

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
on the implementation of practical classes
by discipline
"Random signal analysis"

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

Practical lesson No1

Topic: Investigation of Kolmogorov equations for probabilities of states of Markov systems with continuous time and discrete states

Purpose of the work: To study the procedure for composing Kolmogorov equations for the probabilities of states of Markov systems with continuous time and discrete states.

Initial data: The object of research is internode channels that transmit a data stream without queuing them in cases where there is no free communication channel, that is, transmitting data with failures.

Software: No software required.

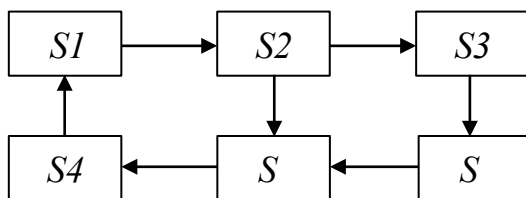
Assumptions:

1. The flow of applications is considered to be the simplest.
2. The time of receipt of applications is distributed according to the exponential law.

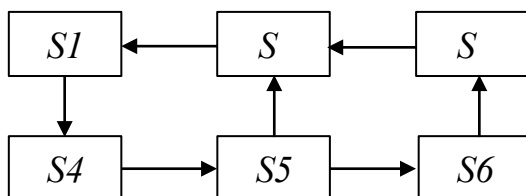
Research task.

Using theoretical information, to compile a system of Kolmogorov equations for the Markov process, presented in the form of a scheme:

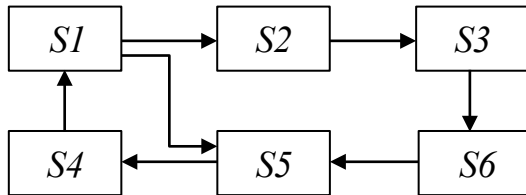
Option 1.



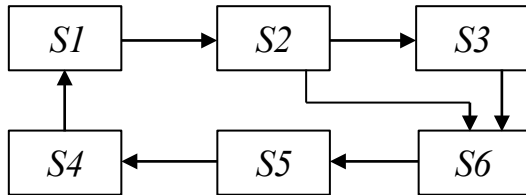
Option 2.



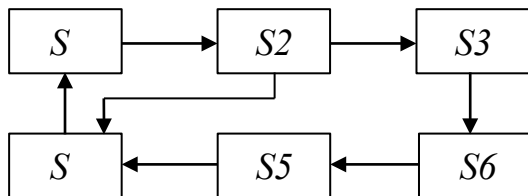
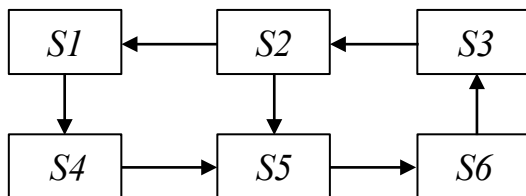
Option 3.



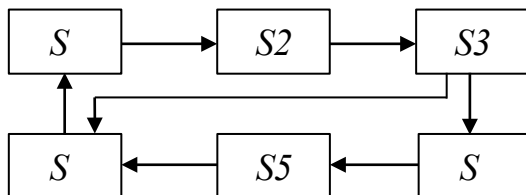
Option 4.



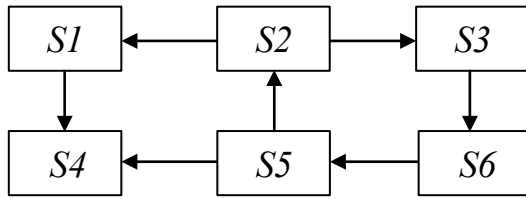
Option 5.



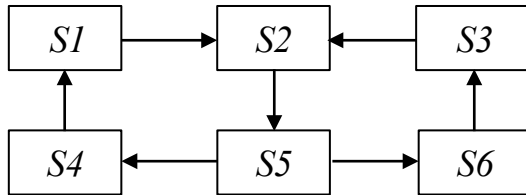
Option 7.



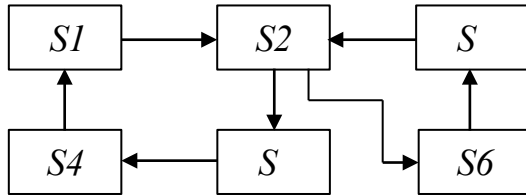
Option 8.



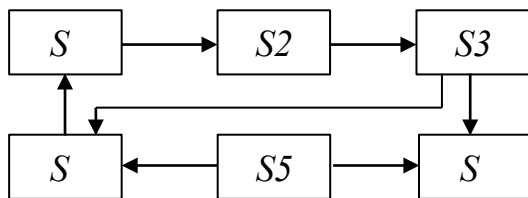
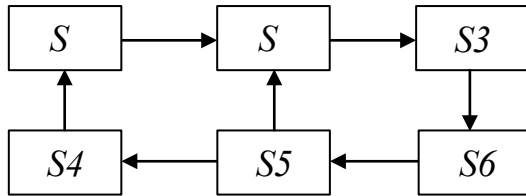
Option 9.



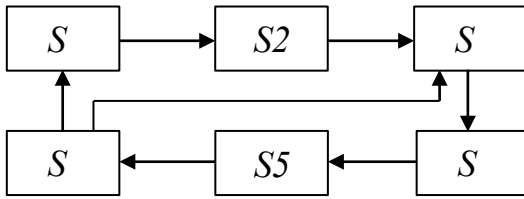
Option 10.



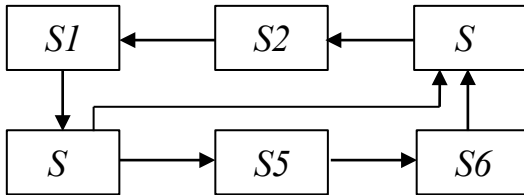
Option 11.



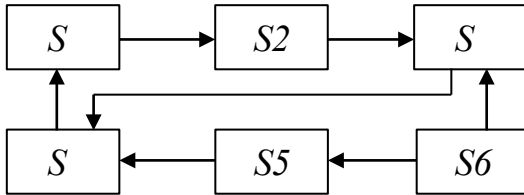
Option 13.



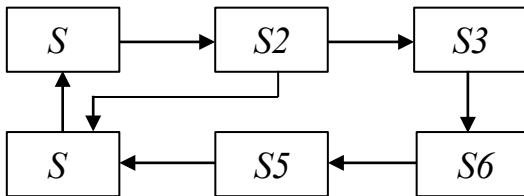
Option 14.



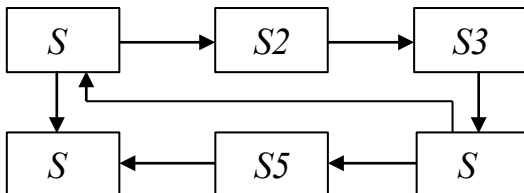
Option 15.



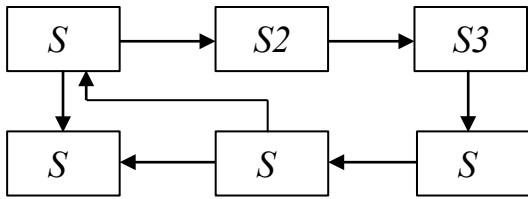
Option 16.



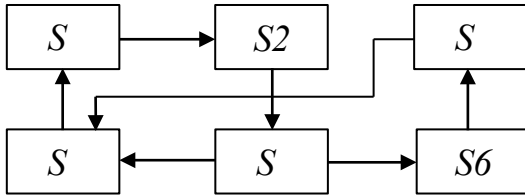
Option 17.



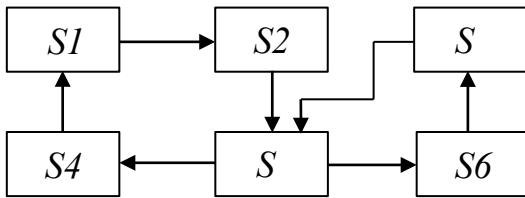
Option 18.



