Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution
of Higher Education
"St. Petersburg State University of Veterinary Medicine"

APPROVED BY
Vice-Rector for Educational
Work and Youth Policy
Sukhinin A.A.
April 10, 2026

Department of veterinary hygiene and radiobiology

EDUCATIONAL WORK PROGRAM

for the discipline

«VETERINARY RADIOBIOLOGY»

The level of higher education
SPECIALIST COURSE

Specialty 36.05.01 Veterinary Medicine
Profile: «General clinical veterinary medicine»
Full-time education
Education starts in 2026

Reviewed and adopted
at the meeting of the department
on March 19, 2026
Protocol No. 8

Head of the Department
of veterinary hygiene and radiobiology,
Doctor of Veterinary Medicine, Associate Professor
Belopolsky A.E.

Saint Petersburg
2026

1. AIMS AND OBJECTIVES OF THE DISCIPLINE «VETERINARY RADIOBIOLOGY»

The purpose of the discipline is to give students theoretical knowledge, master methods and acquire practical skills necessary for the organization and conduct of radiological control in the field of agro-industrial complex.

Tasks:

a) the general educational task is to familiarize students in-depth with the physical foundations and methods of veterinary radiobiology, the laws of the phenomenon of radioactivity and the properties of radioactive radiation, radiation damage to farm animals, pathogenesis, diagnosis and treatment of radiation sickness.

b) the applied task highlights issues related to modern methods of radiation control of agricultural products to determine the levels of its radioactive contamination, the main patterns of migration of radionuclides in natural and agricultural ecosystems, their toxicological characteristics, the peculiarities of accumulation and excretion of waste products and methods of using livestock products and animals in radiation damage in different types of farm animals and creates a conceptual framework for the implementation of interdisciplinary structural and logical connections in order to develop medical thinking skills.

c) a special task is to familiarize students with modern trends and methodological approaches for predicting pollution of agricultural products and dose loads on the population in conditions of radioactive contamination to solve problems of animal husbandry and veterinary medicine, as well as existing achievements in this field.

2. THE LIST OF THE PLANNED RESULTS OF THE DISCIPLINE (MODULE), CORRELATED WITH THE PLANNED RESULTS OF THE REALISED EDUCATIONAL PROGRAM

As a result of mastering the discipline, the student prepares for the following types of activities, in accordance with the educational standard of the Federal State Educational Standard for Higher Education 36.05.01 "Veterinary Medicine".

Area of professional activity:

13 Agriculture

The student's competencies formed as a result of mastering the discipline.

The study of the discipline "**Veterinary radiobiology**" should form the following competencies:

A) Universal competencies:

UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 **To know:** the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

UC-8 ID-2 **To be able to:** identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

UC-8 ID-3 **To possess skills of:** the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergen-

cy situations; skills in maintaining safe living conditions, including those based on digital technologies.

GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.

GPC-2 ID-1 **To know:** ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.

GPC-2 ID-2 **To be able to:** use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors

GPC-2 ID-3 **To possess skills of:** the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.

GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

GPC-4 ID-1 **To know:** the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

GPC-4 ID-2 **To be able to:** apply modern technologies and research methods in professional activities, interpret the results obtained.

GPC-4 ID-3 **To possess skills of:** the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF MPEP

The discipline **B1. O. 29 "Veterinary radiobiology"** is a discipline of Block 1 of the mandatory part of the federal state educational standard of higher education in the specialty 36.05.01 "Veterinary Medicine" (specialty level).

Mastered: full-time-in the 5th semester; part – time-in the 6th semester; part-time in the 4th year.

When studying the discipline "Veterinary Radiobiology", the knowledge and skills acquired by students in the process of mastering the disciplines of civil defense and emergency response, radiobiology, chemistry, physics, biochemistry, physiology, pathophysiology, toxicology are used.

4. SCOPE OF THE DISCIPLINE "VETERINARY RADIOBIOLOGY" FOR FULL-TIME TRAINING

Type of academic work	Hours	Semesters
		5
Classroom sessions (total)	**68**	**68**
Including:		
Lectures, including interactive forms	34	34
Practical lessons (PL), including interactive forms, including:	34	34
Practical training (PT)	8	8
Self-study (total)	**49**	**49**
Control	**27**	**27**
Type of intermediate certification (test, exam)	**exam**	**exam**
Total labor intensity hours / credits	**144/4**	**144/4**

5. CONTENT OF THE DISCIPLINE "VETERINARY RADIOBIOLOGY" FOR FULL-TIME EDUCATION

#	Name	Competencies being formed	Semester	Types of academic work, including independent work of students and labor intensity (in hours)			
				Lectures	Practical lessons	Practical training	Self-study
1.	Subject, objectives and history of radiobiology development	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 **To know:** the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.	5	2	-		4
2.	Sources of ionizing radiation and fundamentals of radiation safety.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-2 **To be able to:** identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.	5	-	2		2
3.	Fundamentals of nuclear physics.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-3 **To possess skills of:** the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-3 **To possess skills of:** the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	2	-		4

4.	Interaction of ionizing radiation with matter.	**UK-8: Is able to create and maintain safe living conditions, including cases of emergency situations.** UC-8 ID-2 **To be able to:** identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. **GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.** GPC-2 ID-1 **To know:** ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-2 **To be able to:** use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors GPC-2 ID-3 **To possess skills of:** the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5	2-4	-		4
5.	Dosimetry of ionizing radiation, calculation of doses and radiation dose rates.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	1	1	2

6.	Final lesson on converting non-system units of ionizing radiation doses and dose rates into a system of international units.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.	5	-	-	2	2
7.	Dosimetry of ionizing radiation.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	2	-		4
8.	Determination of radiation doses by calculation method under external radiation exposure.	UC-8: Is able to create and maintain safe living conditions, including cases of emergen-cy situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situ-ations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-4. Is able to use methods to solve problems, using modern equipment for the de-velopment of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in profes-sional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementa-tion of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	1	1	2

9.	Natural radiation background and artificial sources of ionizing radiation.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.	5	2-4	-		4
10.	Types of dosimetry. Methods, design and operation of dosimetric devices.	GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	2		2

11.	Colloquium on the section "Dosimetry of ionizing radiation"	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	2		2
12.	Radiometry of ionizing radiation.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	2	-		2

13.	Radiometry. Radioactivity and its measurement units.	GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	2		2
14.	Final lesson on calculating the activity of radioisotopes.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.	5	-	2		2
15.	Toxicology of radioactive substances.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors	5	2	-		2

16.	Calculation of radiation doses under internal radiation exposure, specific radioactivity of veterinary surveillance facilities in the external environment.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.	5	-	1	1	2
17.	Biological effect of ionizing radiation and factors affecting the degree of radiation damage.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.	5	2	-		2
18.	Acute radiation sickness of animals.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5	2-2	-		2

19.	Chronic radiation sickness. Radiation burns and long-term consequences of radiation exposure.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5	2-2	-		2
20.	Fundamentals of agricultural radioecology.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.	5	2	-		2
21.	Colloquium on the section "Radiation sickness"	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5-2	-	2		2

22.	Purpose, classification, and operation of radiometers.	GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5	-	2		2
23.	Radiometric devices and their design characteristics.	GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5-2	-	2	2	2
24	Colloquium on the section "Radiometry"	GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	5-2	-	2		2
25	Methods for determining the specific radioactivity of objects of veterinary supervision and the external environment.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.	5-2	-	2		2

26	Features of the course of radiation damage depending on the amount of radiation dose.	GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5-2	-	2		2
27	Migration, forecasting and rationing of the most dangerous radionuclides and features of their transition along feed chains.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5	2-2	-		2
28	Organization and management of animal husbandry in conditions of radioactive contamination.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5	2-2	-		2
29	Forecasting the content of radionuclides in agricultural products	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. UK-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.	5-1	-	1	1	2

30	Measures to reduce the content of radionuclides in feed and livestock products in conditions of radioactive contamination of the environment.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors	5	2-2	-		2
31	Radiation expertise and veterinary and environmental monitoring of objects of veterinary and sanitary supervision.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.	5	2-2	-		2
32	Fundamentals of radiation safety when working with radioactive substances and ionizing radiation.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.	5	2-2	-		2

33	Use of ionizing radiation and radioactive isotopes in crop production, animal husbandry and veterinary medicine.	UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations. UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors	5	2-2	-		2
			TOTAL	34	26	8	76

6. LIST OF EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR INDEPENDENT WORK OF STUDENTS

6.1. Methodical instructions For independent works

1. Guidelines for completing tests on the subject "Veterinary Radiobiology" / N.Yu. Yugatova, A.V. Tsyganov, N.P. Ponomarenko, V.N. Gaponova; SPbGAVM. - St. Petersburg: Publishing house of SPbGAVM, 2018. - 24 p. - URLhttps://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9MjM2JnBzPTI1 (date of access 03.03.2026). – Access mode: for authorized users of the SPbGUVM Electronic Library.

6.2. Literature For independent works

1.Usha, B.V. Veterinary supervision of animals and livestock products in emergency situations: [recommended by UMO]: a teaching aid / B.V. Usha, I.G. Seregin. - St. Petersburg: Quadro, 2013. - 512 p.

2. Zlobin, V.S. Radiobiological foundations of radiation hygiene and veterinary-sanitary examination / V.S. Zlobin, N.P. Lysenko; edited by V.S. Zlobin. - St. Petersburg: no. i., 2008. - 359 p. : ill.

3. Yarmonenko, S.P. Radiobiology of humans and animals: textbook / S.P. Yarmonenko, A.A. Vainson; edited by S.P. Yarmonenko. - Moscow: Higher. school, 2004. - 549 p. : ill. - Text (visual) : direct.

4. Radiobiology: textbook / A. D. Belov, V. A. Kirshin, N. P. Lysenko [et al.]; edited by A. D. Belov. - Moscow: Kolos, 1999. - 384 p.: ill. - (Textbooks and teaching aids for students of higher educational institutions). - Text (visual): direct.

5. Grigoriev, Yu.G. **Space** radiobiology / Yu.G. Grigoriev. - Moscow: Energoizdat, 1982. - 175 p.: ill . - Text (visual): direct.

6. Kirshin, V.A. Veterinary radiobiology / V.A. Kirshin, A.D. Belov, V.A. Burdakov. - Moscow: Agropromizdat, 1986. - 175 p.: ill. - Text (visual): direct

7. LIST OF BASIC AND ADDITIONAL REFERENCES REQUIRED FOR MASTERING THE DISCIPLINE

A) main literature:

1. A Brief Course in Veterinary Radiobiology: A Textbook / compiled by: E. I. Troshin [et al.]; Ministry of Agriculture of the Russian Federation, St. Petersburg State Academy of Veterinary Medicine. - St. Petersburg: Publishing House of St. Petersburg State Academy of Veterinary Medicine, 2019. - 184 p. - URL: https://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9Mjc2JnBzPTE4NA (date of access: 03.03.2026). – Access mode: for authorized users of the SPbGUVM Electronic Library.

b) additional literature:

1. Workshop By radiobiology : add. MSH RF / N.P. Lysenko, V.V. Pak, L.V. Rogozhina [et al.]. - Moscow: KolosS, 2008. - 399 p.: ill. - Text (visual): direct-natural.

