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MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
Higher Education
"NORTH CAUCASUS FEDERAL UNIVERSITY"

APPROVED BY
Acting Director of the Institute
Advanced Engineering
Cand. Tech. Sci., Associate Professor
A.A. Porokhnya

DISCIPLINE ASSESSMENT TOOLS FUND

Random signal Analysis

Field of study	11.03.02 Infocommunication Technologies and Communication Systems
Profile	Intelligent Data Processing in Infocommunication Systems and Networks
Year of start of training	2026
Form of study	Full-time
Implemented in a semester	7

Introduction

1. Purpose: FAT is designed to objectively assess the level of competence formation.

FOS is an appendix to the program of the discipline "Analysis of random signals"

2. Developed by Samus M.V., Associate Professor at the School of Digital, Robotic Systems and Electronics.

3. An examination of the FOC was carried out.

Members of the expert group:

Chairman I.V. Azarov, Acting Director of the Department of Digital, Robotic Systems and Electronics

Members of the Commission:

Dmitry Gaichuk, Associate Professor, School of Digital, Robotic Systems and Electronics

Samus M.V., Associate Professor, School of Digital, Robotic Systems and Electronics

Representative of the employing organization

Mironov V.A., General Director of ORINTEX LLC.

Expert opinion: The FAT for the discipline allows you to assess the level of competence formation. Start approbation.

" ____ " _____ 2026

5. The validity period of the FAT shall be determined by the period of implementation of the educational programme.

1. 1. Description of indicators and assessment criteria at various stages of their formation, description of assessment scales

Levels of competence and indicators	Levels of competence formation			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Intermediate level (good) 4 points	High level (excellent) 5 points
Competency: PC-2				
ID-1PK-2 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.	Unable to complete tasks related to this competency achievement indicator	Performs tasks at the reproductive level related to this indicator of competence achievement	Performs tasks related to this indicator of competence achievement in standard situations, making minor mistakes	Fully performs tasks related to this indicator of competence achievement, including in non-standard situations
ID-2PC-2 analyzes the statistical parameters of traffic, develops solutions for the prompt 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	Unable to complete tasks related to this competency achievement indicator	Performs tasks at the reproductive level related to this indicator of competence achievement	Performs tasks related to this indicator of competence achievement in standard situations, making minor mistakes	Fully performs tasks related to this indicator of competence achievement, including in non-standard situations

and data transmission networks, for organizing new and expanding existing communication directions.				
ID-3PK-2. analyzes the statistics of the main indicators of the efficiency of radio systems and data transmission systems, develops measures to maintain them at the required level, calculates the capacity of telecommunication networks.	Unable to complete tasks related to this competency achievement indicator	Performs tasks at the reproductive level related to this indicator of competence achievement	Performs tasks related to this indicator of competence achievement in standard situations, making minor mistakes	Fully performs tasks related to this indicator of competence achievement, including in non-standard situations

ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Job Number	Correct answer	Content of the question	Competence
Semester 7			
1.	a)	The elements of the communication network are (a) Components having an independent reliability characteristic (b) Components that do not have an independent reliability characteristic (c) Any component parts (d) Components performing the same functions	PC-2
2.	b)	A network element failure is (a) An event with irreparable consequences (b) An accidental event resulting in the impairment and inability of the element to perform the specified functions (c) An accidental event resulting in the temporary inability of the element to perform certain functions (d) Any accidental event	PC-2
3.	d)	The queuing system is understood as (a) A set of service and service systems (b) The maintenance system, together with the rules establishing the organization of the service (c) A set of elements of the service and maintenance systems capable of performing their functions without failures (d) A set of maintenance and maintenance systems, together with rules that establish the organization of services	PC-2
4.	a)	An open system is a system in which the source of requests is located (a) Outside the system (b) Within the system (c) At the system boundary (d) Anywhere in the system	PC-2
5.	a)	In the open CMO, the characteristics of the requisition flow a) do not depend on its condition (how many channels are occupied) (b) Depends on the state in which it is (how many channels are occupied) (c) depend on the condition in which it was before the service began (d) Are independent of the condition in which it was prior to the commencement of maintenance	PC-2
6.	c)	A closed system is a system in which the source of requests is located	PC-2