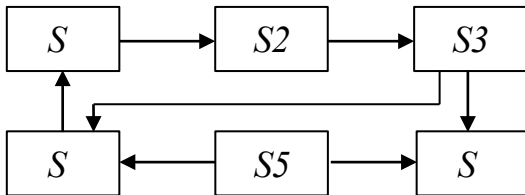
Option 19.



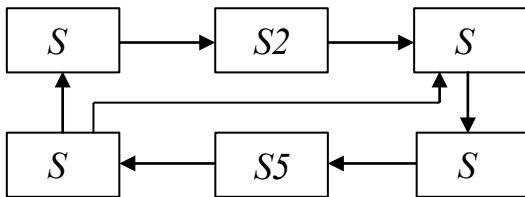
Option 20.



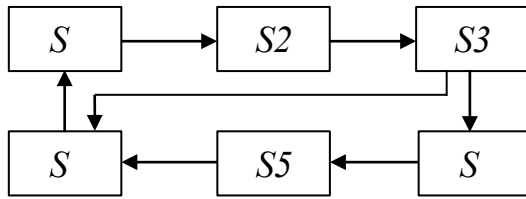
Option 21.



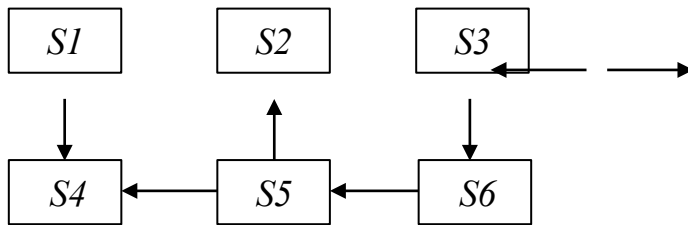
Option 22.



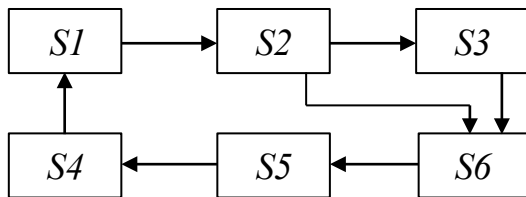
Option 23



Option 24.



Option 25.



Reporting for the lesson.

Contents of the report:

1. Basic theoretical provisions on the topic of the work.
2. Scheme according to the variant.
3. Kolmagoroff's system of equations for a variant scheme.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. What process is called markovsim, why?
2. What is called the probability of the i-th state?
3. What is the sum of all probabilities of states for any given time?
- 4.

Practical lesson No2

Topic: Study of indicators of the efficiency of communication networks in the transmission of messages with service failures.

Purpose of the work:

1. To study the dependence of the probability of service failure in a multichannel system on the total relative load of service channels with a fixed number of service channels;
2. To study the dependence of the required number of service channels on the total load coming to them with a fixed probability of service failure.

Initial data: The object of research is inter-node channels that transmit a data stream without queuing them in cases where there is no free communication channel, that is, transmitting data with refusals.

Software: MathCad or similar software.

Assumptions:

1. The flow of applications is considered to be the simplest.
2. The service time of requests in channels is considered to be distributed according to the exponential law.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. In which communication networks are messages transmitted with service denials?
2. What laws can describe the flow of messages arriving at switching nodes and transmitted through internode branches in large and small communication networks?
3. What law will describe the flow of serviced requests at the output of the system with an exponential distribution of service time?
4. What law will describe the flow of serviced requests at the output of the system with a Poisson flow of requests at the input of the system?
5. Under what law describing the flow of transmitted messages will the largest service resources be needed to meet the requirements of secondary network subscribers in its switching nodes and inter-node communication branches?
6. Under what law of receipt of requests in the system will the smallest number of service channels be needed?
7. Why is Poisson's law most often used to analyse system performance indicators to describe the flow of requests coming into the system?
8. What types of network switching node equipment can be considered systems with service failures when analyzing their performance indicators?
9. Why is the value of the K ratio calculated by the above formula with growth ρ tends to unity?
10. Under what conditions is it advisable to create systems that serve applications received for them with refusals?

Practical lesson No3

Topic: Study of the probability of finding switching equipment in the zero state during the transmission of information with service failures.

Purpose of the work: 1. To study the dependence of the probability of a zero state in a multichannel system on the total relative load of service channels with a fixed number of service channels channels.

Initial data: The object of research is internode channels that transmit information flows without queuing them in cases where there is no free communication channel, that is, transmitting data refusals.

Software MathCad or similar software.

Ensuring:

Assumptions:

1. The flow of applications is considered to be the simplest.
2. The service time of requests in channels is considered to be distributed according to the exponential law.

Research task.

Run the Mathcad or similar computer mathematics system.

On a new sheet of the program, enter formulas and data for calculations in accordance with Figure 2.

```

n := 10

ρ := 10

ρ00 :=  $\frac{\rho}{n}$ 

ρ = 1

P0 :=  $\left| \begin{array}{l} i \leftarrow 1 \\ j \leftarrow 1 \\ \text{for } k \in 1..n \\ \quad \left| \begin{array}{l} i \leftarrow i \cdot \left( \frac{\rho}{k} \right) \\ j \leftarrow (j + i) \end{array} \right. \end{array} \right|$ 

P000 :=  $P0^{-1}$ 

P0 = 0.368

```

Figure 2 – View of the working window for calculations

Perform calculations for n and ρ specified in Table 1. Report the results of the calculations of the probabilities of the zero state in Table 1 and plot them in one figure (on a logarithmic scale) the dependence of the probability of the zero state of the equipment on the total load of the channels $P0 = f(\rho)$ with a different number of channels in the internode branches of the network.

Table 1 – Dependence of the probability of equipment being in the zero state on the incoming load with a fixed number of channels

$n \backslash \rho$	1	10	100	1000	10000
1					
10					
100					
1000					
10000					

Reporting for the lesson.

Contents of the report:

1. The main theoretical provisions on the topic of the work (graph of the states of the system under study, expressions for calculating probabilistic characteristics).
2. Table with the results obtained.
3. Figure with graphs of $P_0 = f(\rho)$ dependencies based on the results of the studies.
4. Conclusions on the work.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. What is the probability of the zero state of the SMO at the initial moment of time?
2. What is $\square$ for a single-channel system?
3. What is ρ for a multi-channel system?
4. What is the relative load of each service device of a four-channel system at $\rho = 4$?
5. What does an increase in the useful load of the system's servicing devices lead to?
6. Why do communication networks try to concentrate information flows wherever possible?

Practical lesson No4

Subject: Investigation of the probability of finding switching equipment in the zero state during information transmission in queued systems.

Purpose of the work: To study the dependencies: $P0$ - the probability of finding switching equipment in the zero state during the transmission of information in systems with queues on the total relative load on the service channels and the number of service canals when using a queue accumulator with the number of waiting places.
giving applications, varying from zero to infinity.

Initial data: The object of research is the switching nodes of communication networks and their inter-node communication branches, serving (transmitting) information flows with their queuing in cases of absence of a free service device (communication channel).

Hardware: Personal computer

Software Excel, MathCad, MatLab or similar software.

Ensuring:

- Assumptions:**
1. Information flows coming to switching nodes and network branches are considered to be the simplest.
 2. The service time of requests in channels is considered to be distributed according to the exponential law.
 3. The time of stay of applications in the queue is not limited.
 4. When performing studies, the ticket service time for each channel is considered fixed and equal to 300 ms.

Research task.

1. The results of calculations of the probabilities of the zero state of the channel in the internode branch should be recorded in the report in tables 1.x and plot (on a logarithmic scale) the dependence of the probability of the zero state on the incoming load $P0. = f(\rho)$ with a fixed storage capacity.

Table 1.x – Dependence of the probability of a zero state on the total incoming load with a fixed volume of the storage device and a given number of channels ($n = \underline{\hspace{2cm}}$).

$\rho \backslash m$	1	5	10	20	30	40	50
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Reporting for the lesson.

