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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

Signal and System

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	3

Introduction

1. Purpose

The fund of assessment tools for the discipline "Signal and System" is intended for an objective assessment of the level of competence formation.

2. FOS is an appendix to the program of the discipline "Signal and System".

3. The developer is V.P. Mochalov, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

4. An examination of the FOC was carried out.

Members of the expert group:

Chairman: V.P. Mochalov, Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Members of the Commission:

S.V. Yakovlev, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

S.V. Melnikov, Senior Researcher of the Interdisciplinary Training and Research Center for Agricultural Technologies, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Representative of the employer's 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.

5. The validity period of the FAT is determined by the period of implementation of the educational program.

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: OPK-1				
ID-1 OPK-1 understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	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-2 OPK-1 applies physical laws and mathematical methods to solve problems of a theoretical and applied nature.	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-3 OPK-1 uses the knowledge of physics and mathematics to solve practical problems.	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
Competency: OPK-2				
ID-3 OPK-2 understands the basic methods and means of conducting experimental research, standardization and certification systems.	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-4 OPK-2 selects methods and means of measurement and conducts experimental	Unable to complete tasks related to this competency	Performs tasks at the reproductive level related to this indicator of	Performs tasks related to this indicator of competence achievement in standard	Fully performs tasks related to this indicator of competence achievement,

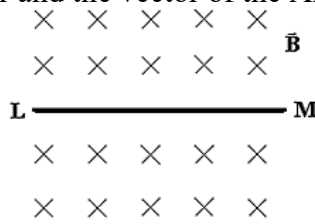
research.	achievement indicator	competence achievement	situations, making minor mistakes	including in non-standard situations
ID-5 OPK-2 is proficient in the methods of processing and presenting the data obtained and assessing the error of measurement results.	Unable to complete tasks related to this 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
Competency: EP K-3				
ID-1 OPK-3 understands the basic patterns of information transmission in infocommunication systems, the main types of signals used in telecommunication systems, the features of the transmission of various signals through channels and paths of telecommunication systems.	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-2 OPK-3 understands the principles, basic algorithms and devices of digital signal processing; the principles of building telecommunication systems of various types and methods of information distribution in communication 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
ID-3 OPK-3 solves data processing problems using computer technology.	Unable to complete tasks related to this competency	Performs tasks at the reproductive level related to this indicator of	Performs tasks related to this indicator of competence achievement in	Fully performs tasks related to this indicator of competence achievement,

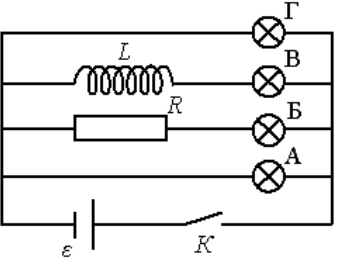
	achievement indicator	competence achievement	standard situations, making minor mistakes	including in non-standard situations
ID-4 _{OPK-3} builds probabilistic models for specific processes, carries out the necessary calculations within the framework of the built model.	Unable to complete tasks related 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-5 _{OPK-3} has methods and skills for ensuring information security.	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 of the level of competence in the discipline is carried out on the basis of the "Regulation on the current monitoring of progress and intermediate certification of students in educational programs of higher education - bachelor's programs, specialist programs, master's programs - in the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" in the current edition.

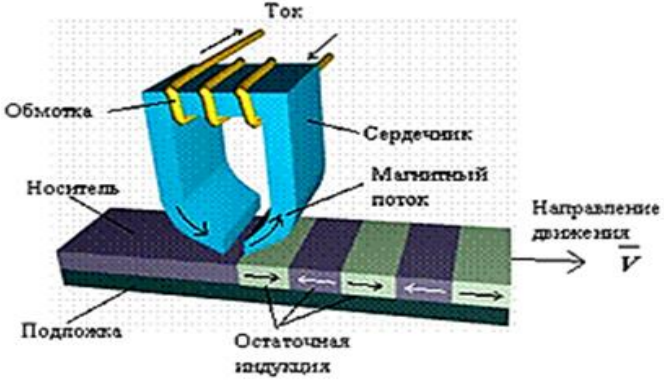
ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Job Number	Correct answer	Content of the question	Competence
Semester <u>3.</u>			
1.	Physical	The transfer of information is ... the process by which the movement of information in the form of a message in space is carried out (insert word)	OPK-1
2.	1 – a 2 – b 3 – c 4 – d 5 – e 6 – g 7 – h	Match the term to its definition 1) physical system 2) physical objects 3) physical process 4) physical phenomenon 5) physical effect 6): Physical Field 7) physical regularity a) a set of physical objects that form a certain structure b) macrobodies, microbodies, fields, elementary particles having physical properties c) sequential change of states of a physical system (object) d) a change in the state of a physical system (object) accompanied by a spasmodic change in its physical properties e) the regularity of the manifestation of the results of the interaction of physical objects carried out by means of physical fields f): a special kind of matter, a physical system with an infinitely large number of degrees of freedom g) stable connection between repetitive physical phenomena and processes (h) A model of a physical object or a combination thereof with some known and unknown physical quantities	OPK-1
3.	1 – a 2 – b 3 – c 4 – d 5 – e	Establish a match: 1) Field Flow 2) Field circulation 3) Field divergences 4) Field Gradient 5) Field rotor (a) A measure of the number of field lines and an indicator of the presence of a field in a region of space (b) A measure of the intensity and direction of the field and a criterion of the potential of the field	OPK-1