		(a) At the system boundary (b) Within the AGR (c) Outside the system (d) Anywhere in the system	
7.	a)	In a closed CMO, the intensity of the flow of incoming applications a) depends on the number of busy service channels (b) Does not depend on the number of service channels employed (c) Depends on the number of storage spaces (d) Independent of the number of storage spaces	PC-2
8.	d)	With absolute priority of requests, in cases where there is no free service channel for immediate servicing of an incoming high-priority request, a) Release of one of the channels of the CMO engaged in servicing a request of any priority (b) Release of one of the channels of the CMO engaged in servicing an equal priority request c) Release of any occupied channel (d) Release of one of the channels of the CMO engaged in servicing the lower priority request	PC-2
9.	b)	With relative priorities, servicing any request after it has started (a) Always interrupted (b) Always completed without interruption c) is transmitted to any free channel (d) Shall be interrupted for the duration of the priority check of the application received	PC-2
10.	a)	A stream is called a) a sequence of homogeneous events following one another at some generally random moments of time b) a sequence of heterogeneous events following one another at some generally random moments of time (c) Any sequence of events (d) Any sequence of random events	PC-2
11.		Markov stochastic processes.	PC-2
12.		The process of "death and reproduction".	PC-2
13.		The simplest flow and its properties.	PC-2
14.		Palm Streams. Erlang Streams.	PC-2
15.		To give a definition of regular (deterministic) flow.	PC-2
16.		To give a definition of stationary flow.	PC-2
17.		Define flow without aftereffect.	PC-2
18.		Kolmogorov equations for probabilities of states of Markov systems with continuous time and discrete states.	PC-2

19.		Derivation of the first Erlang formula.	PC-2
20.		Derivation of Little's formula.	PC-2
21.		To construct a system of Kolmogorov equations for a four-element fully connected system.	PC-2
22.		The law of conservation in queuing systems with priorities.	PC-2
23.		Average wait time in priority queuing systems.	PC-2
24.		Average wait time in queuing systems with fixed relative priorities.	PC-2
25.		Average service time in queuing systems with absolute fixed priorities.	PC-2
26.	a)	A process is called a continuous time process if a) the moments of possible transitions from state to state are not fixed in advance, are accidental and can occur at any time b) the moments of possible transitions from state to state are known in advance and the transition can take place at any time c) the moments of possible transitions from state to state are known in advance and the transition can take place at specified intervals of time d) the moments of possible transitions from state to state are not known in advance and the transition can take place at the specified intervals of time	PC-2
27.	c)	With any type of ticket flow, with any distribution of service time, with any service discipline, the average time a request stays in the system is equal to (a) The intensity of the flow of incoming applications divided by the average number of applications in the system (b) The average number of applications in the system multiplied by the flow rate of applications received (c) the average number of applications in the system divided by the rate of flow of incoming applications (d) The intensity of the flow of requests serviced multiplied by the average number of requests in the system	PC-2
28.	a)	At the initial point in time, the probability of a null state of a single-channel system a) is equal to 1, and in the limit at t tending to infinity, it becomes equal to $\mu / (\lambda + \mu)$ b) is equal to 0, and in the limit at t tending to infinity it becomes equal to $\mu / (\lambda + \mu)$ c) is equal to 1, and in the limit at t tending to infinity it becomes equal to $\lambda / (\lambda + \mu)$ d) is equal to 0, and in the limit at t tending to infinity it becomes equal to $\lambda / (\lambda + \mu)$	PC-2
29.	b)	Probability value of the unit state $PI(t)$ in a single-channel system a) decreases in the limit at t tending to infinity from one to $\lambda / (\lambda + \mu)$ b) grows in the limit with t tending to infinity from zero to $\lambda / (\lambda + \mu)$ c) grows in the limit at t, tending to infinity from zero to $\mu / (\lambda + \mu)$ d) decreases in the limit at t tending to infinity from one to $\mu / (\lambda + \mu)$	PC-2

30.	d)	For a single-channel system with failures, the probability of a free state is numerically equal to (a) Absolute capacity of the system (b) Relative load factor (c) The intensity of the applications received (d) the relative capacity of the system	PP-22
31.	a)	The drive for pending tickets is considered infinite if (a) The probability of filling it is infinitesimal (b) its volume exceeds the number of service channels (c) The likelihood of being filled does not depend on the number of sources of applications (d) The probability of filling depends on the number of service channels	PC-2
32.	b)	The relative throughput of a system with unlimited queue storage is a) 0 b) 1 (c) Absolute capacity (d) The intensity of applications	PC-2
33.	d)	The absolute throughput of a system with unlimited queue storage is a) 0 b) 1 (c) Absolute capacity (d) The intensity of applications	PC-2
34.	a)	A random process occurring in a system is called a Markov process (process without consequences) if (a) For each time t time, <i>the</i> probability of any future state of the system at $t + \Delta t$ depends only on its present state and does not depend on when and how the system arrived at that state (b) For each time t moment, <i>the</i> probability of any future state of the system at $t + \Delta t$ does not depend on its present state, but only on when and how the system arrived at that state (c) for each time t the probability of any future state of the system at $t + \Delta t$ does not depend on its present state and does not depend on when and how the system arrived at that state (d) For each time t time, <i>the probability of</i> any future state of the system at $t + \Delta t$ depends on its present state and on when and how the system arrived at that state	PC-2
35.	a)	An event stream is called a Palm stream (a thread with a limited consequence) if (a) The time intervals between successive events are independent, uniformly distributed random variables (b) The time intervals between any events are independent, uniformly distributed random variables (c) The time intervals between successive events are dependent, uniformly distributed, non-random variables	PC-2

