NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

General Ecology, Radiobiology and Life Safety Department

"CONFIRMED"
Dean of Faculty of Plant Protection,
Biotechnology and Ecology
_____ Julija KOLOMIJETS
«18» May 2023, protocol № 9

"APPROVED"
at the meeting of the department of General Ecology
Radiobiology and Life Safety
Protocol № 9 dated «19» 04 2023
Head of Department
_____ Alla KLEPKO

"REVIEWED"
Program Coordinator of the educational and professional
program "Ecology and Environmental protection"
_____ (Gaychenko V.A.)

PROGRAM OF THE COURSE

"RADIATION HYGIENE"

Specialty:	101 - Ecology
Educational program:	«Ecology and Environmental Protection»
Faculty:	Plant protection, biotechnology and ecology
Developers:	Volodymyr Illienko , PhD in Biology, senior lecturer of General Ecology, Radiobiology and Life Safety Department Alla Klepko , PhD in Biology, docent of General Ecology, Radiobiology and Life Safety Department

Kyiv – 2023

1. Description of the course

_____ RADIATION HYGIENE_____
(name)

Field of knowledge, specialization, educational program, educational degree		
Educational degree	*Master's*	
Specialization	*101 Ecology*	
Educational program	*"Ecology and Environmental Protection"*	
Characteristics of the course		
Mode	Elective	
Total number of hours	120	
Number of credits ECTS	4	
Number of meaningful modules	2	
Course project (work) (if available)	-	
Form of control	*Exam*	
Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Year of study (course)	2	-
Semester	1	-
Lectures	*10 hours*	*- hours*
Practical and seminar lessons	*20 hours*	*- hours*
Laboratory practical	*- hours*	*- hours*
Self-dependent work	*90 hours*	*- hours*
Self-dependent work	*- hours*	*hours*
Week hours for full-time education	*3 hours*	

2. Purpose, objectives, and competencies of the course

The purpose of teaching the discipline " Radiation hygiene " is the formation of knowledge about the peculiarities of the environment formation with a complex of unfavorable factors for the population (environmental, sanitary, hygienic, economic, economic and social) arising as a result of radiation accidents.

The task is to provide opportunities for using the acquired knowledge and skills for the development of recommendations, decision-making, long-term planning of countermeasures in the event of radiation accidents and territory radioactive contamination by radioactive isotopes, as well as for master's thesis.

After finishing of course students have to

The student should know the peculiarities of protecting a person from sources of external and internal irradiation while living on contaminated radionuclide territories (obtaining agricultural products that meet the requirements of PL-2006, reducing the equivalent dose of internal irradiation, the feasibility of countermeasures), possible solutions to socio-economic problems and rehabilitation of the territories affected by radionuclide contamination.

Student should be able to:

- analyze information about the levels of radionuclide pollution of environmental objects;

- in accordance with the requirements of the permissible levels of agricultural products pollution to evaluate its suitability for human consumption;

- make short-term and long-term forecasts for the development of the situation on the territory after radionuclide contamination.

Acquisition of competencies:

general competencies (GC):

1. Ability to learn and acquire modern knowledge.
2. Ability to make informed decisions.
4.
5. Ability to communicate in a foreign language.
6. Ability to search, process and analyze information from various sources.

professional (special) competencies (PC):

1. Ability to apply interdisciplinary approaches in critical understanding of environmental issues.

2. Ability to assess the level of negative impact of natural and anthropogenic environmental hazards on the environment and humans.

3. Ability to prove knowledge and own conclusions to specialists and non-specialists.

4. Ability for self-education and training based on innovative approaches in the field of ecology, environmental protection and sustainable use of nature.

6. Ability to independently develop environmental projects by creatively applying existing ideas and generating new ideas.

7. Ability to organize work related to environmental assessment, environmental protection and optimization of nature use, in conditions of incomplete information and conflicting requirements.

8. Ability to apply new approaches to the analysis and prediction of complex phenomena, critical understanding of problems in professional activities.

9. Ability to prove knowledge and own conclusions to specialists and non-specialists.

Program learning outcomes (PLO):

1. Know and understand fundamental and applied aspects of environmental sciences.

2. Be able to use conceptual environmental patterns in professional activity.

3. Know at the level of the latest achievements the basic concepts of natural science, sustainable development and methodology of scientific knowledge.

4. Know the legal and ethical standards for evaluation professional activity, development and implementation of socially significant environmental projects in conditions of conflicting requirements.

5. Demonstrate the ability to organize collective activities and implement complex environmental protection projects, taking into account available resources and time restrictions

6. Know the latest methods and tools ecological research, including methods and means mathematical and geoinformation modeling.

7. To be able to communicate in a foreign language in the scientific, industrial and social spheres of activity.

8. Be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public.

9. Know the principles of personnel management and resources, basic approaches to decision-making in conditions of incomplete/insufficient information and conflicting requirements.

10. Demonstrate awareness of the latest principles and methods of environmental protection.

11. Be able to use modern information resources on ecology, nature management and environmental protection.

12. Be able to evaluate landscape and biological diversity and analyze the consequences of anthropogenic impact on natural environments.