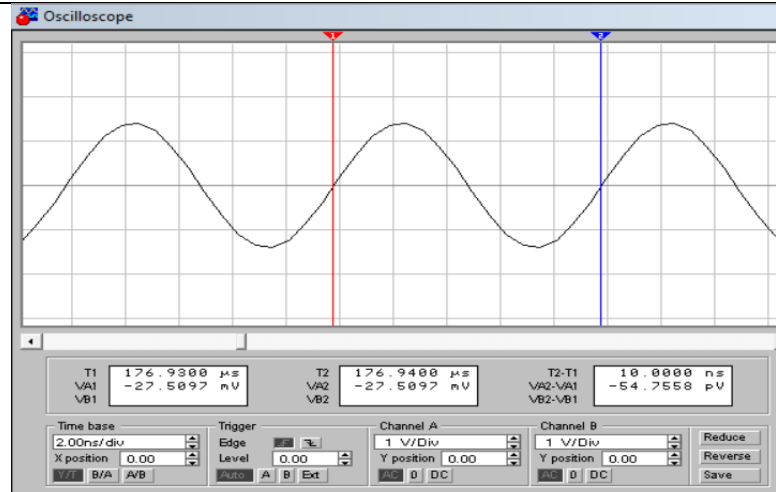
		(c) A measure of the presence of a field source and a characterization of the field source power (d) A measure of the degree and rate of change in the scalar physical field (e) A measure of the magnitude and direction of the twist of the vector field	
4.	a)	The figure shows a conductor with a current placed in a uniform magnetic field with induction B, directed perpendicular to the plane of the drawing from the observer. In this case, the correct combination of the direction of the current in the conductor and the vector of the Ampere force is as follows  a) current in the direction L-M; Ampere force – upwards b) current in the direction M-L; Ampere force – upwards c) current in the direction of L-M; Ampere force – to the observer d) current in the direction M-L; Ampere force – from the observer e) current in the direction of L-M; Ampere force – down f) current in the direction M-L; Ampere force – downward	OPK-1
5.	a) e)	The wave (characteristic) resistance of a vacuum, as a propagation medium, is equal to a) 120π ohms (b) 220π ohms c) $320\pi \Omega$ (d) 20π ohms (e) 377 ohms (f) 477 ohms (g) 177 ohms (h) 277 ohms	OPK-1
6.	1 – a 2 – b 3 – c 4 – d	To establish a correspondence between the parasitic connection and the cause of its occurrence: 1) Capacitive coupling 2) inductive coupling 3) communication through electromagnetic radiation and guidance 4) Galvanic communication	OPK-1

		(a) Near electric field (b) Near magnetic field (c) Electromagnetic field (d) Electric current (e) Galvanic field	
7.	grounding	The effectiveness of electrostatic shielding is achieved due to ... screen (enter word)	OPK-1
8.	b)	Instantaneous Power Value vs. Instantaneous Current and Voltage Values (a) Unchanged (b) Changes at twice the frequency (c) Changes with triple frequency d) changes at a frequency of 2 times less e) changes at a frequency of 3 times less (f) Varies linearly proportionally	OPK-1
9.	c)	After closing the key K in the circuit shown in the figure, the lamp will light up later than the others...  a) A b) B (c) B (d) D (e) A and D (f) B and C	OPK-1
10.	1 – a 2 – b	Establish a correspondence between the type of current density and the expression describing it 1) conduction current density	OPK-1

