outline gives accurate answers to the points of the plan expressed in the form of a question);
- b) a schematic planned outline (reflects the logical structure and interconnection of individual provisions).

Textual is a synopsis created mainly from quotations.

Summary synopsis – combines extracts, quotations, sometimes theses; part of its text can be provided with an outline.

Thematic – gives a more or less exhaustive answer (depending on the number of sources involved and other material, for example, one's own notes) to the question posed – topic: review; chronological.

The role of the outline is purely educational: it helps to fix the main concepts and provisions of the primary text and reproduce them at the right time, for example, when writing an essay or preparing for an exam.

Methods of note-taking.

- **Theses** are briefly formulated main thoughts, provisions of the material being studied. Theses concisely express the essence of what is being read, give an opportunity to reveal content. Starting to master the writing in the form of theses, it is useful to mark in the text itself the places that most clearly formulate the main idea that the author proves (unless, of course, it is a library book). Often such selection is facilitated by the font selection made in the text itself.

- **Linear-sequential writing of the text.** When taking notes in a linear-sequential way, it is advisable to use poster design tools, which include the following:

- shifting the text of the outline horizontally, vertically;
- highlighting especially significant words in bold (or other) font;
- use of different colors;
- underlining;
- Enclosing in the main information frame.

- The method of "questions and answers". It consists in dividing the page of the notebook in half with a vertical line, the note-taker on the left side of the page independently formulates the questions or problems raised in this text, and on the right side gives answers to them.

One of the modifications of the method of "questions and answers" is a table, where the place of the question is taken by the formulation of the problem raised by the author (lecturer), and the place of the answer is solution to this problem. Sometimes additional columns may appear in the table: for example, "my opinion", etc.

- A diagram **with fragments is** a method of taking notes that allows you to more clearly reveal the structure of the text, while fragments of the text (key words, phrases, explanations of all kinds) in combination with graphics help to create a rational and concise synopsis.

- **A simple diagram is** a method of note-taking, close to a diagram with fragments, the explanations for which the note-taker does not write, but must be able to give them orally.

- **Parallel method of** note-taking. The synopsis is drawn up on two sheets in parallel or one sheet is divided in half by a vertical line and notes are made on the right and left sides of the sheet.

However, it is better to use different methods of taking notes to write down the same material.

Combined synopsis is the pinnacle of mastering rational note-taking. At the same time, all these methods are skillfully used, combining them in one synopsis (one of the types of synopsis freely flows into the other, depending on the text being summarized, on the desire and skill of the note-taker). It is with the combined synopsis that the level of training and individuality of the student are most manifested.

Principles of compiling a synopsis of what has been read.

1. Write down all the output data of the source: author, title, year and place of publication. If the text is taken from a periodical (newspaper or magazine), then write down its title, year, month, number, date, place of publication.

2. Select the margins on the left or right, you can on both sides. On the left, in the margins, the pages of the original, structural sections of the article or book (titles of paragraphs, subheadings, etc.) are marked, and the main problems are formulated. On the right are the ways of recording the information read.

One of the types of reading - in-depth reading - involves deep assimilation of what has been read and often the storage of information for the purpose of subsequent reference to it. The effectiveness of such reading increases if what is read is recorded not only in memory, but also on paper. Psychologists say that what is written down is better and more fully assimilated, more firmly stored in memory. It has been established that if you read 1000 words and then write down 50 summarizing what you have read, then the assimilation coefficient will be higher than if you read 10000 words without writing down a single one. In addition, when writing down what you have read, the skill of convoluting information is formed. And, finally, alternating reading and writing reduces fatigue, increases efficiency and productivity of mental work.

1. Summary.

Summary is a brief summary of what has been read, containing its assessment. The summary characterizes the main conclusions of the book, the main results.

The choice of linguistic means for constructing summary conclusions is subordinated to the main task of convoluting information: a minimum of linguistic means – a maximum of information. This is usually one or three clear, concise, expressive sentences, revealing, in the author's opinion, the very essence of the object described.