Contents of the report:

1. The main theoretical provisions on the topic of the work (graph of states of the system under study, expressions for calculating probabilistic-temporal characteristics).
2. Tables with the results obtained.
3. Figures with graphs of the dependencies $P0. = f(\rho)$ based on the results of the studies.
4. Conclusions on each completed item of work.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. In which communication networks messages are transmitted with expectations?
2. What laws can describe the flow of messages transmitted through switching nodes, inter-node branches in global and local networks?
3. What law will describe the flow of serviced requests at the output of the system with an exponential distribution of service time?
4. What law will describe the flow of serviced applications at the output of the system with a Poisson flow of applications at its input?
5. Under which law describing the flow of transmitted messages will the largest service resources be needed to meet the requirements of network subscribers in its switching nodes and inter-node communication branches?
6. Under what law of receipt of applications will the smallest number of service channels be needed?
7. Why is Poisson's law most commonly used to describe the flow of incoming applications to analyse network performance indicators?
8. What types of network switching node equipment can be considered systems with expectations when analyzing their performance indicators?
9. Why is it that a system with expectations, all other things being equal, is less likely to fail a service than a system that serves a request without waiting?
10. Under what conditions is it advisable to create systems that serve incoming applications with expectations?

Table of options.

Option No	n =			
1.	1	3	6	8
2.	2	4	7	8
3.	1	5	6	8
4.	2	3	7	8
5.	1	4	6	8
6.	2	5	7	8
7.	1	3	6	9
8.	2	4	7	9
9.	1	5	6	9
10.	2	3	7	9
11.	1	4	6	9
12.	2	5	7	9
13.	1	3	6	10
14.	2	4	7	10
15.	1	5	6	10

16.	2	3	7	10
17.	1	4	6	10
18.	2	5	7	10
19.	1	3	6	11
20.	2	4	7	11
21.	1	5	6	11
22.	2	3	7	11
23.	1	4	6	11
24.	2	5	7	11

Practical lesson No5

Subject: Study of the dependence of the probability of refusal to service of incoming requests on the operational parameters of switching equipment when transmitting information in systems with queues.

Purpose of the work: Investigate the dependencies of the probability of service failure on the total relative load on the service canals and the number of service channels when using a queue accumulator with a different number of places for pending requests.

Initial data: The object of the research is the switching nodes of communication networks and their inter-node communication branches, which serve (transmit) message flows with their enqueueing in cases where there is no free service device (communication channel).

Hardware: Personal computer

Software Excel, MathCad, MatLab or similar software.

Ensuring:

Assumptions:

1. Message streams that arrive at switching nodes and network branches are considered to be the simplest.
2. The service time of requests in channels is considered to be distributed according to the exponential law.
3. The time of stay of applications in the queue is not limited.
4. When performing studies, the ticket service time for each channel is considered fixed and equal to 300 ms.

Rules and safety measures when performing work.

When working on a personal computer, without the permission of the class leader

DO NOT:

- supply (remove) voltage to the PC and electrical outlets from the switchboard;
- turn on and off the power supply of PCs and monitors;
- to eliminate malfunctions that have arisen during the performance of laboratory work.

Research task.

1. The results of calculations of the probabilities of refusal to obtain a free channel in the internode branch should be entered into the report in tables 1.x and constructed according to them (in the logarithmic scale of the

b) graphs of the probability of refusal from the incoming load $P_{qtk.} = f(\rho)$ with a fixed volume of the storage device.

Table 1.x – Dependence of the probability of failure on the total incoming load with a fixed volume of the storage device and a given number of channels ($n =$ _____).

$\rho \backslash m$	1	5	10	20	30	40	50
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Reporting for the lesson.

Contents of the report:

1. The main theoretical provisions on the topic of the work (graph of states of the system under study, expressions for calculating probabilistic-temporal characteristics).
2. Tables with the results obtained (for each item of work).
3. Figures with graphs of dependencies $P_{otk.} = f(\rho)$, constructed from the results of research.
4. Conclusions on each completed item of work.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. In which communication networks messages are transmitted with expectations?
2. What laws can describe the flow of messages transmitted through switching nodes, inter-node branches in global and local networks?
3. What law will describe the flow of serviced requests at the output of the system with an exponential distribution of service time?
4. What law will describe the flow of serviced applications at the output of the system with a Poisson flow of applications at its input?
5. Under which law describing the flow of transmitted messages will the largest service resources be needed to meet the requirements of network subscribers in its switching nodes and inter-node communication branches?
6. Under what law of receipt of applications will the smallest number of service channels be needed?
7. Why is Poisson's law most commonly used to describe the flow of incoming applications to analyse network performance indicators?
8. What types of network switching node equipment can be considered systems with expectations when analyzing their performance indicators?
9. Why is it that a system with expectations, all other things being equal, is less likely to fail a service than a system that serves a request without waiting?
10. Under what conditions is it advisable to create systems that serve incoming applications with

expectations?

Table of options.

Option No	n =			
1.	1	3	6	8
2.	2	4	7	8
3.	1	5	6	8
4.	2	3	7	8
5.	1	4	6	8
6.	2	5	7	8
7.	1	3	6	9
8.	2	4	7	9
9.	1	5	6	9
10.	2	3	7	9
11.	1	4	6	9
12.	2	5	7	9
13.	1	3	6	10
14.	2	4	7	10
15.	1	5	6	10
16.	2	3	7	10
17.	1	4	6	10
18.	2	5	7	10
19.	1	3	6	11

Practical lesson No6

Topic: Study of the dependence of the average number of applications in the queue on the total relative load on the serving channels and the number of serving channels when using a queue accumulator with a different number of places for pending applications

Purpose of the work: Investigate the dependencies: $Loch$ is the average number of requests in the queue on the total relative load on the serving channels and the number of serving channels when using a queue accumulator with a different number of places for pending requests.

Initial data: The object of research is the switching nodes of communication networks and their inter-node communication branches, serving (transmitting) message flows with their queuing in cases where there is no free service device (communication channel).

Hardware: Personal computer

Software Excel, MathCad, MatLab or similar software.

Ensuring:

- Assumptions:**
1. Message streams that arrive at switching nodes and network branches are considered to be the simplest.
 2. Time Maintenance applications in channels is considered to be distributed according to the exponential law.
 3. The time of stay of applications in the queue is not limited.
 4. When performing studies, the ticket service time for each channel is considered fixed and equal to 300 ms.

Research task.

1. The results of the calculations of the average number of requests in the queue should be recorded in the report in Table 1.x and graphs of the dependence of the average number of requests in the queue on the incoming load $Loch. = f(\rho)$ with a fixed storage capacity.

Table 1.x – Dependence of the average number of requests in the queue on the total incoming load with a fixed storage capacity and a given number of channels ($n = \underline{\hspace{2cm}}$).

ρ	m	1	5	10	20	30	40	50
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

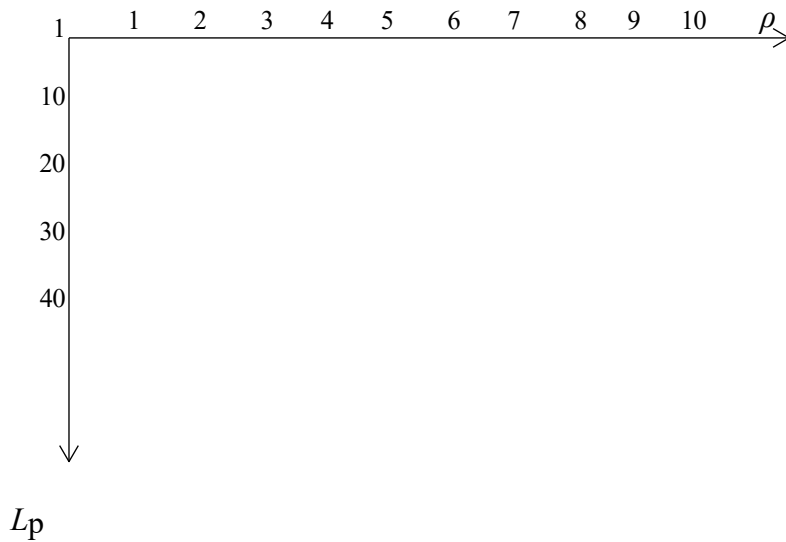


Figure 1.x - Dependence of the average number of requests in the queue on the total incoming load with a fixed storage capacity and a given number of channels ($n = \underline{\hspace{2cm}}$).