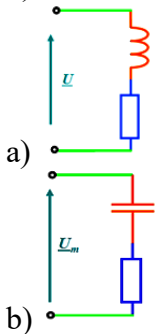
	3 – c 4 – d 5 – e	2) Vacuum Displacement Current Density 3) polarization current density 4) Displacement current density in dielectric 5) Total Current Density $\frac{d\sigma}{dt}$ a) $\frac{\partial \vec{E}}{\partial t}$ b) $\epsilon_0 \frac{\partial \vec{P}}{\partial t}$ c): $\frac{\partial \vec{D}}{\partial t}$ d) $\epsilon_0 \frac{\partial \vec{E}}{\partial t} + \frac{\partial \vec{P}}{\partial t}$ e) $\vec{j} + \frac{\partial \vec{D}}{\partial t}$ f) $\epsilon_0 \vec{E} + \vec{P}$																	
11.		Fill in the table <table border="1"> <thead> <tr> <th>Communicati on channel</th><th>Physical environme nt</th><th>Message carrier</th><th>The process used to transmit the message</th></tr> </thead> <tbody> <tr> <td>Wired (cable)</td><td></td><td></td><td></td></tr> <tr> <td>Radio channel</td><td></td><td></td><td></td></tr> <tr> <td>Fiber optic</td><td></td><td></td><td></td></tr> </tbody> </table>	Communicati on channel	Physical environme nt	Message carrier	The process used to transmit the message	Wired (cable)				Radio channel				Fiber optic				OPK-1
Communicati on channel	Physical environme nt	Message carrier	The process used to transmit the message																
Wired (cable)																			
Radio channel																			
Fiber optic																			
12.		Specify the units of measurement of the following physical quantities: electric charge, electric current, electric field strength, electric field potential, electric displacement vector (electric induction), electric capacitance, electric constant	OPK-1																
13.		Specify the units of measurement of the following physical quantities: magnetic flux, magnetic field induction, magnetic field strength, inductance, magnetic constant, magnetic susceptibility	OPK-1																

14.		The Physical Meaning of Maxwell's Equations in Differential Form	OPK-1
15.		The Physical Meaning of Maxwell's Equations in Integral Form	OPK-1
16.		The sequence of physical processes when writing data to a hard disk and when reading information from a disk (see figure) 	OPK-1
17.		Briefly describe the properties of electromagnetic waves (EMW)	OPK-1
18.		Write down the differential (telegraph) equations of a long line	OPK-1
19.		The physical meaning of the solutions of telegraph equations.	OPK-1
20.		Free oscillations in an ideal oscillating circuit.	OPK-1
21.		Attenuation of free oscillations in a real oscillating circuit.	OPK-1
22.		Forced oscillations in the oscillating circuit.	OPK-1
23.		Interference of electromagnetic waves.	OPK-1
24.		Diffraction of electromagnetic waves. Fresnel zones.	OPK-1
25.		Dispersion of electromagnetic waves.	OPK-1