2. Fundamentals of Practical Radiobiology: A Textbook for Independent Work students of veterinary universities and faculties / E.I. Troshin, R.O. Vasiliev, N.Yu. Yugatova, A.V. Tsyganov; Ministry of Agriculture of the Russian Federation, SPbGAVM. - St. Petersburg: Publishing house SPbGAVM, 2018. - 250 p. – URL: https://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9MjYxJnBzPTI1Mg== (date of access: 03.03.2026). – Access mode: for authorized users of the SPbGUVM Electronic Library.

3. Yugatova, N.Yu. Radiobiology. Collection of practical works : textbook / N. Yu. Yugatova, R. O. Vasilyev, E. I. Troshin ; Ministry of Agriculture of the Russian Federation, St. Petersburg State University of Veterinary Medicine. - Saint Petersburg : Publishing House of SPbGUVM, 2021. - 238 p. – URL: https://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9ODk0JnBzPTI0MA== (date of access: 03.03.2026). - Access mode: for authorization. EB

8. SCROLL RESOURCES INFORMATION AND TELECOMMUNICATION NETWORK "INTERNET" NECESSARY FOR MASTERING THE DISCIPLINE

To prepare for practical classes and complete independent work, students can use the following Internet resources:

https://meduniver.com – Medical information site. https://www.rosatom.ru/ - informational website about atomic industries http://www.niirg.ru - information site of the Ramzaev Research Institute of Geology and Radiation

Electronic library systems:

1. EBS "SPbGUVM" https://search.spbguvm.informsystema.ru/
2. EBS "Consultant student"
3. Reference and legal system "ConsultantPlus"
4. University informational system "RUSSIA"
5. Full text base data POLPRED.COM
6. Scientific electronic library ELIBRARY.RU
7. Russian scientific Net
8. Electronic library system IQlib
9. ProQuest AGRICULTURAL AND ENVIRONMENTAL SCIENCE Full-text interdisciplinary database on agricultural and environmental sciences DATABASE
10. Electronic books from Prospect Publishing House Sciences" http://prospektna uki.ru/ebooks/
11. Collection "Agriculture. Veterinary science" published by "Quadro" http://www.iprbookshop.ru/586.html

9. GUIDELINES FOR STUDENTS ON MASTERING THE DISCIPLINE "VETERINARY RADIOBIOLOGY "

Methodological recommendations for students are a set of recommendations and explanations that allow the student to optimally organize the process of studying this discipline.
The content of methodological recommendations, as a rule, may include:

- Tips for planning and organizing the time required to study the discipline. Description of the sequence of actions of the student, or "scenario of studying the discipline".

The morning time is the most productive for academic work (from 8-14 hours), followed by the afternoon time (from 16-19 hours) and the evening time (from 20-24 hours). The most difficult material is recommended to be studied at the beginning of each time interval after rest. After 1.5 hours of work, you need a break (10-15 minutes), after 4 hours of work, the break should be 1 hour. Mastering the technique of intellectual labor is part of the scientific organization of labor. Normally, a student should spend about 10 hours a day studying (6 hours at the university, 4 hours at home).

- Recommendations for working on the lecture material

When preparing for a lecture, the student is recommended to:

1) view the recordings of the previous lecture and restore the previously studied material in memory;

2) it is also useful to review the upcoming material of a future lecture;

3) if an independent study of individual fragments of the topic of the previous lecture is set, then it should be completed without delay;

4) psychologically tune in to the lecture.

This work includes two main stages: taking notes of lectures and subsequent work on the lecture material.

Taking notes means making a summary, i.e. a brief written statement of the content of something (an oral presentation – a speech, lecture, report, etc., or a written source – a document, article, book, etc.).

The method of work when taking notes on oral presentations differs significantly from the method of work when taking notes on written sources.

By taking notes of written sources, the student has the opportunity to repeatedly read the desired passage of the text, reflect on it, highlight the main thoughts of the author, briefly formulate them, and then write them down. If necessary, they can also note their attitude to this point of view. While listening to the lecture, the student should postpone most of the complex of the above-mentioned works to another time, trying to use every minute to record the lecture, and not to comprehend it – there is no time left for this. Therefore, when taking notes on a lecture, it is recommended to separate the fields for subsequent entries on each page in addition to the summary.

After recording a lecture or making a summary of it, you should not leave work on the lecture material before preparing for the test. It is necessary to do as early as possible the work that accompanies taking notes on written sources and which was not possible to do during the recording of the lecture - read your notes, decipher individual abbreviations, analyze the text, establish logical connections between its elements, in some cases show them graphically, highlight the main thoughts, mark questions that require additional processing, in particular, teacher consultations.

When working on the text of the lecture, the student should pay special attention to the problematic issues raised by the teacher during the lecture, as well as to his tasks and recommendations.

For each lecture, practical lesson, and laboratory work, the number, topic, list of issues covered, length in hours, and references to recommended literature are provided. For classes held in interactive forms, you should indicate their organizational form: computer simulation, business or role-playing game, analysis of a specific situation, etc.

- Recommendations for preparing for practical classes.

Practical (seminar) classes are an important part of students ' professional training. The main purpose of conducting practical (seminar) classes is to form students ' analytical, creative thinking by acquiring practical skills. Practical classes are also held to deepen and consolidate the knowledge gained during lectures and in the process of independent work on regulatory doc-

uments, educational and scientific literature. When preparing for a practical lesson for students, it is necessary to study or repeat theoretical material on a given topic.

When preparing for a practical lesson, the student is recommended to follow the following algorithm:

1) get acquainted with the plan of the upcoming lesson;

2) study the literature sources that were recommended and read the introductory notes to the relevant sections.

Methodological guidelines for practical (seminar) classes in the discipline, along with the work program and schedule of the educational process, refer to methodological documents that determine the level of organization and quality of the educational process.

The content of practical (seminar) classes is recorded in the working curricula of disciplines in the sections "List of topics of practical (seminar) classes".

Tasks are the most important component of any form of practical training. The basis in the task is an example that is understood from the point of view of the theory developed in the lecture. As a rule, the main attention is paid to the formation of specific skills, which determines the content of students ' activities - problem solving, laboratory work, clarification of categories and concepts of science that are a prerequisite for correct thinking and speech.

Practical (seminar) classes perform the following tasks:

- encourage regular study of the recommended literature, as well as attentive attitude to the lecture course;
- consolidate the knowledge gained in the course of lecture training and independent work on literature;
- expand the scope of professionally relevant knowledge, skills and abilities;
- allow you to check the correctness of previously acquired knowledge.
- instill skills of independent thinking, oral presentation;
- promote free use of terminology;
- provide the teacher with the opportunity to systematically monitor the level of independent work of students.

Methodological guidelines for practical (seminar) classes in the discipline should be focused on modern business conditions, current regulatory documents, advanced technologies, the latest achievements of science, technology and practice, modern ideas about certain phenomena, the reality being studied.

* Recommendations for working with literature.

Working with literature is an important stage of a student's independent work on mastering the subject, which contributes not only to consolidating knowledge, but also to expanding their horizons, mental abilities, memory, the ability to think, express and confirm their hypotheses and ideas. In addition, research skills are developed that are necessary for further professional activities.

When starting to study the literature on the topic, it is necessary to make notes, extracts, notes. It is mandatory to take notes on the works of theorists that allow us to understand the theoretical basis of the study. Otherwise, you can limit yourself to extracts from the studied sources. All extracts and citations must have an exact "return address" (author, title of the work, year of publication, page, etc.). It is advisable to write an abbreviated title of the question to which the extract or quote relates. In addition, it is necessary to learn how to immediately make a file of special literature and publications of sources, both proposed by the teacher and identified independently, as well as refer to bibliographic reference books, annals of journal articles, book chronicles, and abstract journals. At the same time, write publications of sources (articles, book titles, etc.) on separate cards, which must be filled in according to the rules of bibliographic description (last name, initials of the author, title of the work. Place of publication, publisher, year of publication, number of pages, and for journal articles – the name of the journal, year of publication, page numbers). On each card, it is advisable to record the idea of the author of the book or a fact from this book only on one specific issue. If the work, even in the same paragraph or

phrase, contains other judgments or facts on another issue, then they should be written out on a separate card. The presentation should be concise, accurate, and free of subjective evaluations. On the back of the card, you can make your own notes about this book or article, its content, structure, what sources it is written in, and so on.

* Explanations about working with control and test materials for the course, recommendations for completing homework.

Testing allows you to determine whether the actual behavior of the program corresponds to the expected one by performing a specially selected set of tests. A test is the fulfillment of certain conditions and actions necessary to verify the operation of the function under test or part of it. Each question in the discipline must be answered correctly by selecting one option.

10. EDUCATIONAL WORK

As part of the implementation of the discipline, educational work is carried out to form a modern scientific worldview and a system of basic values, to form and develop spiritual and moral, civil and patriotic values, a system of aesthetic and ethical knowledge and values, attitudes of tolerant consciousness in society, to form students ' needs for work as the first vital necessity, the highest value and the main success in life, to realize the social significance of your future profession.

11. LIST OF INFORMATION TECHNOLOGIES USED IN THE IMPLEMENTATION OF THE EDUCATIONAL PROCESS

11.1. In the educational process of the discipline, the use of information technologies is provided:

✓ conducting practical classes using multimedia;

✓ interactive technologies (conducting dialogues, collective discussion of various approaches to solving a particular educational and professional task);

✓ interaction with students via e-mail;

✓ joint work in the Electronic information and Educational environment of St. Petersburg State University of Internal Affairs: https://spbguvm.ru/academy/eios/

11.2. Software

List of licensed and freely distributed software, including those produced in Russia

Non /	a Name of technical and computer training tools recommended by sections and topics	License
1	MS PowerPoint	67580828
2	LibreOffice	free software
3	OS Alt Education 8	free SOFTWARE
4	ABIS "MARK-SQL"	02102014155
5	MS Windows 10	67580828
6	System ConsultantPlus	503 / CL
7	Android OS	free software

12. MATERIAL AND TECHNICAL BASE NECESSARY FOR THE IMPLEMENTATION OF THE EDUCATIONAL PROCESS IN THE DISCIPLINE

Name of the discipline (module), practices in accordance with the curriculum	**Name of special rooms and rooms for independent work**	**Equipment of special rooms and rooms for independent work**
Veterinary radiobiology	015 (196084, Saint Petersburg, Moskovsky Prospekt, 99) Classroom for conducting seminar-type	Specialized furniture: desks, chairs, stools, blackboard. Technical training facilities: mul-

	classes, group and individual consultations, current monitoring and intermediate certification.	timedia projector, screen, computer. Visual aids and training materials: specialized stands for the discipline program, devices.
	011 (196084, Saint Petersburg, Moskovsky Prospekt, 99) Training room for conducting seminar-type classes, group and individual consultations, current control and intermediate certification	Specialized furniture: tables, chairs, whiteboard, visual visual aids Technical training tools: projector, screen, computer with Internet connection"and access to the electronic information and educational environment
	016 (99 Moskovsky Prospekt, Saint Petersburg, 196084). Training room for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	Specialized furniture: desks, chairs, stools, blackboard. Technical training facilities: computer, TV. Visual aids and training materials:. specialized stands for the discipline program, devices.
	017 (99 Moskovsky Prospekt, Saint Petersburg, 196084). Training room for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	Specialized furniture: desks, chairs, stools, blackboard. Technical training facilities: multimedia projector, screen, computer. Visual aids and training materials: specialized stands for the discipline program, devices.
	206 Large reading room (5 Chernigovskaya St., Saint Petersburg, 196084) Room for independent work.	Specialized furniture: tables, chairs Technical training facilities: computers with Internet connection and access to the electronic information and educational environment.
	214 Small Reading Room (5 Chernigovskaya St., Saint Petersburg, 196084) Room for independent work.	Specialized furniture: tables, chairs Technical training facilities: computers with Internet connection and access to the electronic information and educational environment
	324 Department of Information Technologies (5 Chernigovskaya St., 196084, Saint Petersburg) Storage and preventive maintenance of educational equipment.	Specialized furniture: tables, chairs, special equipment, materials and spare parts for preventive maintenance of technical training equipment.
	Box No. 3 Carpentry workshop (5 Chernigovskaya St., Saint Petersburg, 196084)	Specialized furniture: tables, chairs, special equipment, materials for preventive maintenance of

	A room for storage and preventive maintenance of educational equipment.	furniture.