Reporting for the lesson.

Contents of the report:

1. The main theoretical provisions on the topic of the work (graph of states of the system under study, computational expressions).
2. Tables with the results obtained.
3. Figures with graphs of dependencies $L = f(\rho)$ based on the results of the studies.
4. Conclusions on each completed item of work.

Table of options.

Option No	n =			
1.	1	3	6	8
2.	2	4	7	8
3.	1	5	6	8
4.	2	3	7	8
5.	1	4	6	8
6.	2	5	7	8
7.	1	3	6	9
8.	2	4	7	9
9.	1	5	6	9
10.	2	3	7	9
11.	1	4	6	9
12.	2	5	7	9
13.	1	3	6	10
14.	2	4	7	10
15.	1	5	6	10
16.	2	3	7	10
17.	1	4	6	10
18.	2	5	7	10
19.	1	3	6	11
20.	2	4	7	11
21.	1	5	6	11

22.	2	3	7	11
23.	1	4	6	11
24.	2	5	7	11
25.	1	3	6	11

Practical lesson No7

Subject: Investigation of the probability of finding switching equipment in the zero state during information transmission in systems with unlimited queue and limited waiting time.

Purpose of the work:

To study the dependencies: P_0 - the probability of switching equipment being in the zero state when transmitting information in systems with queues with a limited waiting time on the total relative load on the service channels and the number of service channels when using the storage device

Queues with different numbers of slots for pending applications.

Initial data:

The object of research is the switching nodes of communication networks and their inter-node communication branches, serving (transmitting) information flows with their queuing in cases of absence of a free service device (communication channel).

Hardware:

Personal computer

Software:

Excel, MathCad, MatLab or similar software.

Assumptions:

1. Information flows coming to switching nodes and network branches are considered to be the simplest.
2. The service time of requests in channels is considered to be distributed according to the exponential law.
3. The time of stay of applications in the queue is limited.
4. When performing studies, the ticket service time for each channel is considered fixed and equal to 300 ms.

Research task.

1. The results of calculations of the probabilities of the zero state of the channel in the internode branch should be recorded in the report in tables 1.x and plot (on a logarithmic scale) the dependence of the probability of the zero state on the incoming load $P_0 = f(\rho)$ with a fixed storage capacity.

Table 1.x – Dependence of the probability of a zero state on the total incoming load with a fixed volume of the storage device and a given number of channels ($n = \underline{\hspace{2cm}}$).

$\rho \backslash m$	1	5	10
1			
2			
3			
4			
5			
6			
7			
8			
9			

10			
----	--	--	--

Figure 1.x - Dependence of the probability of a zero state on the total incoming load with a fixed volume of the storage device and a given number of channels ($n = \underline{\hspace{2cm}}$).

Reporting for the lesson.

Contents of the report:

1. The main theoretical provisions on the topic of the work (graph of states of the system under study, expressions for calculating probabilistic-temporal characteristics).
2. Tables with the results obtained.
3. Figures with graphs of the dependencies $P0. = f(\rho)$ based on the results of the studies.
4. Conclusions on each completed item of work.

Table of options.

Option No	n =				v =
1.	1	3	6	8	1
2.	2	4	7	8	2
3.	1	5	6	8	3
4.	2	3	7	8	1
5.	1	4	6	8	2
6.	2	5	7	8	3
7.	1	3	6	9	1
8.	2	4	7	9	2
9.	1	5	6	9	3
10.	2	3	7	9	1
11.	1	4	6	9	2
12.	2	5	7	9	3
13.	1	3	6	10	1
14.	2	4	7	10	2
15.	1	5	6	10	3

Practical lesson No8

Topic: Study of the performance indicators of communication networks in the transmission of messages with priorities.

Purpose of the work:	To study the dependence of the average total waiting time and transmission of messages of various urgency categories through the channels of the inter-node branches of the secondary network, depending on the load of communication channels and the number of message priorities.
Initial data:	The object of research is the inter-node branches of secondary communication networks with packet-switching and message switching, transmitting message streams taking into account their priorities.
Hardware:	Personal computer
Software:	Excel, MathCad, MatLab or similar software.
Assumptions:	1. The message and packet flows that arrive at switching nodes and links on inter-node branches of the network are considered to be the simplest. 2. There is no limit on the time that packets and messages can be queued to the inter-node branch channel. 3. The volume of queue drives in switching nodes is infinite. 4. In a packet-switched network, there are relative priorities for transmitting packets over inter-node branch links. 5. A message-switched network uses relative priorities for transmitting codegrams over inter-node branch links. 6. Messages of the highest urgency category have an information volume equal to $2^{12} = 4096$ bits. With a decrease in the urgency category of messages by one, the volume of message information increases by $2^3 = 8$ times. 7. The volume of the information field of useful information in packets is $2^{10} = 1024$ bits. 8. Codegrams transmitted in a data transmission channel have a field of useful information with a volume of $2^8 = 256$ bits. 9. The time spent on transmitting service information, packet headers and codegram limit switches is not taken into account. 10. The inter-node branches of the network use one main digital channel with a discrete data rate of 64 bit/s.

Methodological recommendations for research

The purpose of the first item of the laboratory task is to study the dependence of the average total waiting time for the transmission of messages with absolute priorities through the internode channels of communication networks on the total load of channels with the flow of information messages of all urgency categories. At the same time, it is assumed that in the total information flow transmitted through the channel of the internode branch of communication, the shares of information of messages of each category of urgency are the same. Number of priorities $R=6$.

With an exponential distribution of message transmission time over the communication channel and fixed relative priorities for their transmission, the statement to determine the average waiting time for messages in the queue would be:

$$W_i = \frac{\sum_{j=1}^R \rho_j}{\left(\frac{R}{1 - \sum_{j=i}^R \rho_j} \right) \left(\frac{R}{1 - \sum_{j=i+1}^R \rho_j} \right)}, \quad i, j = 1, \dots, R. \quad (1)$$

The average total time spent by the i -th priority message in the queue and in service is made up of the time spent in the queue and in transit, when using fixed absolute priorities in the communication network with additional service of interrupted messages:

$$T_{\bar{i}} = \frac{\left(\frac{R}{1 - \sum_{j=1}^R \rho_j} \right) \left(\frac{R}{1 - \sum_{j=i+1}^R \rho_j} \right)}{\left(\frac{R}{1 - \sum_{j=1}^R \rho_j} \right) \left(\frac{R}{1 - \sum_{j=i+1}^R \rho_j} \right)}. \quad (2)$$

The results of calculations of the average total waiting time and transmission of messages of each urgency category should be written down in a laboratory report and graphs should be built on them depending on the incoming total load, the total average waiting time and transmission of messages. Based on the analysis of the graphs, it is necessary to assess the possibility of network operation in conditions of congestion of the links of its internode branches using absolute and relative priorities of messages.

Control questions

The following questions should be answered orally when submitting a report on laboratory work for defense.

1. In which secondary communication networks are messages transmitted with expectations?
2. In which secondary communication networks should message transmission priorities be introduced?
3. How are packet, message and channel switching networks prioritized?
4. Which switching methods make message prioritization relatively easy?
5. How does the law of maintaining the work of the CMO manifest itself when introducing priority service requests?

6. How are requisitions handled with relative and absolute priorities?
7. What laws can describe the flow of messages arriving at switching nodes and transmitted over internode branches in large and small secondary communication networks?
8. What law will describe the flow of serviced requests at the output of the CMO with an exponential distribution of service time?
9. What law will describe the flow of serviced requests at the output of the SMO with the Poisson flow of requests at the input of the SMO?
10. Under which law describing the flow of transmitted messages will the largest service resources be needed to meet the requirements of secondary network subscribers in its switching nodes and internode communication branches?
11. Under what law of receipt of applications in the CMO will the smallest number of service channels be needed?
12. Why is Poisson's law most often used to describe the flow of applications received by CMOs to analyze the performance indicators of CMOs?

