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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
"Electromagnetic Fields and Waves"

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	4

Introduction

1. Purpose

The fund of assessment tools for the discipline "Electromagnetic Fields and Waves" is designed for an objective assessment of the level of competence formation.

2. FOS is an appendix to the program of the discipline "Electromagnetic Fields and Waves".

3. The developer is O.Kh. Shayakhmetov, 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-1 ^{OPK-2} finds and critically analyzes the information necessary to solve the problem.	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-2} develops a solution to a specific problem, choosing the best option, evaluating its advantages and disadvantages.	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,	Fully performs tasks related to this indicator of competence achievement, including in

			making minor mistakes	non-standard situations
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 research.	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-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

ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Job Number	Correct answer	Content of the question	Competence
Semester <u>4</u> .			
1.	b)	The phenomenon of gradual refraction of rays due to the heterogeneity of the medium is called (a) Diffraction (b) refraction (c) Interference (d) Reflection	OPK-1
2.	d)	The wave impedance of free space is equal to a) 50 ohms (b) $240 \cdot \pi$ Om c) 600 Ω (d) $120 \cdot \pi$ Om	OPK-1
3.	a)	What determines the type of polarization of an electromagnetic wave? a) the electric field strength vector formed by the arrangement and shape of the conductors of the transmitting antenna b) the location and shape of the conductors of the receiving antenna c) weather conditions d) the type of propagation	OPK-1
4.	a)	In places where waves transition from one medium to another, the phenomenon of (a) Reflections and refractions of waves (b) Wave reflections (c) Wave refraction (d) Interference	OPK-1
5.	d)	How are the waves emitted by an elemental emitter located vertically polarized? a) are not polarized (b) Horizontally; (c) Horizontally and vertically (d) Vertically	OPK-1

6.	a)	When radio waves pass through various substances, the absorption of wave energy by these substances is observed. It is absent (a) In airless space (b) In non-ionized air (c) In solid dielectrics, semiconductors and conductors (d) Answers (a) and (b) are correct (e) No correct answer	OPK-1
7.	b)	When radio waves pass through various substances, the absorption of wave energy by these substances is observed. It is very small (a) In airless space; (b) In non-ionized air; (c) In solid dielectrics, semiconductors and conductors; (d) Answers (a) and (b) are correct; (e) There is no correct answer.	OPK-1
8.	c)	When radio waves pass through various substances, the absorption of wave energy by these substances is observed. It is significantly (a) In airless space; (b) In non-ionized air; (c) In solid dielectrics, semiconductors and conductors; (d) Answers (a) and (b) are correct; (e) There is no correct answer.	OPK-1
9.	d)	In horizontal polarization, the vector of the electric field strength of the wave: (a) is parallel to the interface (b) Perpendicular to the interface (c) lies in the plane of fall (d) Perpendicular to the plane of incidence	OPK-1
10.	d)	$D(\vec{r}, t) = \varepsilon_0 \varepsilon(t) E(\vec{r}, t)$. What kind of environment is it? (a) Nonlinear, non-stationary, heterogeneous (b) Linear, non-stationary, homogeneous (c) Linear, stationary, heterogeneous (d) Linear, stationary, homogeneous	OPK-1
11.		Indicate the physical characteristics that describe the electromagnetic field and their dimensions.	OPK-1

12.		Specify the physical parameters that describe the medium of electromagnetic wave propagation and their dimensionality.	OPK-1
13.		The physical meaning of Maxwell's equations in differential form.	OPK-1
14.		The Physical Meaning of Maxwell's Equations in Integral Form	OPK-1
15.		The principle of permutation duality of Maxwell's equations.	OPK-1
16.		Interference of electromagnetic waves.	OPK-1
17.		Diffraction of electromagnetic waves.	OPK-1
18.		Fresnel zones.	OPK-1
19.		Determine the divergence of a vector field that has a single component in the Cartesian coordinate system $E_x = 20 \sin\left(\frac{\pi}{x}\right) \left[\frac{B}{M}\right]$	OPK-1
20.		Determine the rotor of a vector field that has a single component in the Cartesian coordinate system $E_x = 20 \sin\left(\frac{\pi}{x}\right) \left[\frac{B}{M}\right]$	OPK-1
21.		Lorenz lemma.	OPK-1
22.		Write down the equation of a flat electromagnetic medium and explain its components.	OPK-1
23.		Classify electromagnetic waves.	OPK-1
24.		Classify media by conductivity.	OPK-1
25.		Write down the equation for the energy balance of the electromagnetic field and explain its components.	OPK-1
26.	b)	In the far zone, the field of the elementary electric emitter is... a) Inhomogeneous spherical T-wave	OPK-2