Developers:

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Candidate of Veterinary Sciences **N. Yu. Yugatova**

Associate Professor of the Department of veterinary hygiene and radiobiology
Candidate of Biological Sciences **R. O. Vasilev**

Annex 1

Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution
of Higher Education
«Saint Petersburg State University of Veterinary Medicine

Department of veterinary hygiene and radiobiology

FUND OF ASSESMENT TOOLS
for the discipline
"VETERINARY RADIOBIOLOGY "
Level of higher education
SPECIALIST COURSE

Specialty 36.05.01 Veterinary Medicine
Profile: «General clinical veterinary medicine»
Full-time education

Education starts in 2026

Saint Petersburg
2026

1. PASSPORT OF THE APPRAISAL FUND

Table 1

#	Formed competencies	Controlled sections (topics) of the discipline	Assessment tool
1.	**UC-8:** Is able to create and maintain safe living conditions, including cases of emergency situations. **UC-8 ID-1** To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services. **UC-8 ID-2** To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations. **UC-8 ID-3** To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies. **GPC-2.** Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body. **GPC-2 ID-1** To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body. **GPC-2 ID-2** To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors	Section 1. Physical bases of radiobiology.	Colloquium, abstract, tests
2.		Section 2. Dosimetry.	Colloquium, abstract, tests
3.		Section 3. Radiometry.	Colloquium, abstract, tests
4.		Section 4. Radiation injuries of animals.	Colloquium, Abstract
5.		Section 5. Biological effect of AI	Colloquium, abstract, tests
6.		Radel 6. Toxicology of RV	Colloquium, abstract, tests
7.		Section 7. Radioecology	Colloquium, abstract, tests
8.		Section 8. Forecasting and rationing of raw material input to crop and livestock production	Colloquium, abstract, tests

	GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well. **GPC-4.** Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. **GPC-4 ID-1** To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity. **GPC-4 ID-2** To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained. **GPC-4 ID-3** To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.		

2. SAMPLE LIST OF EVALUATION TOOLS

Table 2

#	Name of the valuation tool	Brief description of the valuation tool	Presentation of the valuation tool in the fund
1.	Colloquium	is a means of controlling the assimilation of educational material of a topic, section or sections of a discipline, organized as a training session in the form of a teacher's interview with training	questions on topics/sections of the discipline
2.	Test	A system of standardized tasks that allows you to automate the procedure for measuring the level of knowledge and skills of the student	Fund of test tasks
3.	Abstract	is a product of independent work of the student, which is a summary in writing of the results of theoretical analysis of a certain scientific(educational and research) topic, where the author reveals the essence of the problem under study, gives various points of view, as well as his own views on it	Topics of research papers

3. INDICATORS AND CRITERIA FOR ASSESSING COMPETENCIES AT VARIOUS STAGES OF THEIR FORMATION, DESCRIPTION OF ASSESSMENT SCALES

Table 3

Planned results of competence	The level of development				Assessment tool
	Unsatisfactory	Satisfactory	Good	Excellent	
Is able to create and maintain safe living conditions, including cases of emergency situations **(UC-8).**					
UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.	The level of knowledge is below the minimum requirements, there were gross mistakes	The minimum acceptable level of knowledge, many minor errors have been made	The level of knowledge corresponds to the training program, several minor errors have been made	The level of knowledge corresponds to the training program, no errors have been made	Colloquium, tests, summary
UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations..	Basic skills were not demonstrated in solving standard tasks, and gross errors occurred	Basic skills have been demonstrated, typical problems have been solved with minor errors, all tasks have been completed, but not in full	All the basic skills have been demonstrated, all the main tasks have been solved with minor errors, all the tasks have been completed in full, but some with flaws	All basic skills have been demonstrated, all main tasks have been solved with some minor flaws, all tasks have been completed in full	Colloquium, tests, summary
UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies	When solving standard problems basic skills were not demonstrated, gross errors occurred	There is a minimum set of skills to solve standard tasks with some shortcomings	When solving standard problems basic skills were not demonstrated with some flaws	Skills were demonstrated in solving non-standard tasks without errors and flaws	Colloquium, tests, abstract

. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body **(GPC-2)**					
GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body..	The level of knowledge is below the minimum requirements, there were gross mistakes	The minimum acceptable level of knowledge, many minor errors have been made	The level of knowledge corresponds to the training program, several minor errors have been made	The level of knowledge corresponds to the training program, no errors have been made	Colloquium, tests, summary
GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors.	Basic skills were not demonstrated in solving standard tasks, and gross errors occurred	Basic skills have been demonstrated, typical problems have been solved with minor errors, all tasks have been completed, but not in full	All the basic skills have been demonstrated, all the main tasks have been solved with minor errors, all the tasks have been completed in full, but some with flaws	All basic skills have been demonstrated, all main tasks have been solved with some minor flaws, all tasks have been completed in full	Colloquium, tests, abstract
GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the	When solving standard problems basic skills were not demonstrated, gross errors occurred	There is a minimum set of skills to solve standard tasks with some shortcomings	When solving standard problems basic skills were not demonstrated with some flaws	Skills were demonstrated in solving non-standard tasks without errors and flaws	Colloquium, tests, abstract

laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.					
Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results. **(GPC-4.)**					
GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.	The level of knowledge is below the minimum requirements, there were gross mistakes	The minimum acceptable level of knowledge, many minor errors have been made	The level of knowledge corresponds to the training program, several minor errors have been made	The level of knowledge corresponds to the training program, no errors have been made	Colloquium, tests, abstract
GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.	Basic skills were not demonstrated in solving standard tasks, and gross errors occurred	Basic skills have been demonstrated, typical problems have been solved with minor errors, all tasks have been completed, but not in full	All the basic skills have been demonstrated, all the main tasks have been solved with minor errors, all the tasks have been completed in full, but some with flaws	All basic skills have been demonstrated, all main tasks have been solved with some minor flaws, all tasks have been completed in full	Colloquium, tests, abstract
GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.	When solving standard problems basic skills were not demonstrated, gross errors occurred	There is a minimum set of skills to solve standard tasks with some shortcomings	When solving standard problems basic skills were not demonstrated with some flaws	Skills were demonstrated in solving non-standard tasks without errors and flaws	Colloquium, tests, abstract

4. LIST OF CONTROL TASKS AND OTHER MATERIALS NECESSARY FOR ASSESSING KNOWLEDGE, SKILLS, ABILITIES AND EXPERIENCE OF ACTIVITIES

4.1. Typical tasks for the current control of academic progress

4.1.1. Questions for the Colloquium

Questions for assessing competence

UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

1. Radiobiology and veterinary radiobiology-definition, objectives, history and prospects of development.
2. The structure of the atom, elementary particles.
3. The phenomenon of radioactivity. Isotopes. Natural and artificial radioisotopes.
4. Types of ionizing radiation and their characteristics.
5. Radioactive decay and its types (alpha decay, beta electron decay, beta positron decay).
6. Interaction of gamma radiation with matter.
7. Nuclear reactions. Activation response and its practical significance.
8. The fission reaction of heavy nuclei and its use.
9 The reaction of light nuclear synthesis and its significance.
10. General regularities of movement of radioactive substances in the biosphere.
11. Subject and tasks of radiotoxicology.

UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

12. The effect of small doses of ionizing radiation on living organisms.
13. Intake and methods for predicting the intake of RV in agricultural plants and animals.
14. Veterinary and sanitary expertise of slaughter products of irradiated animals.
15. Radiometry, its tasks and goals.
16. The use of RV and ionizing radiation in biology, animal husbandry, medicine and veterinary medicine.

UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.

17. Principles of animal husbandry in the period of "iodine" danger.
18. The law of radioactive decay.
19. Organization of veterinary activities on the trail of a radioactive cloud.
20. Subject and tasks of radioecology of farm animals.
21. Radiometric studies and drawing up a conclusion.
22. Preparation and processing of samples for radiometry.
23. Procedure for sampling for radiometry.
24. Animal husbandry during the period of surface contamination and root intake of ditches.

Questions for assessing competence

GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal

body.

GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body

25. Mechanism of biological action of ionizing radiation.
26. Influence of ionizing radiation on hematopoietic organs and blood.
27. Factors affecting the degree of radiation damage to the body during internal exposure to radiation.
28. The effect of ionizing radiation on the digestive system.
29. The effect of ionizing radiation on the reproductive organs and offspring of animals.
30. The effect of ionizing radiation on the nervous system, endocrine glands, and sensory organs.
31. Influence of ionizing radiation on the cardiovascular system and respiratory organs.
32. The effect of ionizing radiation on various tissues (skin, connective tissue, bones, cartilage, muscles).

GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors

33. Natural and artificial sources of ionizing radiation and their impact on the animal body.
34. Natural radioactive background and its effect on the animal body.
35. The concept of ionizing radiation and its effect on various objects.
36. The concept of radiation doses and radiation dose rates, units of measurement.
37. Purpose and classification of dosimetric devices.
38. Maximum permissible doses of external and internal radiation to the population in peacetime
39. Metabolism and toxicology of strontium-90 and caesium-137.
40. Metabolism and toxicology of young fission products.
41. Accumulation and elimination of radionuclides from the body. Effective elimination half-life.

GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.

42. Classification of radiation injuries in animals.
43. Pathways of RV ingestion in animals.
44. Radiometric expertise of agricultural products and environmental objects.
45. Organization of animal husbandry in the territory polluted by RV.
46. Types of distribution of radionuclides in the body. The concept of a critical organ.
47. Acute radiation sickness of animals.
48. Chronic radiation sickness of animals. Features of the development and course of the disease.
49. Radiation burns of animals (etiology, pathogenesis, clinic, course and outcome, pre-

vention and treatment).

50. Prevention and treatment of radiation sickness.

51. Genetic effect of ionizing radiation.

52. Somatic effect of ionizing radiation (leukemias, tumors, cataracts of the lens of the eye, reduction of life expectancy).

53. Acute radiation sickness of horses.

54. Acute radiation sickness of K. R. S.

55. Acute radiation sickness of pigs.

56. Acute radiation sickness of sheep.

57. Acute radiation sickness of goats.

58. Acute radiation sickness of fur-bearing animals.

59. Acute radiation sickness of chickens.

60. Diagnosis and path picture of radiation sickness.

Questions for assessing competence

GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

61. Purpose, operating principle and device of the KID-2 dosimeter.

62. Purpose, operating principle and device of dosimeters DK-02, DP-24, ID-1.

63. Units of measurement of the equivalent radiation dose (basic, fractional, multiple).

64. Units of measurement of the absorbed radiation dose (basic, fractional, multiple).

65. Units of measurement of the exposure dose of radiation (basic, fractional, multiple).

GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.