Variants of tasks

Option No	μ
1.	1, 3, 5, 7
2.	2, 4, 6, 8
3.	1, 2, 5, 7
4.	2, 4, 5, 7
5.	1, 3, 6, 8
6.	2, 3, 6, 7
7.	1, 2, 3, 4
8.	2, 3, 4, 5
9.	3, 4, 5, 6
10.	4, 5, 6, 7
11.	1, 3, 6, 8
12.	2, 4, 6, 7
13.	2, 4, 5, 6
14.	1, 3, 5, 8
15.	1, 2, 5, 8
16.	2, 4, 5, 7
17.	1, 4, 7, 8
18.	2, 3, 7, 8
19.	1, 5, 6, 7
20.	1, 4, 7, 8
21.	2, 4, 6, 8
22.	1, 3, 5, 7
23.	2, 3, 6, 7
24.	1, 4, 5, 8
25.	3, 4, 5, 6

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

on the organization and conduct of independent work on the discipline

"Random signal analysis"

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

Methodical instructions for the organization of students' independent work are compiled in accordance with the requirements of the program of the discipline "Analysis of random signals" for students of the direction of training 11.03.02 Infocommunication technologies and communication systems. The textbook is devoted to the planned educational work of students, carried out in extracurricular (classroom) time on the assignment and under the methodological guidance of the teacher, but without his direct participation (with the partial direct participation of the teacher).

CONTENTS

1. Independent work as the most important form of the educational process	4
2. Goals and main objectives of the ACS	5
3. Types of independent work	6
4. Organization of SRS	7
5. General recommendations for the organization of independent work	8
6. Independent work of a student is a necessary link in the formation of Researcher	12
7. Methodical recommendations for students on individual forms independent work	13
8. Independent work of students in the conditions of point-rating Training systems	20
9. Educational, methodological and information support of the discipline	23

1. Independent work as the most important form of the educational process

Independent work is the planned educational, research, research work of students, carried out in extracurricular (classroom) time on the assignment and under the methodological guidance of the teacher, but without his direct participation (with the partial direct participation of the teacher, leaving the leading role behind the work of students).

Independent work of students at the university is an important type of educational and scientific activity of the student. Independent work of students plays a significant role in the rating technology of education. Education at the university includes two parts that are almost the same in volume and mutual influence - the process of learning and the process of self-study. Therefore, the SRS should become an effective and purposeful work of the student.

The concept of modernization of Russian education defines the main tasks of vocational education - "training a qualified worker of the appropriate level and profile, competitive in the labor market, competent, responsible, fluent in his profession and oriented in related fields of activity, capable of effective work in the specialty at the level of world standards, ready for constant professional growth, social and professional mobility."

The solution of these problems is impossible without increasing the role of students' independent work on educational material, increasing the responsibility of teachers for the development of independent work skills, for stimulating the professional growth of students, fostering creative activity and initiative.

Society imposes a fairly wide range of requirements on a modern specialist, among which it is important that graduates have certain abilities and ability to independently obtain knowledge from various sources, systematize the information received, and assess a specific financial situation. The formation of such a skill occurs during the entire period of study through the participation of students in practical classes, the performance of control tasks and tests, the writing of term papers and graduation qualification papers. At the same time, the independent work of students plays a decisive role in the entire educational process.

The forms of independent work of students are diverse. The discipline provides the following:

Use of the material of the educational and methodological complex

Disciplines

At the first stage, it is necessary to familiarize yourself with the mandatory minimum content of the basic educational program in the discipline being studied. Next, it is necessary to study the work program of the discipline, which considers the content of the topics of the lecture course, the relationship of lecture topics from laboratory classes, topics and types of independent work. For each type of independent work, certain forms of reporting are provided.

Work with literature

For the successful development of the discipline, it is necessary to independently study the presented topics in detail according to the recommended sources of information:

No p/n	Types of independent work	Recommended sources of information (No source)			
		Main	Additional Telnaya	Methodical	Internet Resources
1	Independent study of literature	1, 2	1, 2	1	1, 2, 3

Independent work introduces students to scientific creativity, the search for and solution of urgent modern problems.

2. Goals and main objectives of the ACS

The leading goal of the organization and implementation of SRS should coincide with the goal of teaching a student - the preparation of a bachelor with higher education. In the organization of SRS, an important and necessary condition is the formation of the ability to work independently to acquire knowledge, skills and the ability to organize educational and scientific activities.

The purpose of students' independent work is to master fundamental knowledge, professional skills and abilities in the profile, experience in creative and research activities. Independent work of students contributes to the development of independence, responsibility and organization, a creative approach to solving problems of the educational and professional level.

The objectives of the SRS are:

- systematization and consolidation of the theoretical knowledge and practical skills of students;
- deepening and expanding theoretical knowledge;
- formation of skills to use regulatory, legal, reference documentation and special literature;
- development of cognitive abilities and activity of students: creative initiative, independence, responsibility and organization;
- formation of independent thinking, abilities for self-development, self-improvement and self-realization;
- development of research skills;
- the use of material collected and obtained in the course of independent studies at

seminars, practical and laboratory classes, when writing term papers and final qualification papers, for effective preparation for final tests and exams.

3. Types of independent work

In the educational process of a higher professional educational institution, there are two types of independent work

– classroom, under the guidance of a teacher, and extracurricular. The close relationship between these types of work provides for the differentiation and effectiveness of the results of its implementation and depends on the organization, content, logic of the educational process (interdisciplinary connections, promising knowledge, etc.):

Classroom independent work on the discipline is carried out in classes under the direct guidance of the teacher and on his assignment.

Extracurricular independent work is performed by the student on the instructions of the teacher, but without his direct participation.

The main types of independent work of students without the participation of a teacher in this discipline are:

- formation and assimilation of the content of lecture notes on the basis of educational literature recommended by the lecturer, including information educational resources (electronic textbooks, electronic libraries, etc.);
- preparation for laboratory work, their design.

The main types of independent work of students with the participation of teachers are: current consultations; acceptance and defense of laboratory work (during the l/r).

4. Organization of SRS

The methodology for organizing students' independent work depends on the structure, nature and features of the discipline "Teletraffic of Multiservice Networks", the number of hours for its study, the type of tasks for students' independent work, the individual qualities of students and the conditions of educational activity.

The process of organizing students' independent work includes the following stages:

- preparatory (definition of goals, drawing up a program, preparation of methodological support, preparation of equipment);
- the main one (implementation of the program, the use of methods of information search, assimilation, processing, application, transfer of knowledge, recording of results, self-organization of the work process);
- final (assessment of the significance and analysis of the results, their systematization, assessment of the effectiveness of the program and methods of work, conclusions about the directions of labor optimization).

Students' activities for the formation and development of skills of educational independent work.

In the process of independent work, the student acquires the skills of self-organization, self-control, self-management, self-reflection and becomes an active independent subject of educational activity.

Performing independent work under the supervision of a teacher, the student must:

master the minimum content submitted for independent work of students and proposed by the teacher in accordance with the educational standards of higher education;

plan independent work in accordance with the schedule of independent work proposed by the teacher;

– the student must carry out independent work in the organizational forms provided for by the curriculum and the teacher's work program;

perform independent work and report on its results in accordance with the schedule for submitting results, types and terms of reporting on students' independent work.

A student can:

in addition to the one proposed by the teacher (with justification and agreement with him) and the minimum mandatory content determined by the program for this discipline:

- independently determine the level (depth) of the study of the content of the material;
- Suggest topics and questions for self-study;
- within the framework of the general schedule for the performance of independent work, offer a reasonable individual schedule for the implementation and reporting on the results of independent work;
- offer their own options for organizational forms of independent work;
- use teaching aids, manuals, developments in addition to the list proposed by the teacher for independent work;
- use not only control, but also self-control of the results of independent work in accordance with the methods of self-control proposed by the teacher or chosen independently.

Independent work of students should have an important impact on the formation of the personality of the future bachelor, it is planned by the student independently. Each student independently determines the mode of his work and the degree of work spent on mastering the educational content in each discipline. He performs extracurricular work according to a personal individual plan, depending on his preparation, time and other conditions.