2. Abstract.

An abstract is a brief generalized description of a printed work (book, article), sometimes including its assessment. This is the shortest summary of the content of the primary document, giving a general idea of the topic.

Its main purpose is to give some idea of the book (article, scientific work) in order to recommend it to a certain circle of readers or to use your notes when performing research and abstract work. Therefore, the annotation does not require a presentation of the content of the work, it only lists the issues that are covered in the original source (the content of these questions is not disclosed). The annotation answers the question: "What does the primary text say?", gives an idea only of the main topic and the list of issues touched upon in the text of the original source.

The text of the annotation is not standardized. In the scientific literature, you can find different annotation requirements. For example, the text of a reference annotation might include the following information:

- type and title of the annotated document (monograph, dissertation, collection, article, etc.)
- Tasks set by the author of the annotated document
- the method used by the author (experiment, comparative analysis, compilation of other sources)
 - the author's belonging to a certain scientific school or direction
 - the structure of the annotated document
 - the subject and theme of the work, the main provisions and conclusions of the author
 - characteristics of auxiliary illustrative materials, supplements, appendices, reference apparatus, including indexes and bibliography.

4. GUIDELINES FOR LABORATORY WORK

Execution laboratory works by discipline Structured Cabling Systems

At the first lesson, get from the teacher the course assignments, plans for preparing for laboratory work. Get all the necessary methodological support.

Objectives of laboratory tests:

- mastering the tools for designing structured cabling systems,
- Study of the design and elements of communication lines,
- development of the SCS project of a two-storey building.

When performing a workshop on the discipline (laboratory work) to achieve a basic level of competence formation, the student must be able to apply basic knowledge in the sections of the discipline, possess the skills of independent solution of educational tasks of the basic level. When performing a workshop on the discipline (laboratory work) to achieve an increased level of competence formation, the student must be able to apply increased knowledge in the sections of the discipline, possess the skills of independent solution of educational tasks of an advanced level.

Preparation for practical work is recommended to be carried out in the following sequence:

- to understand the topic and purpose of the upcoming practical work;
- study theoretical material in accordance with the topic of practical work (use recommended literature, lecture notes, textbook (workshop on laboratory work);
- get acquainted with the equipment and materials used in practical work (when using specialized equipment or software, it is necessary to study the procedure and rules for its use).

Methodical instructions for practical work

When performing practical work, students must strictly comply with the established safety requirements. When performing practical work, students are recommended:

- to understand the purpose of the tasks performed and ways to solve them;
- to perform the tasks specified in the practical work in the sequence in which they are indicated in the laboratory workshop;
- use the help of a teacher when performing a practical task and studying theoretical material;
- draw up a report on practical work;
- answer control questions.

Methodical instructions for preparing for the defense of practical work

When preparing for the defense of practical work, students are recommended:

- prepare a report on practical work; □ prepare a justification for the conclusions made;
- consolidate knowledge of theoretical material on the topic of practical work (it is recommended to use control questions);
- know the procedure for making calculations (conducting research);
- be able to show and explain the order of research when using specialized equipment or software.

The defense of practical work is carried out by interviewing the student with the teacher. During the interview, the student submits a report on practical work for verification. Interview with a student applying for an "excellent" grade

is conducted on questions and practical tasks of an advanced level of study. An interview with a student who does not apply for an "excellent" grade is conducted on questions and practical tasks of the basic level of study.