66. The radioisotope activity is 1 Ci, 1 mcCi, and 5 mcCi; express this activity in Becquerels (Bc).

67. Procedure for determining radiation doses by calculation method under external radiation exposure.

68. Calculate the equivalent radiation dose if the absorbed dose from fast neurons is 5 rad.

69 Dosimetry, its tasks and goals.

70. Units of measurement of radiation dose rate (basic, fractional, multiple).

71. Radiometric expertise of agricultural products and environmental objects.

72. Relative biological efficiency of radiation and equivalent (biological) radiation dose.

73. Calculate the absorbed radiation dose in Gy if the dose measured in air is 1000 rubles.

74. Calculate the equivalent radiation dose in Sieverts (SV) if the exposure dose of gamma radiation is 300 rubles.

75. The level of radiation on the ground is 10 P/hour. Determine what absorbed radiation dose the animals will receive when they are in this area for 3 and 12 hours.

GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

76. The concept of specific radioactivity and stages of its determination.

77. Purpose, design and operation of radiometers.

78. Activity measurement units – the number of RVs (basic, fractional, and multiples).

79. Express methods for determining specific radioactivity.

80. Individual dosimetric control using condenser-type dosimeters. Principle of operation of the ionization chamber.

81. Methods of dosimetric control.

82. Calculate the maximum absorbed dose (rad) of internal alpha radiation that a professional can receive within one year.

83. Basic methods for determining radioactivity.

84. Gas-discharge and scintillation meters, device and principle of their operation.

4.1.2. Abstract topics

Topics of abstracts for competency assessment

UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.

GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.

GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.

GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors

GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.

GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.

GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

1. The effect of radiation on the sex glands, pregnancy, fetus and offspring.
2. Molecular aspects of the action of ionizing radiation at the cell level.

3. The effect of ionizing radiation on the blood and hematopoietic organs.
4. Features of radiation damage to plants.
5. History of radiobiology development.
6. Main types of ionizing radiation and their characteristics.
7. Natural sources of decay.
8. The main sources of radioactive contamination of the environment.
9. Biological effects of ionizing radiation.
10. Radiosensitivity of organisms.
11. Ecology of radiation pollution.
12. Metabolism and toxicology of the main fission products of uranium and the most dangerous radionuclides (I-131, Sr-90, Cs-137).
13. The peculiarity of animal husbandry in areas with different levels of radioactive contamination.
14. Radionuclide migration along biological chains.
15. Use of ionizing radiation and radioactive substances in agricultural production.
16. Radiation and hygienic expertise of objects of veterinary supervision and the external environment.
17. Dosimetry and assessment of the impact of radiation exposure on the environment.
18 Methods and instruments used to determine radiation doses and quantities of radioactive substances.
19. Interaction of ionizing radiation with matter and fundamentals of dosimetry.
20. Prevention of entry and accumulation of radioactive substances in agricultural products.
21. Keeping animals in case of radioactive contamination of the environment.
22. Long-term effects of radiation on animals.
23. Fundamentals of radiation safety and organization of work with ionizing radiation sources.
24. Radiation rationing and radiation safety
25. Radiation sickness of farm animals.
26. Radiation burns of farm animals.
27. Diagnostics, prevention and treatment of animals exposed to radiation.
28. Combined radioactive damage.

4.1.3. Tests

UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

CLOSED TYPE TASKS

Tasks of a combined type with the choice of one correct answer from the proposed options

Task 1.

Read the task and choose the correct answer.

What is the name given to the increase in the dose of ionizing radiation per unit of time during which this increase occurred?

1. Kerma;
2. Specific ionization;
3. Equivalent dose of ionizing radiation;
4. Dose rate of ionizing radiation;

Answer: 4

Task 2.

Read the task and choose the correct answer.

What is the name of the ratio of doses of different types of ionizing radiation absorbed by the body that cause the same biological effect?

1. Dose change factor;
2. Kerma;
3. Relative biological effectiveness;
4. Maximum permissible dose of radiation.

Answer: 3

Task 3.

Read the task and choose the correct answer.

According to the planetary model of the structure of the atom, the latter consists of a nucleus and an electron shell. What is the maximum number of electron levels an atom can have?

1.3;
2.5;
3.7;
4.8;
5. 9.

Answer: 3.

Task 4.

Read the task and choose the correct answer.

In what units of measurement is the absorbed dose of ionizing radiation calculated?

1. Coulomb per kilogram and Roentgen;
2. ber and sievert;
3. Gray and glad;
4. Curie and Becquerel.

Answer: 3.

Task 5.

Read the task and choose the correct answer.

In what units of measurement is the equivalent dose of ionizing radiation calculated?

1. Coulomb per kilogram and Roentgen;
2. ber and sievert;
3. Gray and glad;
4. Curie and Becquerel.

Answer: 2.

Closed-ended tasks to establish a sequence

Task 6.

Establish a chronological sequence of scientific discoveries in the field of physics and chemistry that became the impetus for the development of radiobiology.

1. V.K. Roentgen discovered X-rays;
2. I. Curie and F. Joliot-Curie artificial radioactivity;
3. A. Becquerel discovered natural radioactivity;
4. M. Skladowska-Curie and P. Curie discovered the radioactive properties of polonium and radium.

Answer: 1; 3; 4; 2.

Task 7.

Establish a chronological sequence of radiation accidents that occurred in different countries of the world.

1. Chernobyl nuclear power plant accident, USSR;
2. Accident at the Mayak production association, USSR;
3. Fukushima Daiichi nuclear power plant accident, Japan;
4. Three Mile Island Nuclear Power Plant Accident, USA

Answer: 2; 4; 1; 3.

Task 8.

Place the number of operating nuclear power plants in the world in ascending order as of January 1, 2024.

1. Russia;
2. USA;
3. France;
4. Great Britain.

Answer: 4; 1; 3; 2.

Task 9.

List the countries of the world in ascending order by the share of electrical energy generated by operating nuclear power plants as of January 1, 2024.

1. USA;
2. France;
3. Russia;
4. China;
5. India

Answer: 5; 3; 4; 2; 1.

Task 10.

Establish a chronological order of countries that created nuclear weapons.

1. USA;
2. USSR;
3. China;
4. India;
5. Pakistan.

Answer: 1; 2; 3; 4; 5.

Closed-ended tasks to establish compliance

UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

Task 11.

Establish a correspondence between the principles of radiation safety specified in SanPiN 2.6.1.2523-09 (NRB-99/2009) and their meaning: *(For each position given in the left column, select the corresponding position from the right column).*

The principle of ensuring radiation safety		**The importance of the principle of ensuring radiation safety**	
A	Standardization	1	Non-exceedance of permissible limits of individual radiation doses of

			citizens from all radiation sources
B	Justifications	2	Maintaining at the lowest possible and achievable level, taking into account economic and social factors individual radiation doses and the number of persons exposed when using any radiation source
IN	Optimizations	3	prohibition of all types of activities involving the use of radiation sources in which the benefit received by humans and society does not exceed the risk of possible harm caused by additional radiation
		4	The effective dose for personnel should not exceed during the period of work activity (50 years) - 1000 mSv, and for the population over a lifetime (70 years) - 70 mSv.

Write the selected numbers under the corresponding letters:

A	B	IN

Answer: A-1; B-3; B-2.

Task 12.

Establish a correspondence between ionizing and non-ionizing types of radiation: *(for each position given in the left column, select the corresponding positions from the right column).*

Types of radiation by ionization ability		**Type of radiation**	
A.	Non-ionizing radiation	1.	Gamma radiation
B.	Ionizing radiation	2.	Infrared radiation
		3.	X-ray radiation
		4.	Neutron radiation
		5.	Radio wave radiation
		6.	Alpha radiation

Write the selected numbers under the corresponding letters:

A	B

Answer: A-1;3;4;6. B-2;5.

Task 13.

The power of ionizing radiation is expressed in certain physical quantities. Establish a correspondence between the types of power of the dose of ionizing radiation and the units of their measurement: *(for each position given in the left column, select the corresponding positions from the right column.*

Types of ionizing radiation dose rate		**Units of measurement (SI and non-SI)**	
A.	Exposure dose rate	1.	Ampere per kilogram

B.	Absorbed Dose Rate	2.	Gray per hour
IN.	Equivalent dose rate	3.	Glad at the hour
		4.	X-ray per hour
		5.	Sievert per hour
		6.	Ber per hour

Write the selected numbers under the corresponding letters:

A	B	IN

Answer: A-1;4. B-2;3. C-5;6.

Task 14.

Establish a correspondence between the categories of irradiated persons and the personnel and population of Russia in accordance with SanPiN 2.6.1.2523-09 (NRB-99/2009): *(for each position given in the left column, select the corresponding positions from the right column).*

Category of exposed persons		**Personnel and population included in the relevant categories**	
A.	Group A staff	1.	Personnel working in rooms adjacent to a source of ionizing radiation and/or within the sanitary protection zone.
B.	Group B staff	2.	Personnel temporarily or permanently working with a source of ionizing radiation
IN.	Group B	3.	Population of the country not included in other groups
G.	the entire population, including personnel outside the scope and conditions of their production activities	4.	The current version of SanPiN 2.6.1.2523-09 (NRB-99/2009) does not include

Write the selected numbers under the corresponding letters:

A	B	IN	G

Answer: A-2; B-1; B-4; D-3.

Task 15.

Establish a correspondence between the types of ionizing radiation that have an electric charge (charged) and do not have an electric charge (uncharged): *(for each position given in the left column, select the corresponding positions from the right column).*

Electric charge of ionizing radiation		**Types of ionizing radiation**	
A.	Charged (have a positive or negative electrical charge)	1.	Alpha radiation
B.	Uncharged (neutral electrical charge)	2.	Beta radiation
		3.	Gamma radiation
		4.	X-ray radiation
		5.	Proton radiation
		6.	Neutron radiation

Write the selected numbers under the corresponding letters:

A	B	IN	G

Answer: A-1;2;5. B-3;4;6.

UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.

OPEN TYPE ASSIGNMENT

Task 16.

Read the historical background and write a detailed, reasoned answer.

Historical background. While experimentally studying cathode rays, he noticed that evening that cardboard coated with barium platinocyanide, which was near the cathode-ray tube, began to glow in a dark room. Over the next few weeks, he studied all the basic properties of the newly discovered radiation. The first public announcement of his discovery at the Physical Institute of the University of Würzburg and the first article of the Würzburg Physical-Medical Society were published by him under the title "On a New Type of Rays". For this discovery, the scientist was awarded the first Nobel Prize in Physics in 1901. This discovery is considered to be the first "great" discovery that gave rise to radiobiology as a science.

Specify the name of the scientist who discovered the new type of radiation, what this type of radiation is called, and the year of discovery.

Answer: Wilhelm Conrad Roentgen, X-rays, 1895.

Task 17.

Read the historical background and write a detailed, reasoned answer.

Historical background. February 26, 1896 was cloudy in Paris, which meant that the experiment was postponed. Therefore, the scientist put away the mineral (double uranium sulfate), the photographic plate, and the copper Maltese cross for the time being, wrapping them in black cloth. On March 1, the sun shone brightly. Having pulled out the box with the photographic plates and developed them, the scientist was puzzled, since the plates were overexposed - an image of a patterned metal plate appeared on the photographic plate. Since no light fell on the plates, it could be concluded that the scientist encountered some other rays. It turned out that uranium salts themselves, without any external influence, emit invisible rays that overexposed the photographic plate and passed through the opaque layers. On March 2, the scientist reported his discovery. This discovery is considered the second “great” discovery, which gave rise to radiobiology as a science.