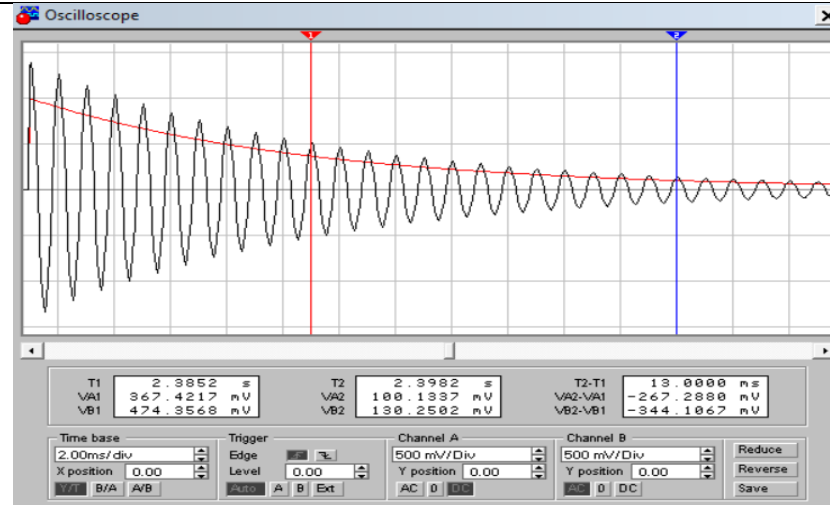
26.	0.5 or 0.5	In the region of space in which a homogeneous vector field of force 1 N is defined, there is a platform S with a size of 1 square meter, then the flux of the field, the field lines of which intersect the specified field at an angle of 60 degrees to the vector of the normal of its plane, is equal to ... (enter the result as a number).	OPK-2
27.	1 – a 2 – b 3 – c 4 – d 5 – e	Establish the correspondence based on the results of the studies carried out on various electrical circuits: 1) a circuit containing a resistor 2) a circuit containing inductance 3) a chain containing a capacitance 4) Mixed RL Circuit 5) Mixed RC Circuit a) the electric current and voltage are the same in phase b) the current vector lags behind the voltage vector by a right angle c) the current vector is ahead of the voltage vector by a right angle (d) The current vector lags behind the voltage vector (e) The current vector is ahead of the voltage vector	OPK-2
28.	1 – a 2 – b 3 – c 4 – d	Establish the correspondence based on the results of the analysis of the oscillating circuit parameters: 1) $\frac{1}{\sqrt{LC}}$ 2) $\sqrt{\frac{L}{C}}$ 3) $\frac{1}{R} \sqrt{\frac{L}{C}}$ 4) $R \sqrt{\frac{C}{L}}$ (a) Resonant circular frequency of the circuit (b) Characteristic (wave) impedance of the circuit (c) Quality factor of the contour (d) Loop attenuation (e) Contour decrement (f) Contour reinforcement	OPK-2
29.	3 m	When measuring the wavelength by the indirect method using an oscilloscope, the period of electromagnetic oscillation is obtained (see figure). Determine the wavelength provided that the phase velocity of its propagation $300 \cdot 10^6$ is m/s	OPK-2



30.	e)	Based on the results of the research, it was found that when choosing a physical medium according to the criterion of minimum attenuation and time delay at the maximum distance without re-reception, the optimal choice is (a) Magnetic media (b) Copper wire (c) Coaxial cable (d) Twisted pair (e) Fibre optic cable (f) Radio broadcasting (g) Vacuum	OPK-2
31.	3 m	At a frequency of oscillation of 100 MHz, the length of the electromagnetic wave is ... (enter a number and is abbreviated through a space of the unit)	OPK-2
32.	1) – a, b, c 2) – d, e, f	To classify statements according to the criterion of their relation to the zones of the elementary electric emitter (dipole) 1) Near Field Electric Dipole 2) Far-field electric dipole field (a) The phases of electric and magnetic field intensities are independent of spatial coordinates (b) The movement of energy is oscillatory c) The Umov-Poynting vector has a radial and polar component	OPK-2

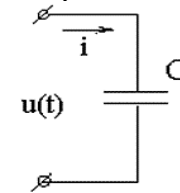
		(d) The phases of electric and magnetic field intensities depend on spatial coordinates (e) The movement of energy has a wave character (f) The Umov–Poynting vector has only a radial component	
33.	a)	As a result of the research, it was established that the electric field strength in free space at a distance R from the isotropic emitter is determined by the expression $ \vec{E}_o = \sqrt{\frac{P \cdot 120\pi}{4\pi R^2}} = \frac{\sqrt{30P}}{R}$ Therefore, it can be concluded that the amplitude of the wave in free space decreases ... (a) Increasing distance from the emitter due to spherical divergence of the wave front (b) with an increase in phase due to the spherical divergence of the wave front (c) With a decrease in the power of the secondary emitters due to the uniform divergence of the wave front (d) With an increase in the distance from the emitter due to the uniform divergence of the wave front e) due to all of the above factors	OPK-2
34.	1 – a 2 – b 3 – c 4 – d	Establish a correspondence between the circuit and its circuitry: 1) RL Circuit 2) RC Circuit 3) Sequential oscillating circuit 4) Parallel oscillating circuit 	OPK-2

		c) d) e)	
35.	a)	As a result of the research, it has been established that the condition for the occurrence of stress resonance is the fulfillment of the a) $\omega \cdot L = \frac{1}{\omega \cdot C}$ b) $\omega \cdot L < \frac{1}{\omega \cdot C}$ c) $\omega \cdot L > \frac{1}{\omega \cdot C}$ d) $\omega \cdot C > \frac{1}{\omega \cdot L}$ e) $\omega \cdot C < \frac{1}{\omega \cdot L}$	OPK-2
36.		The oscilloscope (see the figure below) shows a time diagram of a simulated damped wave. The red cursor is set to a time stamp equal to 10 ms, in which the amplitude of the wave has decreased exponentially times. The blue cursor is set to a time stamp in which the amplitude of the wave has decreased by a factor of 10. The phase velocity of wave propagation is 1000 m/s. Determine the attenuation coefficient and distances at which the wave attenuates in e and 10 times.	OPK-2



37.