5. General recommendations for the organization of independent work

The main form of independent work of the student is the study of lecture notes, their supplementation, recommended literature, active participation in laboratory classes. But for successful educational activity, its intensification, it is necessary to take into account the following subjective factors:

1. Knowledge of school program material, the presence of a solid system of gaps necessary for mastering the main university courses. This is especially important for mathematical disciplines. It is necessary to distinguish gaps in knowledge that make it difficult to assimilate new material from small abilities. By spending effort to overcome these gaps, the student will ensure normal academic performance and believe in his abilities.

2. Availability of skills, skills of mental work:

- a) the ability to take notes at lectures and when working with a book;

b) mastery of logical operations: comparison, analysis, synthesis, generalization, definition of concepts, rules of systematization and classification.

3. The specifics of cognitive mental processes: attention, memory, speech, observation, intelligence and thinking. Poor development of each of them becomes a serious obstacle in learning.

4. Good working capacity, which is provided by normal physical condition. After all, serious learning is a large, versatile and diverse work. The result of learning is evaluated not by the amount of information communicated, but by the quality of its assimilation, the ability to use it and the development of one's ability for further independent education.

5. Correspondence of the chosen activity, profession to individual abilities. It is necessary to develop the ability to self-regulate one's emotional state and eliminate circumstances that disturb the business mood, interfere with the planned work.

6. Mastering the optimal style of work that ensures success in activities. Alternating work and pauses in work, rest periods, individually justified sleep duration, preference for evening or morning classes, stress resistance at exams and features of preparation for them,

7. The level of requirements for oneself, determined by the established self-esteem.

An adequate assessment of knowledge, advantages, disadvantages is an important component of a person's self-organization, without it it is impossible to successfully manage one's behavior and activity.

One of the main features of education in higher school is that constant external control is replaced by self-control, the active role in learning belongs not so much to the teacher as to the student.

Knowing the basic methods of scientific organization of mental work, it is possible to achieve the best results with the least expenditure of time, money and labor efforts.

The effectiveness of assimilation of incoming information depends on the working capacity of a person at a particular moment of his activity.

Working capacity is the ability of a person to work with a high degree of intensity for a certain time. There are internal and external factors of working capacity.

Internal factors of working capacity include intellectual characteristics, will, and state of health.

External:

- organization of the workplace, work and rest schedule;
- Level Organizations labor - Trait Get it Reference
and use information;
- the amount of mental load.

Outstanding Russian Physiologist N. E. Vvedensky identified the following conditions for the productivity of mental activity:

- every work must be entered into gradually;
- dimensionality and rhythm of work. Different people have a more or less different pace of work;
- the usual sequence and systematicity of activity;
- correct alternation of work and rest.

Rest does not imply obligatory complete inaction on the part of a person, it can be achieved by a simple change of business. During the day, the working capacity changes. The most fruitful is the *morning time (from 8 to 14 hours)*, and the maximum working capacity falls on the period from 10 to 13 hours, then *the afternoon (from 16 to 19 hours)* and *the evening (from 20 to 24 hours)*. It is better to study the material that is very difficult to understand at the beginning of each period of time (preferably in the morning) after a good rest. After 1-1.5 hours, breaks of 10 - 15 minutes are needed, after 3 - 4 hours of work, the rest should be long - about an hour.

An integral part of the scientific organization of mental labor is the mastery of the technique of mental labor.

The time that the student has to complete the curriculum consists of two components: one of them is classroom work at the university according to the schedule of classes, the other is extracurricular independent work. Tasks and materials for independent work are given during classes according to the schedule, in the same classes the teacher controls independent work, and also assists students in the correct organization of work.

Self-study will require intensive mental work, which must not only be properly organized, but also stimulated. At the same time, it is very important to be able to maintain a steady attention to the material being studied. The development of attention requires significant volitional efforts. That is why, if a student notices that he is often distracted during self-study, he needs to force himself to concentrate. Such a procedure must be done constantly, since this

is a training of attention. Sustained attention appears when a person treats a matter with interest.

It is necessary to properly organize your classes in time: 50 minutes - work, 5-10 minutes - break; after 3 hours of work, a break - 20-25 minutes. Otherwise, increasing fatigue will lead to instability of attention. A very significant factor affecting the increase in mental performance is systematic physical education. The organization of active recreation provides for the alternation of mental and physical activity, which completely restores a person's working capacity.

6. Independent work of a student is a necessary link in the formation of a researcher

The progress of science and technology, information technology leads to a significant increase in scientific information, which imposes higher requirements not only on the moral and ethical qualities of a person, but also, in particular, constantly increasing requirements in the field of education - renewal, modernization of general and professional knowledge, skills of a specialist.

Any education should act as a dynamic process inherent in a person and continuing throughout his life. Mastering scientific thought and the language of science is a necessary component in the self-organization of a future research specialist. This is understood not so much as the accumulation of knowledge, but the mastery of scientifically based ways of acquiring it. This, generally speaking, is the main task of the university.

The specificity of the university educational process, in the organization of which more and more space is given to the independent work of the student, is that it seems to be the last and most adequate link for the implementation of this task. For during the study at the university, the development of the style and skills of educational (cognitive) activity takes place, the rational nature of which will contribute to the constant renewal of the knowledge of a highly qualified university graduate.

However, there are certain difficulties before this path, in particular, the transition of the student from the synthetic process of learning in secondary school to the analytical one in higher school. This is due both to the new content of education (expansion of general education and deepening of professional training) and to new, hitherto unknown forms of training (lectures, seminars, laboratory classes, etc.). The student receives not only the knowledge provided by the program and teaching aids, but he must also become familiar with the ways of acquiring knowledge in such a way as to be able to assess what we know, how we know it and how we have achieved this knowledge. All this is achieved through one's own independent work.

This is also because self-acquired knowledge is more operational, it becomes personal property, as well as a motive for behavior, develops intellectual traits, attention, observation, criticality, and the ability to evaluate. The role of the teacher is mainly to guide the accumulation of knowledge (in relation to first-year students), and in the subsequent years of study, in the senior years, in the joint identification of problems and care for independent search

student, as well as control over their activities. It should be noted that it is not possible to limit oneself only to the acquisition of knowledge provided for by the program of the discipline studied, it is necessary to constantly deepen the knowledge gained, concentrating it on some narrow specific area that corresponds to the interests of the student. In-depth study of all subjects provided for by the program is possible in practice, and good organization of work allows you to save time, which creates conditions for a deep, systematic, interested study of the topic independently chosen by the student.

Of course, all the advice, examples, recommendations in this area given by the teacher, or certain publications, or other sources, do not guarantee any success without the manifestation of one's own activity in this matter, i.e. they do not give ready-made recipes, but should contribute to the analysis of one's own work, its goals, organization in accordance with individual characteristics. Taking into account personal capabilities, existing living and working conditions, skills, on the basis of these recommendations, it is possible to develop an individually justified set of methods, ways, find one's own style or improve it, in order to study certain material, have time to assess its significance, suitability and possibilities of its application, in order to ultimately ensure the success of one's studies from future professional activity

7. Methodical recommendations for students on certain forms of independent work

The system of university education implies a much greater independence of students in planning and organizing their activities. It can be very difficult for yesterday's schoolchildren to do this: if at school the daily control by the teacher forced them to constantly and systematically prepare for classes, then at the university the question of the level of knowledge arises closely before the student only during the exam period. For some, this situation turns into a temptation to devote the whole semester to free time ("when necessary, I will learn!"), and when the time comes for exams, there is so much material to be mastered that no memory is able to cope with it in the remaining period of time.

Work with literature.

When working with a book, it is necessary to select literature, learn how to read it correctly, and keep notes. For the selection of literature in the library, alphabetical and systematic catalogs are used.

It is important to remember that rational skills of working with a book are always a great saving of time and effort.

The correct selection of textbooks is recommended by the teacher who reads the lecture course. The necessary literature can also be indicated in the methodological developments for this course.

Studying the material from the textbook, you should move on to the next question only after the correct understanding of the previous one, describing on paper all the calculations and calculations (including those that are omitted in the textbook or given in the lecture for independent conclusion).