		b) Uniform spherical T wave c) Inhomogeneous cylindrical T wave (d) Uniform cylindrical T wave	
27.	b)	Electromagnetic wave without longitudinal components It's called... (a) E-wave b) T-wave (c) H-wave (d) EN wave	OPK-2
28.	d)	Tangent component to the surface of the magnetic field intensity vector at the interface of media (in the absence of magnetic currents and charges) (a) tolerates a gap numerically equal to the surface current density (b) Suffers a gap numerically equal to the density of the surface charge (c) Tolerates a gap numerically equal to the bias current density (d) Continuous	OPK-2
29.	c)	What process does the term $\int_V \frac{\vec{j}^2}{\sigma} dv$ in the energy balance equation $\int_V \frac{\vec{j} \vec{E}^{cm}}{\sigma} dv = \int_V (\vec{H} \frac{\partial \vec{B}}{\partial t} + \vec{E} \frac{\partial \vec{D}}{\partial t}) dv + \int_V \frac{\vec{j}^2}{\sigma} dv + \oint_S [\vec{E}, \vec{H}] d\vec{s}$ correspond to? a) absorption of energy from the external environment (b) Emission of energy to the external environment c) energy losses in the system due to heating of the medium (d) Change in the energy reserve in the system	OPK-2
30.	a)	Helmholtz's equation... a) $\nabla^2 \vec{A} + k^2 \vec{A} = -\vec{j}^{cm}$ b) $\nabla^2 \vec{A} - \epsilon_a \mu_a \frac{\partial^2 \vec{A}}{\partial t^2} - \sigma \mu_a \frac{\partial \vec{A}}{\partial t} = -\vec{j}^{cm}$ c) $\nabla^2 \vec{A} + k^2 \vec{A} = \vec{j}^{cm}$	OPK-2

		d) $\nabla^2 \vec{A} - \epsilon_a \mu_a \frac{\partial^2 \vec{A}}{\partial t^2} - \sigma \mu_a \frac{\partial \vec{A}}{\partial t} = \vec{j}^{cm}$	
31.	a)	Equation of Front of Plane Wave Propagating Upwards y a) $\cos(\omega t - ky) = const$ b) $\cos(\omega t + ky) = const$ c) $\cos(\omega t - kr) = const$ d) $\cos(\omega t + kr) = const$	OPK-2
32.	b)	The magnetic field energy in the system is defined as... a) $\int_V \vec{E} \frac{\partial \vec{D}}{\partial t} dv$ b) $\int_V \vec{H} \frac{\partial \vec{B}}{\partial t} dv$ c) $\int_V \frac{\partial \vec{E}^2}{\partial t} dv$ d) $\int_V \frac{\partial \vec{H}^2}{\partial t} dv$	OPK-2
33.	b)	A wave spreading over infinity must be... (a) Longitudinal (b) Transverse (c) Standing (d) Flat	OPK-2
34.	b)	For a non-ideal dielectric, the ratio is true... a) $\frac{\sigma}{\omega \epsilon_a} \gg 1$ b) $\frac{\sigma}{\omega \epsilon_a} \ll 1$	OPK-2

		c) $\frac{\sigma}{\omega \epsilon_a} = 0$ d) $\frac{\sigma}{\omega \epsilon_a} \rightarrow \infty$	
35.	a)	The equation of the wave $\vec{E}(\vec{r}, t) = \vec{E}_0 \cos(\omega t - kt + \varphi_0)$, where $\vec{E}_0 = f(y)$. It is ... (a) Uniform divergent spherical wave (b) Inhomogeneous divergent spherical wave (c) Uniform plane wave moving in the direction of increasing x (d) Uniform plane wave moving in the decreasing direction x (e) Inhomogeneous plane wave moving in a decreasing direction x (f) Inhomogeneous plane wave moving in the direction of increasing x	OPK-2
36.		Formulate the diffraction problem on the cylinder.	OPK-2
37.		To conduct a study of the diffraction of an electromagnetic wave on a cylinder.	OPK-2
38.		To conduct a study in the program "Mathcad" of the characteristics of the directivity of an elementary electric emitter.	OPK-2
39.		To conduct a study in the program "Mathcad" of the characteristics of the directivity of an elementary magnetic emitter.	OPK-2
40.		The main type of oscillations in a rectangular waveguide.	OPK-2
41.		The main type of oscillations in a circular waveguide.	OPK-2
42.		To give a classification of guiding systems.	OPK-2
43.		Propagation conditions in the waveguide of only the basic type of oscillations.	OPK-2
44.		To conduct a study of diffraction on a round hole in the "Mathcad" program.	OPK-2
45.		To conduct a study of half-plane diffraction in the "Mathcad" program.	OPK-2

46.		The main type of oscillation is in a rectangular resonator.	OPK-2
47.		To classify the types of oscillations in guiding systems.	OPK-2
48.		Methods of excitation of electromagnetic waves in a rectangular waveguide.	OPK-2
49.		Determine the depth of penetration of an electromagnetic wave into dry soil at a frequency of 2 MHz.	OPK-2
50.		Determine the frequency at which dry soil can be considered a conductor.	OPK-2

Description of the grading scale

Within the framework of the rating system, 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 the 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 basics of the theory of electromagnetic fields and waves.

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 basics of the theory of electromagnetic fields and waves.

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 basics of the theory of electromagnetic fields and waves.

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 basics of the theory of electromagnetic fields and waves, makes gross mistakes that he cannot correct even with the help of leading questions from the teacher.