5. QUESTIONS FOR INTERVIEWS Software INDEPENDENT STUDY OF LITERATURE

Basic level:

1. Structured cabling system as part of infocommunication
2. Main types of SCS communication lines
3. Structured cabling of the building
4. Classification of Electrical Communication Cables
5. Structural Elements of Symmetrical Communication Cables
6. Structural Elements of Coaxial Communication Cables
7. Labeling and Types of Electrical Communication Cables
8. Electrical cables for digital subscriber lines
9. Primary and Secondary Transmission Parameters of Balanced Cables
10. Basic Definitions and Methods of Mutual Influence Research
11. Influences in Homogeneous Symmetrical Communication Lines
12. Influence between chains of symmetrical cable communication lines
13. Effects in Cable Construction Lengths
14. Fiber fiber. Single-mode and multimode fibers
15. Main Dependencies of Optical Fiber Characteristics
16. Transmission Options
17. Measurement of FOCL parameters
18. Hierarchy in a cabling system.
19. Choice of cable type for horizontal subsystems.
20. Choosing the type of cable for vertical subsystems.
21. Standards for the implementation of SCS
22. Patch and hardware cables
23. Horizontal subsystem
24. Reservation of transport lines

Advanced Level:

25. Fundamentals of Electrodynamics of Communication Lines
26. Electromagnetic Processes in Symmetrical Cables
27. Electromagnetic Processes in Coaxial Cables
28. The Problem of Electromagnetic Compatibility in Communication Lines
29. Attenuation Factor
30. Variance
31. Radiological Analysis of Radiation Propagation in an Optical Fiber
32. Wave Analysis of Radiation Propagation in an Optical Fiber
33. SCS switching equipment
34. Line aggregation
35. SCS design taking into account the use of virtual network technology

6. GUIDELINES FOR PREPARING FOR A TEST WITH A GRADE

Control and assessment of students' knowledge is an integral part of the educational process at the university. The exam session is the most responsible

Time in student life: it is the result of a lot of work of students in the semester. A test with a grade is a method of testing students' knowledge in a part or a full course of an academic discipline, made by asking oral or written questions. It gives an objective, officially recorded assessment of students' progress for a certain period of time.

A test with a grade pursues a multifaceted goal: firstly, it is a test of the student's knowledge, secondly, it is an important link in the mastery of science, thirdly, it is a continuation of the educational process; finally, it is of great importance as a factor in stimulating in-depth study of the subject.

Preparation for a test with a grade consists of two interrelated stages. The first is systematic work during a semester, academic year, covering all forms of academic process: lectures, Study and taking notes of recommended literature, active participation in seminars (practical) and laboratory classes.

The second is preparation immediately before the test with a grade. It allows students to cover the entire perspective of what they have learned in a relatively short period of time and better understand the main patterns and phenomena.

No additional time is allocated for direct preparation for the test with a grade.

It is necessary to prepare according to a strictly thought-out schedule, consistently moving from topic to topic, without missing any of them.

Complex questions that are not sufficiently understood in the process of preparing for the test must be written down and clarified by teachers during pre-examination consultations.

It should be noted that students who do not go to consultations because of the absence, in their opinion, of difficult questions, act recklessly. At consultations, very often the lecturer not only answers the questions asked, but also on his own initiative explains the most difficult sections of the course.

So, the main task of preparing students for the test with assessment is the systematization of knowledge of the educational material, its creative comprehension. The most important textbook at this stage of the student's work is his own summary of the lectures listened to and independently worked out topics of the course.

In accordance with the regulations on exams, they are usually accepted by teachers who give a course of lectures.

Having received a ticket, the student must think carefully about the content of the questions posed. A significant number of unsuccessful answers is due to a vague understanding of the problem posed. A correct understanding of the question will ensure success in answering it. When preparing to answer the ticket, you need to make a detailed plan for each question

When answering the questions on the ticket, one should not be in a hurry. It is necessary to present the material calmly, without haste, to control oneself, to follow the construction of phrases. Approaches from afar, general reasoning should be avoided. It is recommended to construct answers clearly, consistently, concretely, and as exhaustively as possible. At the same time, it is highly desirable to quickly and correctly illustrate your answer with examples.

The examinee is required to: define concepts, substantiate the propositions put forward, freely operate with factual material, and give alternative approaches to certain problems. Logic, harmony, literary literacy of presentation are integral features of a full-fledged answer. When answering, neither excessive brevity, turning into schematism, nor verbosity should be allowed. Both are not justified. Brevity does not give the teacher the opportunity to understand whether the student knows the educational material, and verbosity can show that the student does not know how to focus on the main thing and speaks too vaguely.