In the study of any discipline, independent individual work plays a large and important role.

Particular attention should be paid to the definition of the basic concepts of the course. The student should analyze in detail the examples that explain such definitions, and be able to build similar examples independently. It is necessary to achieve an accurate idea of what you are studying. It is useful to make reference notes. When studying the material from the textbook, it is useful to supplement the lecture notes in the notebook (in specially designated margins). There you should also note the questions selected by the student for consultation with the teacher.

It is recommended to highlight the conclusions obtained as a result of the study in the notes so that they are better remembered when rereading the notes.

Experience shows that many students are helped by compiling a list of reference signals containing the most important and most frequently used formulas and concepts. Such a sheet helps to memorize formulas, the main points of the lecture, and can also serve as a permanent reference for the student.

There are two types of reading; primary and secondary. *Primary reading* is attentive, unhurried reading, in which you can dwell on difficult places. After it, not a single incomprehensible tin should remain. The content may not always be understood after the primary reading.

The task of *secondary* reading is the complete assimilation of the meaning of the whole (this reading may not be the second, but the third or fourth).

Rules for independent work with literature.

As already noted, independent work with textbooks and books (as well as independent theoretical research of the problems identified by the teacher at lectures) is the most important condition for the formation of a scientific way of cognition. The main tips here can be summarized as follows:

- Make a list of books that you should get acquainted with;
- "Do not try to remember everything that you will not need in the near future," G. Selye advises the student and young scientist, "just remember where you can find it" (Selye, 1987, p. 325).
- Such a list itself should be systematized (what is necessary for seminars, what is necessary for exams, what is useful for writing term papers and diploma papers, and what interests you outside the framework of official educational activities, that is, what can expand your general culture...).
 - Be sure to write out all the imprints for each book (when writing term papers and diploma papers, this will save a lot of time).
 - Figure out for yourself which books (or which chapters of books) should be read more carefully, and which should just be looked through.
 - When compiling lists of literature, you should consult with teachers and supervisors (or even with more prepared and erudite fellow students), who will help you better orient yourself on what you should pay more attention to, and what is not worth wasting time on at all...
 - Naturally, all books, textbooks and articles read should be taken notes, but this does not mean that it is necessary to take notes of "everything": you can briefly write down the main ideas of the author and sometimes give the most vivid and indicative quotes (with pages indicated).
 - If the book is your own, then it is allowed to make brief notes in the margins of the book or at the end of the book, on blank pages, just make your own "subject index", where the most interesting thoughts for you are noted and the pages in the author's text are necessarily indicated (this is a very good tip that allows you to save time and quickly find "selected" passages in a variety of books).
 - If you have not worked much with scientific literature before, then you should develop the ability to "perceive" complex texts; for this, the best technique is to learn to "read slowly", when you understand every word you read (and if the word is unfamiliar, then either with the help of a dictionary or with the help of a teacher, it is necessary to recognize it), and this may take

a considerable time (for some - up to several weeks and even months); experience shows that after that, by some "miracle", the student begins to literally swallow books and almost see "through the cover" whether this work is worthwhile or not...

- "Either read or flip through the material, but do not try to read quickly... If I am interested in the text, then reading, thinking and even fantasizing about it merge into a single process, while forced speed reading not only does not contribute to the quality of reading, but also does not bring the feeling of satisfaction that we get when thinking about what we have read," G. Selye advises (Selye, 1987. – P. 325-326).

- There is another effective way to optimize acquaintance with scientific literature – you should be carried away by some idea and look through all the books from the point of view of this idea. In this case, the student (or young scientist) will look for arguments "for" or "against" the idea he is interested in, and at the same time he will communicate with the authors of these books about his ideas and reflections... The only problem is how to find "your" idea...

Reading a scientific text is a part of cognitive activity. Its purpose is to extract the necessary information from the text. The effectiveness of the action largely depends on how conscious the reader is of his own inner attitude when referring to the printed word (to find the necessary information, to assimilate the information fully or partially, to critically analyze the material, etc.).

There are ***four main attitudes in reading a scientific text***:

1. information retrieval (the task is to find, highlight the information sought)
2. assimilative (the reader's efforts are aimed at understanding and remembering as fully as possible both the information presented by the author and the entire logic of his reasoning)
3. analytical-critical (the reader seeks to critically comprehend the material, analyzing it, determining his attitude to it)
4. creative (creates in the reader a readiness in one form or another – as a starting point for his reasoning, as an image for action by analogy, etc. – to use the author's judgments, the course of his thoughts, the result of observation, the developed methodology, to supplement them, to subject them to a new check).

The existence of several types of reading *is associated with the presence of different attitudes to addressing a scientific text*:

1. bibliographic – viewing catalog cards, recommendation lists, summary lists of journals and articles for the year, etc.;
2. browsing – used to search for materials containing the necessary information, it is usually resorted to immediately after working with references and catalogs, as a result of such a review, the reader establishes which of the sources will be used in further work;
3. introductory – implies a continuous, sufficiently detailed reading of the selected articles, chapters, individual pages, the purpose is to get acquainted with the nature of the information, to find out what issues are submitted by the author for consideration, to sort the material;
4. studying – involves a thorough mastery of the material; in the course of such reading, the reader's trust in the author, readiness to accept the information presented, the attitude to the most complete understanding of the material is realized;
5. Analytical-critical and creative reading are two types of reading that are close to each other in that they participate in solving research problems. The first of them involves a directed critical analysis of both the information itself and the ways of its receipt and presentation by the author; the second is the search for those judgments, facts, on which or in connection with which, the reader considers it necessary to express his own thoughts.

Of all the types of reading considered, the main one for students is the learning one - it allows them to accumulate knowledge in various fields when working with educational literature. That is why this type of reading should be mastered in the first place. In addition, when mastering this type of reading, the main techniques are formed that increase the effectiveness of working with a scientific text.

The main types of systematized recording of what has been read:

1. Annotation is an extremely brief coherent description of the book (article) viewed or read, its contents, sources, nature and purpose;
2. Planning is a brief logical organization of the text, revealing the content and structure of the studied material;
3. Thesis is a concise reproduction of the author's main statements without involving factual material;

4. Quotation is a verbatim excerpt from the text of excerpts, extracts that most significantly reflect one or another thought of the author;

5. Note-taking is a brief and consistent presentation of the content of what has been read.

A synopsis is a complex way of presenting the content of a book or article in a logical sequence. A synopsis accumulates the previous types of notes, allows you to comprehensively cover the content of a book or article. Therefore, the ability to make a plan, theses, make extracts and other notes determines the technology of compiling a synopsis.

Methodical recommendations for compiling a synopsis:

1. Read the text carefully. Clarify the incomprehensible words in the reference literature. When writing down, do not forget to put the reference data in the margins of the note.

2. Highlight the main thing, make a plan.

3. Briefly formulate the main provisions of the text, note the author's argumentation.

4. Take notes of the material, clearly following the points of the plan. When taking notes, try to express the idea in your own words. Notes should be kept clearly.

5. Write down quotes correctly. When quoting, take into account the conciseness and significance of the thought.

In the text of the synopsis, it is desirable to give not only thesis statements, but also their proofs. When drawing up a synopsis, it is necessary to strive for the capacity of each sentence. The thoughts of the author of the book should be stated briefly, taking care of the style and expressiveness of what is written. The number of additional elements of the synopsis should be logically justified, the notes should be distributed in a certain sequence that corresponds to the logical structure of the work. Margins should be left for clarification and addition.

Mastering the skills of taking notes requires purposefulness and daily independent work from the student.

Laboratory classes.

It should be emphasized that only after mastering the lecture material from a certain point of view (namely, from the point from which it is presented at the lectures), it will be consolidated in practical classes both as a result of discussion and analysis of the lecture material, and with the help of performing tasks of laboratory work, tasks. With these

The student will not only learn the material well, but also learn how to apply it in practice, and will also receive an additional incentive (and this is very important) to actively study the lecture.