Please indicate the name of the scientist in question, what phenomenon did he discover and in what year?

Answer: Henri Antoine Becquerel, Natural Radioactivity, 1896.

Task 18.

Read the historical background and write a detailed, reasoned answer.

Historical background. From the scientist's diary: "I can say without exaggeration that this period was a heroic era in our life together for me and my husband... I often cooked some food right there so as not to interrupt the progress of a particularly important operation. Sometimes I stirred the boiling mass all day with an iron pin almost as long as I was tall. In the evening I would collapse from fatigue. But it was in this lousy shed that the best and happiest years of our lives were spent, entirely devoted to work." In one of the experiments, the scientists discovered a mysterious substance that was 400 times more radioactive than pure uranium. It sounds

simple, but try to imagine. The concentration of the element in uranium pitchblende is 4,000 times lower than the concentration of polonium. To isolate 0.1 grams of this element in 1902, the couple had to process 8 tons of uranium from the Joachimsthal ironworks, which were delivered to their barn free of charge with the assistance of the Austro-Hungarian government and the Vienna Academy of Sciences. The frail woman manually carried the ore into giant boilers and heated it in 20 kg portions. This discovery is considered the third "great" discovery, which gave rise to radiobiology as a science.

Please indicate the name of the scientists in question, what chemical elements they discovered and in what year?

Answer: Maria Sklodowska and Pierre Curie, radium and polonium, 1898.

Task 19.

Read the definitions and write a reasoned answer.

This science studies the effect of ionizing radiation on living objects, their communities and the biosphere as a whole. One of the sections of this science is the study of the effect of ionizing radiation and radioactive substances on the organism of farm animals, and the disclosure of the patterns of biological response to the effect of ionizing radiation and radioactive substances in order to master the methods of managing these responses is the subject of this section of this science.

Please indicate what science and what section of science we are talking about?

Answer: Radiobiology. Veterinary (agricultural) radiobiology.

Task 20.

Read the description of the physical phenomenon and answer the question.

This type of ionizing radiation belongs to the group of electromagnetic (photon, wave) radiation. This type of ionizing radiation has an extranuclear origin and is formed in two main ways: 1) when an electron moves from a layer farther from the nucleus of an atom to a closer one; 2) when charged particles and quanta are slowed down in the electron shell of an atom. This type of ionizing radiation is used, among other things, in veterinary science and medicine in diagnostic, therapeutic and experimental studies using generating sources of ionizing radiation.

Specify what type of ionizing radiation we are talking about? Note the classification of this type of ionizing radiation by the mechanism of formation.

Answer: X-rays. According to the mechanism of formation, X-rays are classified as bremsstrahlung and characteristic.

GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.

GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.

CLOSED TYPE TASKS

Tasks of a combined type with the choice of one correct answer from the proposed options

Task 1.

Read the text and choose the correct answer.

The science that studies the ways in which radionuclides enter the body, their distribution, accumulation and excretion from the body; establishing acceptable levels of radionuclide content in the environment, food products and the human body; finding effective means to pre-

vent damage by radionuclides; developing means and methods that accelerate the excretion of radioactive substances from the body. What science are we talking about?

1. Radiobiology;
2. Radiotoxicology;
3. Radiation hygiene;
4. Radiology.

Answer: 2

Task 2.

Read the text and choose the correct answer.

The ability of nuclei of some chemical elements to transform into nuclei of other chemical elements with the emission of ionizing radiation. What phenomenon are we talking about?

1. Specific ionization;
2. Half-life;
3. The particle's path length;
4. Radioactivity.

Answer: 4

Task 3.

Read the text and choose the correct answer.

Short-lived radioisotopes are those whose half-life is expressed in seconds, minutes, hours, days. Which of the listed radioisotopes belong to this group?

1. Radium-226;
2. Strontium-90;
3. Iodine-131;
4. Uranium-238.

Answer: 3

Combined type tasks with multiple correct answers from the proposed options

Task 4.

Read the text and choose the correct answers.

All radionuclides are divided into four main groups according to the type of distribution and accumulation in the body. Determine which of the listed radioisotopes belong to the group of uniformly distributed radioisotopes?

1. Calcium-40;
2. Strontium-90;
3. Cesium-137;
4. Cerium-144;
5. Potassium-40;
6. Rubidium-86.

Answer: 3; 5; 6.

Task 5.

Read the text and choose the correct answers.

In the mechanism of biological action of ionizing radiation, indirect influence is distinguished due to water radiolysis. What stages of water radiolysis are distinguished?

1. Biological;
2. Physical;
3. Molecular;
4. Chemical;

5. Physicochemical.
Answer: 2; 4; 5.

GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors

Closed-ended tasks to establish compliance

Task 6.
Read the text and match
Establish a correspondence between the theories and processes characterizing the stages of the biological action of ionizing radiation: (*for each position in the first column, select the corresponding position from the second column).*

Theories		Processes (manifestations)	
A	Target theory (Crowser)	1	The theory takes into account not only the wide variety of damage caused by ionizing radiation, but also the role of reparative processes.
B	Theory of indirect action	2	a state in which the absolute number of damaged molecules of a substance in a weak solution does not depend on its concentration and remains constant for a given exposure dose
IN	Stochastic (probabilistic) theory	3	In animal and plant cells there are radiation-sensitive "target" areas (for example, chromosome genes) and when an ionizing particle hits these areas, changes occur that can be assessed quantitatively.
G	Dilution effect	4	the biological effect in irradiated tissues and organs occurs as a result of exposure to water radiolysis products
D	Structural-metabolic theory	5	in cells, under the influence of reactions, not only primary and initial radioactive-chemical damage occurs, but also highly reactive products are synthesized, leading to additional damage to biologically important macromolecules and the appearance of low-molecular toxic metabolites - quinones and orthoquinones

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G	D

Answer: A-3; B-4; B-1; G-2; D-5.

Task 7.

Read the text and match

Establish a correspondence between the forms of acute radiation sickness and the absorbed doses that cause the corresponding reaction to high doses of radiation: (*for each position in the first column, select the corresponding position from the second column).*

Form of acute radiation sickness		Absorbed dose	
A	Toxemic	1	10-20 Gr
B	Bone marrow	2	20-50 gr
I N	Intestinal	3	More than 50 gr
G	Cerebral	4	1-10 Gr

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A-2; B-4; C-1; D-3.

Task 8.

Read the text and match

Establish a correspondence between the forms of acute radiation sickness and pathological manifestations that cause the corresponding reaction: (*for each position in the first column, select the corresponding position from the second column).*

Form of acute radiation sickness		Pathological manifestations	
A	Toxemic	1	The main role in the mechanisms of submucosal layer exposure is attributed to direct radiation damage to epithelial stem cells. Also of importance is the disruption of intestinal wall trophism, caused by a decrease in the excitability threshold of neurons of the intramural parasympathetic ganglia and the development of spasm of intestinal smooth muscles.
B	Bone marrow	2	This form is characterized by severe hemodynamic disorders associated with paresis and increased vascular permeability, manifestations of intoxication with tissue decay products, radiotoxins and intestinal microflora toxins.
I N	Intestinal	3	Here, signs of cerebral edema, agitation, ataxia, hyperkinesis, convulsions, respiratory disorders and vascular tone are characteristic.
G	Cerebral	4	is determined by damage to predominantly hematopoietic tissue. Sometimes this form is called typical, since it most clearly shows the periodization characteristic of ARS.

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A-2; B-4; C-1; D-3.

Task 9.

Read the text and match

Establish a correspondence between the serial number and the name of the period of acute radiation sickness of the bone marrow form: *(for each position of the first column, select the corresponding position from the second column).*

Period ordinal number		Name of the period	
A	First	1	clinical manifestations
B	Second	2	recovery
I N	Third	3	latent
G	Fourth	4	primary reactions

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A-4; B-3; C-1; D-2.

GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.

Task 10.

Read the text and match

Establish a correspondence between the type of animal and the absorbed doses of acute radiation sickness of mild, moderate, severe and extremely severe degrees of manifestation: (*for each position in the first column, select the corresponding position from the second column).*

Animal species		Absorbed doses	
A	Cattle	1	light – 4.0-6.0 Gy average - 6.0-8.0 Gy heavy – 8.0-10.0 Gy extremely severe – over 10.0 Gy
B	Mink	2	light – up to 4.0 Gy average - 4.0-4.5 Gy heavy – 4.5-8.0 g extremely severe – over 8.0 Gy
I N	Pigs	3	light – 1.0-1.5 g average - 1.5-2.0 Gy heavy – 2.5-4.0 g extremely severe – over 4.0 Gy
G	Goats	4	light – 1.5-2.0 g average - 2.0-4.0 Gy heavy – 4.0-6.0 Gy

			extremely severe – over 6.0 Gy
D	Sheep	5	light – 1.0-1.5 g average - 1.5-2.5 Gy heavy – 2.5-3.0 g extremely severe – over 4.0 Gy
E	Chickens	6	light – 2.5-3.0 g average - 3.0-4.0 Gy heavy – 4.0-6.0 Gy extremely severe – over 6.0 Gy

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G	D	E

Answer: A-4; B-5; B-2; G-3; D-6; E-1.

Closed-ended tasks to establish a sequence

Task 11.

Read the text and establish the sequence.

Radionuclides that enter plants are distributed in them differently. The more free fraction of radionuclides in plants, the more accessible they are for assimilation by the organism of monogastric animals. The entry and accumulation of radionuclides in plant products depends on the distribution of the root system in the soil, plant productivity, the duration of the vegetation period and some other biological characteristics. Indicate the numbers of the correct answers in descending order of accumulation of radioisotopes ^{90} Sr and ^{137} C s in a unit of dry mass of crop yield :

1. Potatoes;
2. Carrots;
3 Wheat;
4. Soy.

Answer: 2; 4; 1; 3.

Task 12.

Read the text and establish the sequence.

Intensive varieties require a lot of potassium to form a crop. If there is a potassium deficiency in the soil, its deficiency can be compensated for by cesium. Early-ripening spring crops and winter grain crops accumulate fewer radionuclides, since they form a high yield of plant mass. When radionuclides are distributed over a large amount of plant mass, biological dilution of radionuclides occurs. The accumulation of radionuclides depends on the type of mineral nutrition, i.e. on the crops' need for potassium, calcium and other nutrients. Potassium-loving crops accumulate more cesium, and calcium-loving crops accumulate more strontium. Specify the numbers of the correct answers in descending order of accumulation of radionuclides in the commercial part of the crop of plant products:

1. Cereals;
2. Root vegetables;
3. Vegetable crops;
4. Legumes;
5. Potatoes;
6. Cereals.

Answer: 2; 4; 5; 1; 6; 3.

Task 13.

Read the text and establish the sequence.

During long-term observations it was established that more than 30% of the studied berries, harvested by the population in the territory of radioactive contamination, exceed the permissible levels for the content of the radionuclide cesium-137, and their uncontrolled consumption can lead to an increased dose of internal radiation. Indicate the numbers of the correct answers in order of increasing intensity of accumulation of cesium-137 in wild berries:

1. Lingonberry;
2. Strawberries;
3. Viburnum;
4. Blueberry;
5. Blackberry;
6. Cranberry.

Answer: 4; 6; 1; 5; 2; 3.

Task 14.

Read the text and establish the sequence.