Competency assessment criteria *

An "excellent" grade is given to a student if he/she fully and at a high level understands and orients himself in the principles of construction and operation of structured cabling systems; develops high-level solutions for the prompt reconfiguration of structured cabling systems (SCS), parameters of the switching subsystem, transport networks and data transmission networks, for the organization of new and expansion of existing information and communication networks based on SCS technology; designs structured cabling systems at a high level with the possibility of implementing plans to expand the existing equipment of network platforms and new technologies; understands and actively applies international and national standards, regulatory documents for the design of structured cabling systems in practice; at a high level, carries out calculations of the parameters of structured cabling systems, including the use of specialized software; identifies and analyzes the advantages and disadvantages of design solutions for structured cabling systems; collects initial data for the design of structured cabling systems and their components at a high level; observes at a high level the technologies for the installation and configuration of structured cabling system equipment; selects and uses test and measuring equipment at a high level for the installation and configuration of structured cabling systems.

A "good" grade is given to a student if he/she understands and is well versed in the principles of construction and operation of structured cabling systems; in general, is able to develop solutions for the prompt reconfiguration of structured cabling systems (SCS), parameters of the switching subsystem, transport networks and data transmission networks, for the organization of new and expansion of existing information and communication networks based on SCS technology; is able to design structured cabling systems at a good level with the possibility of implementing plans to expand the existing equipment of network platforms and new technologies; applies international and national standards, regulatory documentation for the design of structured cabling systems without gross errors in practice; calculates the parameters of structured cabling systems, including the use of specialized software; identifies and analyzes the advantages and disadvantages of options for design solutions for structured cabling systems; collects initial data at a good level for the design of structured cabling systems and their components; complies with the technologies for the installation and configuration of structured cabling system equipment; is able to select and use test and measurement equipment for the installation and configuration of structured cabling systems.

A "satisfactory" grade is given to a student if he/she has a poor understanding and is mainly oriented in the principles of construction and operation of structured cabling systems; makes minor mistakes in the development of solutions for the prompt reconfiguration of structured cabling systems (SCS), parameters of the switching subsystem, transport networks and data transmission networks, for the organization of new and expansion of existing infocommunication networks based on SCS technology; is poorly able to design structured cabling systems with the possibility of implementing plans to expand the existing equipment of network platforms and new technologies; poorly understands and generally applies in practice international and national standards, regulatory documentation for the design of structured cabling systems; in general, without gross errors, calculates the parameters of structured cabling systems, including the use of specialized software; is able to identify and

analyze the advantages and disadvantages of a limited number of options for the design of structured cabling systems; collect initial data for the design of structured cabling systems and their components without gross errors; in general, without gross errors, comply with the technologies for the installation and configuration of structured cabling system equipment; select and use test and measuring equipment for installation and configuration of structured cabling systems without gross errors.

An "unsatisfactory" grade is given to a student if he/she does not understand and is not guided by the principles of construction and operation of structured cabling systems; is not able to develop solutions for the prompt reconfiguration of structured cabling systems (SCS), parameters of the switching subsystem, transport networks and data transmission networks, for the organization of new and expansion of existing information and communication networks based on SCS technology; is not able to design structured cabling systems with the possibility of implementing plans to expand the existing equipment of network platforms and new technologies; does not understand and does not apply in practice international and national standards, regulatory documentation for the design of structured cabling systems; is not able to calculate the parameters of structured cabling systems, including using specialized software; is not able to identify and analyze the advantages and disadvantages of design options for structured cabling systems; is not able to collect initial data for the design of structured cabling systems and their components; does not understand and does not comply with the requirements of standards, technical regulations and industry regulatory documents that determine the requirements for the design of structured cabling systems; does not comply with the technology of installation and configuration of structured cabling system equipment; is unable to select and cannot use test and measuring equipment for installation and configuration of structured cabling systems