When performing tasks independently, it is necessary to justify each stage of the solution, based on the theoretical provisions of the course. If the student sees several ways to solve a problem (task), then it is necessary to compare them and choose the most rational one. It is useful to draw up a brief plan for solving the problem (task) before starting calculations. The solution of problems or examples should be presented in detail, calculations should be arranged in a strict order, separating auxiliary calculations from the main ones. Solutions, if necessary, should be accompanied by comments, diagrams, drawings and drawings.

It should be remembered that the performance of each educational task should be brought to the final logical answer required by the condition, and, if possible, with a conclusion. The answer obtained should be checked in ways that follow from the essence of the given task. It is also useful (if possible) to solve in several ways and compare the results obtained. For example, tasks are performed using NetCracker Professional 4.1 tools, then analytically and the results are compared to substantiate the result of the task. Laboratory work. Tasks of this type should be continued until you acquire solid skills in solving them.

Self-check.

After studying a certain topic from the notes in the notes and textbook, as well as solving a sufficient number of relevant tasks in laboratory classes and independently, the student is recommended, using a sheet of reference materials, to reproduce from memory definitions, conclusions of formulas, formulations of the main provisions and evidence.

If necessary, you need to carefully understand the material again.

Sometimes the insufficiency of assimilation of a particular issue becomes clear only when studying further material. In this case, it is necessary to go back and repeat the poorly mastered material. An important criterion for mastering theoretical material is the ability to solve problems or pass a test on the material covered. However, it should be remembered that the correct solution to the problem can be obtained as a result of the use of mechanically memorized formulas without understanding the essence of theoretical provisions.

Consulting

If in the process of independent work on the study of theoretical material or when performing tasks, the student has questions that cannot be solved independently, it is necessary to contact the teacher to obtain explanations or instructions from him. In his questions, the student should clearly express what he is experiencing difficulties, the nature of this difficulty. Advice should also be sought if there are doubts about the correctness of the answers to the self-test questions.

8. Independent Work of Students in the Conditions of the Point-Rating System of Education

The rating system of education involves multi-point assessment of students, but this is not a simple transition from a five-point scale, but an opportunity to objectively reflect in points the expansion of the range of assessment of individual abilities of students, their efforts spent on performing this or that type of independent work. There is a lot of room for creating a block of differentiated individual tasks, each of which has its own "price". A properly organized technology of rating education allows you to get away from the five-point assessment system from the very beginning and come to it only when summing up, when the points earned by students are converted into the usual grades (excellent, good, satisfactory, unsatisfactory). In addition, the rating system includes additional incentive points for originality, novelty of approaches to performing tasks for independent work or solving scientific problems. A student has the opportunity to increase his educational rating by participating in extracurricular work (participation in Olympiads, conferences; performing individual creative tasks, essays; participating in the work of a scientific circle, etc.). At the same time, students who are in no hurry to submit their work on time can also receive negative points. At the same time, individual students are encouraged to complete the program faster. For example, if a student is ready to take a test or write an independent work before the group, you can add additional points to him.

The rating system is a regular monitoring of the quality of knowledge and skills assimilation in the educational process, the implementation of the planned amount of independent work. Maintaining a multi-point assessment system allows:

On the one hand, to reflect the individual characteristics of students in the point range, and on the other hand, to objectively evaluate in points the efforts of students spent on the performance of certain types of work. Thus, each type of educational activity acquires its own "price".

The "cost" of the work performed by the student flawlessly is a quantitative measure of the quality of his learning in the totality of the educational material studied by him, which was necessary for the successful completion of the task.

The maximum possible score for the entire current control is set at 55. The current control activity 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 activities is determined as follows:

Level task	Performance of the control	Rated Score (in % from the maximum score for the control task)
	Excellent	100
	Good	80
	Satisfactory	60
	Unsatisfactory	0

The final grade for a discipline studied in one semester is determined by the sum of points scored for the work during the semester

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

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

The developed scale for converting the rating in the discipline into a final five-point grade is available and easily calculated by both the teacher and the student.

When using the rating system:

- the main emphasis is placed on the organization of active types of educational activities, the activity of students goes to the creative comprehension of the proposed tasks;
- In the relationship between the teacher and students, there is cooperation and co-creation, there is psychological and practical

the teacher's readiness for the fact of the individual originality of the "self-concept" of each student;

- a variety of stimulating, emotionally regulating, directing and organizing methods of intervention (if necessary) of the teacher in the independent work of students is assumed;
- the teacher acts as a teacher-manager and director of training, ready to offer students the minimum necessary set of teaching tools, and not only transmits educational information; the student acts as a subject of activity along with the teacher, and the development of his individuality acts as one of the main educational goals;
- Educational information is used as a means of organizing educational activity, and not as a goal of learning.

The rating system of education provides the greatest informational, procedural and creative productivity of independent cognitive activity of students, provided that it is implemented through the technologies of personality-oriented learning (problem, dialogue, discussion, heuristic, game and other educational technologies).

Most students have a positive attitude to such a system for tracking the results of their training, noting that the rating system of training contributes to the even distribution of their efforts during the semester, improves the assimilation of educational information, and provides systematic work without "rushes" during the session. A large number of various tasks offered for independent study, and different scales of their assessment allow the student to monitor his progress, and if desired, he always has the opportunity to improve his rating (by performing additional types of independent work) without waiting for the exam. The organization of the learning process within the framework of the rating system of education using various types of independent work allows you to get better results in teaching students in comparison with the traditional university system of education.

The use of the rating system allows you to achieve a more rhythmic work of the student during the semester, as well as activates the cognitive activity of students by stimulating their creative activity. The use of tests directly in the learning process, in independent work, is very effective

students. In this case, the student tests his knowledge himself. Without immediately answering the test task, the student receives a hint explaining the logic of the task and performs it a second time.

It should also be noted that automated training and teaching-control systems are increasingly penetrating into the educational process, which allow the student to independently study a particular discipline and at the same time control the level of mastering the material.

9. Educational, methodological and information support of the discipline

On this discipline, the teacher recommends the following literature:

The following are considered as the main literature:

1. Iversen V.B. Development of Teletraffic and Planning of Networks Elektronnyi resurs: uchebnoe posobie [Development of Teletraffic and Planning of Networks]. - Development of Teletraffic and Planning of Networks, 2019-12-20. Moscow: Internet University of Information Technologies (INTUIT), 2016. - 625 p. - The book is in the basic version of the EBS IPRbooks.
2. Reshetnikova I.V. Teoriya teletraffic: Elektronnyi resurs [Theory of teletraffic: Elektronnyi resurs] / Reshetnikova I.V. : textbook. - Rostov-on-Don: RGUPS, 2019. - 80 p. - ISBN 978-5-88814-923-2.

As additional literature:

1. Fundamentals of Infocommunication Technologies: Theory of Teletraffic textbook / E.D. Bychkov, V.A. Maistrenko, O.N. Kovalenko, D.N. Kovalenko; ed. by V.A. Maistrenko; Ministry of Education and Science of Russia; Omsk State Technical University. - Omsk: OmSTU Publishing House, 2017. - 156 p. : graph., scheme. - <http://biblioclub.ru/>. - References: p. 130-131. - ISBN 978-5-8149-2433-9.
2. Bratchenko N.Y. Theory of Teletraffic Elektronnyi resurs : uchebnoe posobie [Theory of Teletraffic: Electronic Resource]. - Stavropol: North-Caucasian Federal University, 2014. - 177 p. - The book is in the basic version of the EBS IPRbooks.

Students can also use methodological literature:

Theory of Teletraffic : Textbook : Direction of training 210700.62 (11.03.02) – Infocommunication Technologies and

Communication Systems. Profile of training "Communication Networks and Switching Systems" / author. Bratchenko; FGAOU VPO Sev.-Kav. Federal. University. - Stavropol: NCFU, 2014. - 55 p. : ill.

The following sources are offered as Internet resources:

1. <http://biblioclub.ru>
2. <http://www.iprbookshop.ru>
3. <http://catalog.ncfu.ru/catalog/ncfu>

For independent development theoretical and The following software will be required:

1. The operating system of the Microsoft Windows family.
2. MathCad.
3. MS Office 2010.
4. MatLab.
5. Net Cracker 4.1.
6. MS Power Point.