In poultry, eggs are a specific way of removing radionuclides from the body. The transfer of strontium-90 from the diet into the egg does not exceed 39% of the daily intake of the radionuclide, and in low-productivity chickens it can reach 60%. Indicate the numbers of the correct answers in descending order of the intensity of strontium-90 accumulation in the eggs of agricultural poultry:

1. Protein;
2. Shell;
3. Yolk.

Answer: 2; 3; 1.

Task 15.

Read the text and establish the sequence

Agrotechnical methods provide for an increase in the share of areas under crops with a low level of radionuclide accumulation. Analysis of radionuclide accumulation per unit of dry matter allows ranking crops in descending order of 137Cs and 90Sr in products. Indicate the numbers of the correct answers in descending order of the intensity of strontium-90 accumulation in grain:

1. Peas;
2. Vika;
3. Spring rape;
4. Winter wheat;
5. Lupine;
6. Barley;
7. Spring wheat;
8. Oats.

Answer: 3; 5; 1; 2; 6; 7; 8; 4.

OPEN TYPE ASSIGNMENT

Task 16.

Read the text and write down a detailed, reasoned answer.

The results of the studies conducted on the territories contaminated with radionuclides allow us to state that in order to obtain agricultural products with the permissible content of radionuclides and to ensure the radiation safety of workers, it is necessary to carry out organizational measures. Within the framework of these measures, it is possible to carry out agrochemical analyses to determine the content of radionuclides, to plan in advance the set of crops for sowing in

order to obtain high-quality products. List what measures are included in the category of organizational measures?

Answer: inventory of lands according to the density of radionuclide contamination and compilation of cartograms; forecast of radionuclide content in crops; exclusion of land from economic use or transfer of land withdrawn from land use to economic circulation; changes in the structure of crop areas and crop rotations; respecialization of industries.

Task 17.

Read the text and write down a detailed, reasoned answer.

In conditions of radioactive contamination of the territory, measures must be taken at livestock facilities to prevent radiation damage to people and animals from external irradiation due to increased external gamma background and internal irradiation due to the entry of radioactive substances (RS) into the body. The first period after radioactive fallout is the period of "iodine hazard". During this time, there is an intensive fallout of radioactive isotopes from the air onto objects of the external environment - plants, soil, buildings and structures, onto animals in the pasture. In emergency situations resulting from a radiation accident or a ground nuclear explosion, the territory is divided into 4 zones according to the degree of radiation hazard (expected doses), i.e. according to the level (density) of radioactive contamination. The first zone is called the selective control zone. Name the main characteristics of this zone and the measures taken to ensure radiation safety.

Answer: In the event of a radiation accident, this zone includes territories with an increase in radiation levels up to 10 times above the natural background. Veterinary and agrochemical laboratories conduct selective (up to 20%) radiation monitoring of livestock and plant products.

Task 18.

Read the text and write down a detailed, reasoned answer.

In order to reduce the radiation impact on farm animals and reduce radioactive contamination of livestock products, a strict radiation control zone is established. Provide a description of this zone and list the main activities carried out in the area.

Answer: This zone includes territories with a significant increase in radiation up to 100 times above the natural background. All crop and livestock products are subject to radiation monitoring. Animals are prohibited from grazing on pasture. Feeding is carried out with coarse and succulent feed prepared before the emergency. All fresh milk is withdrawn from consumption and processed at dairies into dairy products. Stable iodine preparations are introduced into the diet of dairy cattle.

Task 19.

Read the text and write down a detailed, reasoned answer.

The main source of radioactive substances entering the organism of farm animals during unfavorable conditions during accidents at nuclear enterprises are feed and water. If it is not possible to obtain water for drinking animals from uncontaminated sources, then decontamination is carried out in order to reduce the concentration of radioisotopes in the water. List the main methods of decontaminating water for drinking animals.

Answer: Coagulation followed by settling. Filtration through soil filters and other filter materials. Ion exchange filtration. Distillation.

Task 20.

Read the text and write down an expanded, reasoned answer.

Carrying out conventional or special methods of processing livestock products helps to reduce the content of radionuclides in products. The use of standard and special methods of technological culinary processing of livestock products allows to significantly reduce the content

of radionuclides in the resulting products. A significant part of the removed radionuclides goes into waste of low food value. List the main methods of meat processing that allow to reduce the content of radioisotopes in it.

Answer: Deboning meat. Boiling meat with the addition of salt at the end of cooking. Replacing the water in which the meat is boiled with fresh water at the moment of boiling. Salting meat in small pieces with multiple changes of brine. Soaking meat in tap water.

GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

CLOSED TYPE TASKS

Tasks of a combined type with the choice of one correct answer from the proposed options

GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

Task 1.

Read the text and choose the correct answer.

The equivalent dose of ionizing radiation created by cosmic radiation of naturally distributed natural radionuclides in the surface layers of the Earth, the near-ground atmosphere, food, water and the human body. Which term fits this definition?

1. man-made radiation background;
2. primary cosmic radiation;
3. natural background radiation;
4. secondary cosmic radiation.

Answer: 3

Task 2.

Read the text and choose the correct answer.

Natural potassium is the most common element on Earth. It is a mixture of three isotopes. Only one of the known isotopes is radioactive and is used as a standard in laboratories for comparative radiometric research. Which of the listed isotopes meets the characteristics?

1. potassium - 39;
2. potassium-40;
3. potassium-41;
4. potassium-42.

Answer: 2

Combined type tasks with multiple correct answers from the proposed options

Task 3.

Read the text and choose the correct answers.

Cosmic radionuclides of natural origin (cosmogenic radionuclides) are formed in the atmosphere under the influence of cosmic radiation with nuclei of nitrogen, oxygen, and hydrogen. Which of the listed radioisotopes are cosmogenic?

1. beryllium-7;
2. thorium-232;
3. carbon-14;
4. radium-226;

5. tritium.
Answer: 1; 3; 5.

Task 4.

Read the text and choose the correct answers.

Radioactive isotopes of gases cause radioactivity in indoor air. In nature, this gas occurs in various forms. Which of the listed radioisotopes have the indicated properties?

1. radon-222;
2. potassium-40;
3. tritium;
4. Thoron;
5. actinone-219.

Answer: 1; 4; 5.

Task 5.

Read the text and choose the correct answers.

Radioisotopes that have pronounced resorption in the gastrointestinal tract and lungs belong to the group with a high degree of absorption. Which of the listed radioisotopes belong to this group?

1. strontium-90;
2. uranium-238;
3. iodine-131;
4. iron-59;
5. cesium-137;
6. radon-222.

Answer: 3; 5; 6.

Closed-ended tasks to establish compliance

Task 6.

Read the text and match

Primary processes include ionization and luminescence, secondary processes include photochemical reactions and changes in the physical and chemical properties of a substance. Establish a correspondence between the methods of dosimetric control and the processes characterizing the method: (*for each position in the first column, select the corresponding position from the second column).*

Methods of dosimetric control		Characteristics of the method	
A	Individual photo control	1	The radiation dose is measured using ionization chambers. The received radiation dose is determined using a measuring device or on a scale located in the dosimeter itself.
B	Individual fluorescent control	2	It is based on the change in colour of some transparent plastics (polystyrene) and types of glass (phosphate, silver-activated).
IN	Individual dosimetric control	3	The amount of radiation is determined by the amount of chemical reaction products.
G	Calorimetric method	4	The operation of dosimeters is based on the use of special substances (NaI (Tl), ZnS (Ag), LiI (Sn)), which, under the influence of ionizing radiation, are capable of accumulating excitation energy and storing it, and then quickly releasing it in the form of light when the tablets are additionally illuminated with infrared rays.

D	Colorimetric method	5	is based on the fact that the radiation energy absorbed by a substance is converted into heat. The amount of heat is measured using special devices.
E	Chemical method	6	To measure radiation, dosimetric photographic film is used, placed in a light-proof cassette. After developing the photographic film, blackening is observed in the places of radiation exposure, the degree of intensity of which depends on the dose.
AND	Neutron activation method	7	The ability of radiation to change biological objects is used.
Z	Biological method	8	The radiation dose in these cases is determined by mathematical calculations. This is the only possible method for determining the dose from incorporated radionuclides.
AND	Calculation method	9	This method is related to or based on the measurement of induced activity.

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G	D	E	AND	Z	AND

Answer: A-6; B-4; B-1; G-5; D-2; E-3; F-9, Z, 7; I-8.

Task 7.

Read the text and match

Match the name of the device with the characteristics of its structure and operation: (*for each position in the first column, select the corresponding position from the second column).*

Name of the device			Purpose and structure
A	K ID-2	1	dosimeter for individual photo monitoring, universal. Designed to determine equivalent doses in the range from 0.05 to 2 ber when registering gamma radiation with an energy of 0.1-3 MeV, beta radiation with an energy of 0.02-3 MeV, as well as thermal neutrons.
B	D P-24	2	provides measurements of the absorbed dose of gamma and mixed gamma-neutron radiation in the ranges from 10 to 1500 rad. The radiation dose is summed up during periodic irradiation and stored in the dosimeter for 12 months. It operates on the luminescent method.
IN	I D-1	3	The device uses a thermoluminescent dosimetry method: storing energy in the dosimeter detector under the influence of radiation and preserving the stored energy until the moment of measurement (thermal release of energy).
G	I D-11	4	The device consists of two parts: a charger (ZD-6) operating on piezoelectric elements and a set (10 pieces) of dosimeters. Direct-reading dosimeters. Measurement range from 20 to 500 rad. At a dose rate from 10 to 366,000 rad/h.
D	I FKU-1	5	The dosimeter is a detector of X-ray and gamma radiation and consists of two ioi ization chambers. Using one of the chambers (yellow), the dose is measured on th lower scale of the measuring device from 0.005 to 0.5 R. Using the second chan ber (red on the upper scale) from 0.05 to 1 roentgen.
E	K DT-02	6	The gamma radiation exposure dose is measured in the range of 2–50 R, with a radiation dose rate of 0.5–200 R/h and gamma quanta energy from 200 keV to 200 MeV. The operating principle is based on measuring the residual charge of the ionization chamber. The dosimeter is direct-reading.

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G	D	E

Answer: A-5; B-6; B-4; G-2; E-3.

GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.

Task 8.

Read the text and match

Establish a correspondence between the names of the phenomenon and its characteristics: (*for each position in the first column, select the corresponding position from the second column).*

Phenomenon		Characteristic	
A	Isotopes	1	Atomic nuclei of the same chemical element, in different energy states.
B	Isobars	2	Atoms of the same element that differ from each other in mass number.
IN	Isotones	3	Atomic nuclei of different elements with the same mass number but different atomic numbers.
G	Isomers	4	Atomic nuclei of different elements with an equal number of neutrons.

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A-2; B-3; C, D-1.

Task 9.

Read the text and match

Establish a correspondence between the term of the properties of radioactive substances and its characteristics: (*for each position of the first column, select the corresponding position from the second column).*

Term		Characteristic	
A	Half-life of a radionuclide	1	The time it takes for half of the radioactive substance to be eliminated from the body through urine, feces, milk, etc.
B	Biological half-life of a radionuclide	2	The time it takes for the amount of radioisotope in the body to decrease by half, due to excretion in urine, feces, milk, etc., as well as as a result of physical decay.
I	Effective half-life of a radionuclide	3	The time it takes for half the atoms of an original substance to decay, regardless of the original number.

Write the selected numbers in the table under the corresponding letters.

A	B	IN

Answer: A-3; B-1; B-2.