		(d) The time intervals between any events are dependent, equally distributed, non-random variables	
36.		Calculate the probability of receiving a call in time intervals of 1 second; 5 seconds; 10 seconds if the intensity of the incoming flow is 160 requests/hour.	PC-2
37.		The intensity of the flow of requests is 160 requests/hour, and the intensity of their service is 200 requests/hour. Calculate the mathematical expectation of service duration; variance; standard deviation of the interval between orders; average relative load of the system.	PC-2
38.		The average waiting time for the start of service in a single-channel communication network is 4.3 minutes, and the service time is 3 minutes. Calculate the number of requests in the queue and in service.	PC-2
39.		A single-channel branch of the communication network receives the simplest flow of requests with an intensity of 5 requests per hour. The mathematical expectation of the service time is 0.1 hours. Determine the probability of the maintenance devices being in the zero state.	PC-2
40.		The single-channel system allows you to serve 20 requests per hour. Find the relative throughput of the system if the relative load factor is 0.8 Erl.	PC-2
41.		A single-channel system with an unlimited queue accumulator accepts the simplest flow of requests with an intensity of 5 requests per minute. The average service time of one request is 0.1 minutes. Determine the probability of the maintenance devices being in the zero state.	PC-2
42.		The flow of requests coming into the two-channel system has an intensity of 2 requests per second. The average service time of one request is 0.5 seconds. There can be up to three requests in the queue drive. Find the probability of service denial.	PC-2
43.		Procedure for calculating the probability of finding the equipment of a single-channel system without a queue accumulator in a free state.	PC-2
44.		Procedure for calculating the probability of finding the equipment of a multichannel system without a queue accumulator in a free state	PC-2
45.		How to Calculate the Probability of Service Failure in a Single-Channel System Without a Queue Accumulator	PC-2
46.		How to calculate the probability of a service failure in a multi-channel system without a queue accumulator	PC-2
47.		Procedure for calculating the probability of finding the equipment of a single-channel system with a queue accumulator in a free state	PC-2
48.		Procedure for calculating the probability of finding the equipment of a multichannel system with a queue accumulator in a free state	PC-2
49.		How to calculate the probability of a service failure in a single-channel system with a queue accumulator	PC-2

50.		How to calculate the probability of a service failure in a multichannel system with a queue accumulator	PC-2
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Description of the grading scale

Within the framework of the rating system, the performance of students in each discipline is assessed during current control and intermediate certification. The rating system for assessing students' knowledge is based on the use of a set of control measures to check the material covered (control points), optimally located throughout the time interval of studying the discipline. The principles of the rating system for assessing students' knowledge are based on the requirements described in the Regulation on the organization of the educational process based on the rating system for assessing students' knowledge at NCFU.

Criteria for assessing competencies

An "excellent" grade is given to a student if he/she fully and accurately performs the tasks of assessment tools in the discipline related to this competence (indicators of competence achievement), while demonstrating at a high level the ability to solve standard and non-standard applied practical problems of teletraffic of multiservice networks.

A "good" grade is given to a student if he/she, making minor mistakes, performs the tasks of assessment tools in the discipline related to this competence (indicators of competence achievement), while demonstrating at an average level the ability to solve only standard applied practical problems of teletraffic of multiservice networks.

A "satisfactory" grade is given to a student if he/she makes mistakes, which are corrected with the help of leading questions from the teacher, performs the tasks of assessment tools in the discipline related to this competence (indicators of competence achievement), while demonstrating at a minimum level the ability to solve standard applied practical problems of teletraffic of multiservice networks.

An "unsatisfactory" grade is given to a student if he/she, performing the tasks of the assessment tools in the discipline, does not reach the minimum level of competence formation ((indicators of competence achievement), while not demonstrating the ability to solve standard applied practical problems of teletraffic of multiservice networks, makes gross mistakes that he cannot correct even with the help of leading questions from the teacher.