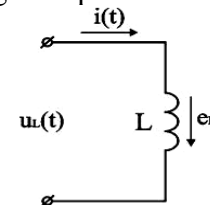
Analysis (verbal description) of electromagnetic processes in an ideal capacitance circuit



OPK-2

38.

Analysis (verbal description) of electromagnetic processes in the ideal inductance circuit

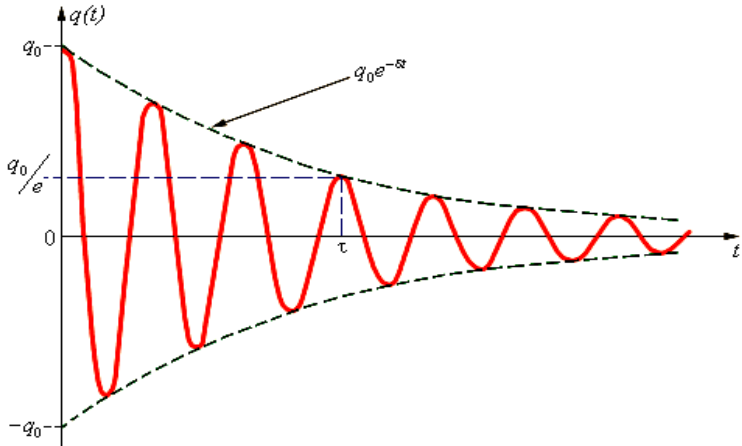


OPK-3

39.

To conduct a study in Mathcad of the resonance properties of a series oscillating circuit containing a coil with an inductance of $L = 10^{-3}$ H and a capacitor with capacitance $C = 10^{-9}$ F, provided that the active resistance of the circuit can take values of 0.1, 1 and 10 Ohm.

OPK-3

40.		To carry out a study in Mathcad by calculating the secondary parameters of a homogeneous lossless long line having the following primary parameters: $L = 10 \cdot 10^{-6}$ H, $C = 10^{-9}$ F, at input exposures with cyclic frequencies $\omega_1 = 10^3$ and $\omega_2 = 10^6$ radian/s.	OPK-3
41.		To conduct a study in Mathcad of the vibrational properties of a parallel oscillating circuit containing a coil with an inductance of $L = 10^{-3}$ H and a capacitor with capacitance $C = 10^{-9}$ F, provided that the active resistance of the circuit can take the values of 1 and 100 Ohms. 	OPK-3
42.		To calculate and analyze the parameters of the optical fiber under the following conditions: $n_1 = 1.49$ – refractive index of the RH core, $n_2 = 1.486$ – refractive index of the RH cladding, radius of the RH core $a = 4 \mu\text{m}$, $d = 8 \mu\text{m}$ – diameter of the RH core, wavelength $\lambda = 1.55 \mu\text{m}$.	OPK-3
43.		To conduct a study in the "Mathcad" program of the process of passing a harmonic signal and a sequence of square pulses through an integrating RC circuit.	OPK-3
44.		To study the process of passing a harmonic signal and a sequence of square pulses through an integrating RL circuit in the "Mathcad" program.	OPK-3
45.		Transient analysis in RL circuits.	OPK-3
46.		Analysis of RC transients.	OPK-3
47.		Analysis of transients in an oscillating circuit.	OPK-3
48.		Simulate and test a single-link LC low-pass filter in Electronics Workbench.	OPK-3

49.		Simulate and examine a single-link LC high-pass filter in Electronics Workbench.	OPK-3
50.		Simulate and examine a sequential oscillating circuit in Electronics Workbench.	OPK-3

Description of the grading scale

Students' progress in each discipline is assessed during current control and intermediate certification.

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 the physical foundations of telecommunications.

A grade of "good" 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 the physical foundations of telecommunications.

A "satisfactory" grade is given to a student if he/she 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 the physical foundations of telecommunications.

An "unsatisfactory" grade is given to a student if he/she, performing the tasks of 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 the physical foundations of telecommunications, makes gross mistakes that he cannot correct even with the help of leading questions from the teacher.