Task 10.

Read the text and match

Establish a correspondence between the name of the block of the radiometer device circuit and its characteristic: (*for each position of the first column, select the corresponding position from the second column).*

Block name			Characteristic
A	power unit	1	designed to increase the resolution of the radiometer.
B	Detector	2	records the total number of pulses received per unit of time.
IN	Pulse amplifier	3	It is designed to supply power to the components of the equipment and to supply high voltage to the detector.
G	Counting device	4	designed to capture ionizing radiation and convert it into electrical impulse energy.
D	Recording device	5	designed to amplify and normalize electric current impulses.

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G	D

Answer: A-3; B-4; B-5; G-1; D-2.

GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

Closed-ended tasks to establish a sequence

Task 11.

Read the text and establish the sequence.

Post-radiation changes in the blood system are directly dependent on the dose of ionizing radiation. Hematopoietic organs and blood are very sensitive to ionizing radiation. Soon after irradiation, a disruption of the function of the hematopoietic organs is noted. However, different cells of the peripheral blood have different degrees of sensitivity to ionizing radiation. Indicate the numbers of the correct answers in descending order of the radiosensitivity of peripheral blood cells:

1. Platelets;
2. Erythrocytes;
3 Leukocytes.

Answer: 3; 1; 2.

Task 12.

Read the text and establish the sequence.

Radiation cell death is realized by two mechanisms — mitotic and interphase. The cause of mitotic death is unrepairable damage to DNA and the chromosomal apparatus, which prevents mitosis. Interphase death affects dormant cells. Its cause is the development of apoptosis. Indicate the numbers of the correct answers in descending order of radiosensitivity of leukocyte cells:

1. Basophils;
2. Lymphocytes;
3. Eosinophils;
4. Neutrophils;

5. Monocytes.
Answer: 2; 4; 3; 1; 5.

Task 13.

Read the text and establish the sequence.

In the dynamics of the population of neutrophilic granulocytes in mild and moderate acute radiation sickness, a characteristic periodization of the response to the action of ionizing radiation is observed. Indicate the numbers of the correct answers in the sequence of the onset of periods:

1. Abortive lift;
2. The first devastation;
3. Primary neutrophilia;
4. Recovery;
5. The Second Devastation.

Answer: 3; 2; 1; 5; 4.

Task 14.

Read the text and establish the sequence.

The KID-2 device is designed for individual dosimetric monitoring and is used in X-ray rooms, radiological laboratories and other institutions where they work with ionizing radiation. Using one of the chambers (yellow), the dose is measured on the lower scale of the measuring device from 0.005 to 0.5 R. Using the second chamber (red on the upper scale) from 0.05 to 1 roentgen. Specify the numbers of the correct answers in the order of the stages of working with the KID-2 dosimeter when preparing it for work:

1. Turn on the device (move the toggle switch to the upper position);
2. Connect the charging and measuring device to the AC voltage network;
3. Check the charge of the dosimeter in the "MEASUREMENT" socket;
4. Place the dosimeter in the "CHARGE" socket;
5. Disconnect the two ionization chambers of the dosimeter;
6. Issue dosimeters to personnel;

Answer: 2; 1; 5; 4; 3; 6.

Task 15.

Read the text and establish the sequence

The DP-24 dosimeter consists of a charger and direct-reading dosimeters DKP-50A. (5 pcs. in the set) An ionization chamber is placed in the body as a detector. Specify the numbers of the correct answers in the order of the stages of working with the DP-24 dosimeter when preparing it for work

1. Rotate the potentiometer knob to set the dosimeter's sighting line to the "ZERO" value;
2. Remove the protective cap from the lower end of the dosimeter;
3. Place the dosimeter into the device's charging socket;
4. Remove the dosimeter from the charging socket and put on the protective cap.

Answer: 2; 3; 1; 4.

OPEN TYPE ASSIGNMENT

Task 16.

Read the text and solve the problem.

The main task of dosimetry is to determine the radiation dose of living organisms. Knowledge of the radiation dose is necessary for quantitative and qualitative assessment of the degree of damage to a living organism caused by radiation, as well as for identifying and pre-

venting possible radiation injuries to people and animals. Calculate the absorbed dose in rads (rad) received by a cow while grazing on a pasture, if it is known that the exposure dose received by the animal was 5.0 roentgens (R)?

Answer: to calculate the absorbed dose in rads, the exposure dose value must be multiplied by the body coefficient (0.93).

$D_{rad} = 5.0\ P \cdot 0.93 = 4.65$ rad.

Task 17.

Read the text and solve the problem.

Most dosimetric devices are calibrated in roentgens. Therefore, when irradiating biological objects, the dose is measured in roentgens, and then the absorbed dose in rads and grays is calculated. Calculate the absorbed dose in grays (Gy), if it is known that the exposure dose during irradiation of pig lungs was 10.0 roentgens (R).

Answer: To calculate the absorbed dose in Gray, you must first calculate the absorbed dose in rads using the soft tissue coefficient (1), and then convert rads to Gray using the equality (1 rad = 0.01 Gy).

$D_{rad} = 10.0 \cdot 1 = 10.0$ rad.

$D_{Gr} = 10.0$ rad $\cdot\ 0.01 = 0.1$ Gr.

Task 18.

Read the text and write down a detailed, reasoned answer.

The measure of the amount of RV is activity. The more nuclei of atoms of a given RV decay per unit of time, the greater its activity. Activity is directly proportional to the amount of RV, i.e. the more RV, the greater its activity. Give a definition of the term "Activity". List the units of measurement of activity in international units of measurement (SI) and in non-systemic units.

Answer: Activity is the number of spontaneous decays of atomic nuclei per unit of time. The activity of radioactive substances in international units of measurement (SI) is expressed in becquerels (Bq), and in non-systemic units in curies (Ci).

Task 19.

Read the text and write down a detailed, reasoned answer.

There are a number of difficulties in performing dosimetry. Therefore, one method of dosimetry or one device cannot solve the problem. Therefore, there are several methods of dosimetry. Any substance that changes under the influence of radiation can be used as a dosimeter. The following main criteria are taken into account when creating a dosimetric system. List these criteria.

Answer: 1) sensitivity of the dosimeter, i.e. the lower limit of the measured dose; 2) dependence of sensitivity on radiation energy; 3) measurement error; 4) possibility of a design solution; 5) possibility of registering different types of radiation.

Task 20.

Read the text and write down a detailed, reasoned answer.

Radioactive substances can be radioactive isotopes of chemical elements, mixtures of radioactive and stable isotopes, chemical compounds that include radionuclides as impurities or additives. Give a definition of such concepts as isotopes, isobars, isotones.

Answer: Isotopes are atoms of the same element that differ from each other in mass number. Isobars are atomic nuclei of different elements with the same mass number but different atomic numbers. Isotones are atomic nuclei of different elements with an equal number of neutrons.

4.2. Standard tasks for intermediate certification

4.2.1. Exam questions

Emerging competence: UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 To know: the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

1. Radiobiology and veterinary radiobiology - definition, goals, tasks.
2. History and prospects of radiobiology development.
1. Atomic structure, elementary particles, nuclear mass defect.
2. The phenomenon of radioactivity. Isotopes, isobars, isotones, and spectra. Natural and artificial radioisotopes.
3. Types of ionizing radiation and their characteristics.
4. Radioactive decay and its types (alpha-decay, beta-decay).
5. Interaction of gamma radiation with matter (elastic scattering, photoelectric effect, Compton effect, electron-positron pair formation).
6. Nuclear reactions. Activation response and its practical significance.
7. The fission reaction of heavy nuclei and its use.
8. The synthesis reaction of light nuclei and its significance.

UC-8 ID-2 To be able to: identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

9. The main limits of radiation doses for personnel and the public in peacetime.
10. Permissible doses of radiation to people during wartime and radiation accidents.
11. Natural radioactive background and its effect on the body of animals and humans.

UC-8 ID-3 To possess skills of: the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies

12. Methods for predicting the supply of RV to agricultural plants (the seedling method, using the Klechkovsky complex indicator, the proportionality coefficient, etc.).
13. A method for predicting the supply of radioactive substances to livestock products.
14. Veterinary and sanitary expertise of slaughter products of irradiated animals (for external and internal irradiation).
15. Principles of animal husbandry in the period of "iodine" danger.
16. The principle of animal husbandry in the period of surface pollution.
17. The principle of animal husbandry during the root intake of radionuclides.
18. Organization of veterinary and agrotechnological activities on the trail of a radioactive cloud.
19. Effect of ionizing radiation on the digestive system.
20. The effect of ionizing radiation on the reproductive organs and offspring of animals.
21. The effect of ionizing radiation on the nervous system, endocrine glands, and sensory organs.
22. Influence of ionizing radiation on the cardiovascular system and respiratory organs.
23. The effect of ionizing radiation on various tissues (skin, connective tissue, bones, cartilage, muscles).

24. Division of territory in a nuclear explosion.

Formed competence: GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.

GPC-2 ID-1 To know: ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body

25. Pathways of RV ingestion in animals. The concept of the concentration and content of radioactive substances in the organ and body.

26. Natural sources of ionizing radiation and their impact on the animal body.

27. Artificial sources of ionizing radiation and their impact on the animal body.

28. Genetic effects of ionizing radiation.

29. Factors affecting the degree of radiation damage to the body during internal exposure to radiation.

30. Somatic effect of ionizing radiation (leukemias, tumors, cataracts of the eye lens, shortening of life expectancy).

31. Types of radionuclide distribution in the body. The concept of a critical organ.

GPC-2 ID-2 To be able to: use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors.

32. General patterns of movement of radioactive substances in the biosphere (biotic and abiotic cycles).

33. Mechanism of biological action of ionizing radiation (theories of primary direct and indirect action).

34. Mechanism of biological action of ionizing radiation (theories of primary indirect action, oxygen effect and water radiolysis).

35. Influence of ionizing radiation on hematopoietic organs and blood.

36. Subject and tasks of radiotoxicology. Classification of radionuclides by their degree of toxicity.

37. The effect of small doses of ionizing radiation on living organisms.

38. The law of radioactive decay.

39. Metabolism and toxicology of strontium-90 and caesium-137.

GPC-2 ID-3 To possess skills of: the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well

40. Metabolism and toxicology of young fission products (iodine isotopes, etc.).

41. Ways of removing radionuclides from the body. Effective and biological half-lives.

42. Subject and tasks of agricultural radioecology.

43. Acute radiation sickness of animals (definitions, etiology, pathogenesis, syndromes).

44. Chronic radiation sickness of animals. Features of the development and course of the disease.

45. Radiation burns of animals (etiology, pathogenesis, clinic, course and outcome, prevention and treatment).

46. Prevention and treatment of acute radiation sickness in animals.

47. Features of the clinical manifestation of acute radiation sickness in horses.

48. Features of the clinical manifestation of acute radiation sickness in cattle.

49. Features of the clinical manifestation of acute radiation sickness in pigs.

50. Clinical features of acute radiation sickness in sheep and goats.

51. Clinical features of acute radiation sickness in fur-bearing animals (sable, mink, fox).

52. Features of the clinical manifestation of acute radiation sickness in chickens.

53. Pathoanatomical changes in acute radiation sickness and differential diagnosis of acute radiation sickness.

Emerging competence: GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

GPC-4 ID-1 To know: the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

54. The system of state veterinary control over radioactive contamination of objects of veterinary supervision.

55. The first and second stages (sampling and preparation of samples) of determining the specific radioactivity of objects of veterinary supervision.

56. The third and fourth stages (proper radiometric research and drawing up a conclusion) determine the specific radioactivity of veterinary surveillance facilities.

57. Dosimetry, its types, goals and objectives.

58. Units of measurement of radiation dose rate (basic, fractional, multiple).

59. Sorting and economic use of farm animals against the background of exposure to ionizing radiation.

60. Radiometry, its tasks and goals.

61. The use of RV and ionizing radiation in biology, animal husbandry, medicine and veterinary medicine.

GPC-4 ID-2 To be able to: apply modern technologies and research methods in professional activities, interpret the results obtained.

62. Methods of dosimetric control (photo control).

63. Methods of dosimetric control (luminescent control).

64. Methods of dosimetric control (with condenser-type dosimeters).

65. Methods of dosimetric control (colorometric, calorimetric, chemical, biological, neutron activation).

66. Relative biological efficiency of radiation and equivalent (biological) radiation dose.

67. Purpose, operating principle and device of the dosimeter KID-2, ID-11.

68. Purpose, operating principle, and device of the DP-22V, DP-24, and ID-1 dosimeters.

69. Procedure for determining radiation doses by calculation method under external radiation exposure.

70. Activity measurement units – the number of RVs (basic, subdivided, and multiples).

71. Purpose, operating principle and device of the SRP-68-01 (SRP – 88N), DP-5.

72. Rapid methods for determining specific radioactivity using SRP-68-01 and DP-5.

GPC-4 ID-3 To possess skills of: the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

73. The concept of radiation doses, units of measurement (basic, fractional, multiples).
74. Methods of radiometric examination of agricultural products and environmental objects (absolute, relative, calculated).
75. Units of measurement of the equivalent and effective radiation dose (basic, fractional, multiple).
76. Units of measurement of absorbed radiation (basic, fractional, multiple).
77. Gas-discharge detectors, their design and principle of operation.
78. Scintillation detectors, device and principle of their operation.
79. Units of measurement of the exposure dose of radiation (basic, fractional, multiple).
80. The concept of specific radioactivity and the stages of its determination.
81. Purpose, design and operation of radiometers.
82. Purpose, design and operation of spectrometers.

5. METHODOLOGICAL MATERIALS DEFINING PROCEDURES FOR ASSESSING KNOWLEDGE, SKILLS AND ABILITIES AND EXPERIENCE OF ACTIVITIES THAT CHARACTERIZE THE STAGES OF COMPETENCE FORMATION

Criteria for evaluating students ' knowledge during the colloquium:

- **Mark "excellent"**- the student clearly expresses their point of view on the issues under consideration, giving appropriate examples.
- **Mark "good"** - the student makes some errors in the answer
- **Mark "satisfactory"**- the student discovers gaps in knowledge of the main educational and regulatory material.
- **Mark "unsatisfactory"**- the student discovers significant gaps in knowledge of the main provisions of the discipline, the inability to get the correct solution to a specific practical problem with the help of the teacher.

Criteria for evaluating students ' knowledge during testing:

The test result is evaluated on a percentage rating scale. Each student is offered a set of test tasks consisting of 25 questions:

- **The mark "excellent"** – 25-22 correct answers.
- **Mark "good"** – 21-18-correct answers.
- **Mark "satisfactory"** –17-13 correct answers.
- **"Unsatisfactory" mark** – less than 13 correct answers

Criteria for evaluating students ' knowledge when conducting research papers:

- **Mark "excellent"** - the problem is identified and its relevance is justified; an analysis of various points of view on the problem under consideration is made and one's own position is logically stated; conclusions are formulated, the topic is fully disclosed, the volume is maintained; external design requirements are met, the main requirements for the abstract are met
- **Mark "good"**- there are some mistakes made. In particular, there are inaccuracies in the presentation of the material; there is no logical sequence in the judgments; the volume of the abstract is not maintained; there are omissions in the design, there are significant deviations from the requirements for referencing.

• **Mark "satisfactory"**- the topic is only partially covered; factual errors were made in the content of the abstract; there are no conclusions, the topic of the abstract is not disclosed

• **Mark "unsatisfactory"** - there is a significant misunderstanding of the problem or the abstract is not presented at all.

Knowledge criteria for the exam:

• **Mark "excellent"** – completed all types of academic work provided for in the curriculum. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with the acquired knowledge, skills and abilities, and applies them in various situations of increased complexity. At the same time, there may be inaccuracies, difficulties in analytical operations, and the transfer of knowledge and skills to new, non-standard situations. –

• **Mark "good"** – all types of academic work provided for in the curriculum are completed. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with the acquired knowledge, skills and abilities, and applies them in standard situations. However, minor errors, inaccuracies, difficulties in analytical operations, and the transfer of knowledge and skills to new, non-standard situations may occur.

• **Mark "satisfactory"** – one or more types of academic work provided for in the curriculum were not completed. The student demonstrates incomplete compliance of knowledge, skills, and abilities with the indicators shown in the tables, significant errors are made, a partial lack of knowledge, skills, and abilities is manifested in a number of indicators, and the student has significant difficulties in operating with knowledge and skills when transferring them to new situations. –

• **Mark "unsatisfactory"** – the types of academic work provided for in the curriculum were not completed. demonstrates incomplete correspondence of knowledge, skills, and abilities to those listed in the tables of indicators, significant errors are made, the lack of knowledge, skills, and abilities is manifested in a larger number of indicators, and the student has significant difficulties in operating with knowledge and skills when transferring them to new situations.

6. ACCESSIBILITY AND QUALITY OF EDUCATION FOR DISABLED PEOPLE

If necessary, persons with disabilities and persons with disabilities are given additional time to prepare a response to the test.

When carrying out the procedure for evaluating the results of training of disabled people and persons with disabilities, their own technical means can be used.

The procedure for evaluating the results of training of disabled people and persons with disabilities in the discipline provides for the provision of information in forms adapted to the limitations of their health and perception of information:

For people with visual impairments:	- in printed form with an enlarged font, – in the form of an electronic document.
For people with hearing impairments:	– in printed form, – in the form of an electronic document.
For persons with musculoskeletal disorders–	– in printed form, but: - in the form of an electronic document.

When conducting the procedure for evaluating the results of training of disabled people and persons with disabilities in the discipline, it ensures that the following additional requirements are met, depending on the individual characteristics of students:

a) instructions on the procedure for conducting the assessment procedure are provided in an accessible form (orally, in writing);

b) an accessible form of providing tasks with assessment tools (in printed form, in printed form in an enlarged font, in the form of an electronic document, tasks are read out by the teacher);

c) an accessible form of providing answers to tasks (written on paper, a set of answers on a computer, orally).

If necessary, for students with disabilities and disabled people, the procedure for evaluating the results of training in a discipline can be carried out in several stages.

The procedure for evaluating the learning outcomes of disabled people and persons with disabilities is allowed using distance learning technologies.

Program abstract of the discipline
B1.O.29 "Veterinary radiobiology"
specialty 36.05.01 Veterinary Medicine
Profile: «General clinical veterinary medicine»

The purpose of the discipline: to give students theoretical knowledge, to master the methods and acquire practical skills necessary for the organization and conduct of radiological control in the field of agro-industrial complex.

The place of discipline in the curriculum: B1.O.29 is a mandatory part, the discipline is mastered in the 5th semester for full-time education.

Requirements for the results of mastering the discipline: The study of the discipline should form the following competencies:

UC-8: Is able to create and maintain safe living conditions, including cases of emergency situations.

UC-8 ID-1 **To know:** the consequences of harmful and dangerous factors exposure on the body of animals, humans and the natural environment, methods of protection from emergencies and military conflicts; fundamentals of life safety, telephone numbers of rescue services.

UC-8 ID-2 **To be able to:** identify the signs, causes and conditions of emergencies and military conflicts; assess the likelihood of a potential danger to the student and take measures to prevent it in an educational institution; provide first aid in emergency situations.

UC-8 ID-3 **To possess skills of:** the ways to ensure safety in the human-animal-habitat system. Possess methods of forecasting the occurrence of dangerous or emergency situations; skills in maintaining safe living conditions, including those based on digital technologies.

GPC-2. Is able to interpret and evaluate in professional activity the influence of natural, socio-economic, genetic and economic factors on the physiological status of the animal body.

GPC-2 ID-1 **To know:** ecology factors of the environment, its classification and the nature of relationships with living organisms; basic ecological concepts; interspecific relations of animals and plants, terms and bio ecology laws, parasites and hosts; ecological features of some types of pathogenic microorganisms; mechanisms of influence of anthropogenic and economic factors on the animal body.

GPC-2 ID-2 **To be able to:** use environmental factors and environmental laws in agricultural manufacture; apply the achievements of modern microbiology and ecology of microorganisms in animal husbandry and veterinary medicine in order to prevent infectious and invasive diseases and treat animals; use environmental monitoring methods in the environmental assessment of agricultural facilities and the production of agricultural products; assess the impact on the animal body, anthropogenic and economic factors

GPC-2 ID-3 **To possess skills of:** the knowledge of the origin of living organisms, the levels of organization of living matter, favorable and unfavorable factors affecting the body; the basis for studying environmental knowledge of the environment, the laws of the development of nature and society; skills of observation, comparative analysis, historical and experimental modeling of the impact of anthropogenic and economic factors on living objects, with the use of digital technologies as well.

GPC-4. Is able to use methods to solve problems, using modern equipment for the development of new technologies in professional activity and use modern professional methodology to conduct experimental research and interpret the results.

GPC-4 ID-1 **To know:** the technical capabilities of modern specialized equipment, methods of problems resolution in professional activity.

GPC-4 ID-2 **To be able to:** apply modern technologies and research methods in professional activities, interpret the results obtained.

GPC-4 ID-3 **To possess skills of:** the work with specialized equipment for implementation of the set tasks for research and the development of new technologies, digital ones, as well.

Summary of the discipline:

In order to achieve this goal, it is necessary to solve the following tasks:

a) The general education task is to get acquainted in depth students with the physical foundations and methods of veterinary radiobiology, the laws of the manifestation of radioactivity and properties of radioactive radiation, radiation effects of farm animals, pathogenesis, diagnosis and treatment of radiation sickness.

b) The applied problem highlights issues related to modern methods

radiation monitoring of agricultural products to determine the levels of its radioactive contamination, the main patterns of migration of radionuclides in natural and agricultural ecosystems, their toxicological characteristics, features of accumulation and excretion in different types of agricultural animals and ways of using livestock products and animals with radiation damage and creates a conceptual framework for the implementation of interdisciplinary structural and logical connections in order to develop medical thinking skills.

c) A special task is to familiarize students with modern trends and methodological approaches for predicting pollution of agricultural products and dose loads on the population in conditions of radioactive contamination to solve problems of animal husbandry and veterinary medicine, as well as existing achievements in this field.

As a result of mastering the discipline, the student must:

To know: the physical foundations of veterinary radiobiology, methods for identifying the isotopic composition of radionuclide pollutants, the mechanism of biological action of ionizing radiation.

Be able to: measure and control doses of external and internal radiation, carry out radiometric, dosimetric and spectrometric control of agricultural products and feed, make a forecast of contamination of agricultural products.

Possess: skills of working on radiometric, dosimetric and spectrometric equipment, methods of analyzing feed, crop and livestock products, methods of assessing the radiation situation.

The complexity of the discipline is: 144 academic hours (4 credits).

Final control of the discipline: exam.