13. Be able to assess the potential impact of man-made objects and economic activity on the environment.

14. Apply new approaches to production decision-making strategies in complex, unpredictable conditions.

15. Assess environmental risks under conditions of insufficient information and conflicting requirements.

16. Choose the optimal management and/or nature management strategy depending on environmental conditions.

18. Be able to use modern methods of information processing and interpretation when carrying out innovation activity.

19. To be able to independently plan the implementation of an innovative task and formulate conclusions based on its results.

20. Possess the basics of ecological engineering design and ecological expert assessment of the impact on the environment.

3. PROGRAM AND STRUCTURE OF THE COURSE FOR:

– complete full-time (part-time) form of study

№	Topic	The topic content, recommended literature	Types of educational activity, hours.		
			lectures	Laboratory works	independent work
Module 1. Biological regulation of ionizing radiation and the basis of radiation hygiene					
1.1.	Basic principles of biological regulation of ionizing radiation	The limitless concept of the ionizing radiation action on human body. The concept of acceptable risk. The principle of not exceeding, optimizing and justifying. Categories of exposed persons and their regulation. Permissible levels and temporarily permissible levels of radionuclide content in food. *Lliterature: 1, 2, 4, 22, 23*	2	4	18
1.2	Basic sanitary rules of radiation protection	Population in the conditions of radiation accidents. Radiation and hygiene regulations. Radiotoxicity groups of radioactive isotopes. Principles of protection against closed and open sources of ionizing radiation. Rationing of radionuclide content in agricultural products. *Lliterature: 1, 2, 4, 22, 23*	2	4	18
1.3	The basic documents of radiation safety standards regulation	Activities of the International Commission on Radiation Protection (ICRP) and the National Commission for Radiation Protection of Ukraine (NCRP). "The principle of optimizing ALARA". Norms of radiation safety of Ukraine. Law of Ukraine "On the Use of Nuclear Energy and Radiation Safety" *Lliterature: 1, 2, 4, 7*	2	2	18

Module 2. Population in the close and remote period after a radiation accident

2.1	Combined action of hygiene and social factors caused by the consequences of the accident	Significance of social and psychogenic factors against the background of the radiation factor. The quality of information provision, management decisions and mechanisms for their implementation in the implantation of anti-radiation measures. Features of social and physical well-being, mental state of different groups of the population. *Lliterature: 1, 15,16*	2	4	18
2.2	System approach to public health research at radiation accidents	Level and dynamics of population morbidity in radionuclide contaminated territories. Features of the subjective perception of the situation and the level of socio-psychological stress. Hygienic and social approaches to preventive measures for the preservation of public health. Population in the event of Chernobyl disaster and Fukushima -1 nuclear power plant accident. *Lliterature: 15, 16, 19, 23*	2	6	18
		Total:	**10**	**20**	**90**

4.Topics of seminars

№ s/n	Topic name	Number of hours
	not provided	

5. Topics of practical classes

№ s/n	Topic name	Number of hours
1	Sequential extraction method for isolation of physicochemical forms of radionuclides	4
2	Soil sampling methods for radiometric studies	4
3	Calculation of the required number of samples in the field study of radionuclide contaminated areas	4
4	Size and charge fractionation methods	4
5	Atmosphere dispersion. Discharge to the atmosphere H>2.5 H_B (CROM tool)	4
	Total	20

6. Topics of laboratory classes

№ s/n	Topic name	Number of hours
1	not provided	-

8. Samples of control questions, tests for assessing the level of knowledge acquisition by students.

National University of Life and Environmental Sciences of Ukraine			
Master 2st year study Specialty Radioecology	General Ecology, Radiobiology and Life Safety Department	Test № __ from the course **Radiation Hygiene**	Approved Head of department _____

Tests

1. A maximum accessible equivalent dose received by any individual within one year is ……

2. By whom does the control levels are established?
a) ICRP; b) ALARA; c) IAEA; d)enterprise manager

3. Please combine and description of principles of biological norm setting of radiological protection

1. Optimization	a) All doses should be kept as low as reasonably achievable, social and economic factors being taken into account
2. Dose limits	b) Actions should be more good than harm
3. Justification	c) Limitation to the degree of exposure to “acceptable” levels

4. Please, decipher abbreviation ALARA

5. The development of the organism under the exposure in doses , in dozens and hundreds of times lower than LD_{50} will cause?
a)Stimulation b) Morphological changes c)Inhibition if growth d) Radisensitization

6. What does dose-response curve describes?

7. ……- time during which the number of radionuclides in the body being reduced twice due to biological processes during metabolic processes.

8. Who of the named categories of population refers to category B according to radiation safety norms?
   a) the persons who do not work directly with sources of ionizing radiations, but nevertheless may be additionally exposed to irradiation due to location of their workplaces in premises, on industrial sites of radiation-nuclear technologies enterprises or due to location of their living places. Such persons belong to the personnel
   b) the personnel (professional workers) – individuals working constantly or temporarily directly with sources of ionizing radiation. Those are workers of the nuclear fuel cycle enterprises, physicians-radiologists, some other categories of individuals which may be exposed to irradiation when perform their duties
   c) population that lives on a contaminated territories

9. Arrange the correct links,

1	Radioblokers	a	Adaptogens
2	Radiodecorporants	b	Complexons - 2
3	Radiorenewals	c	Entherosorbents
4	Radioprotectors	d	Regeneration activators

10.	The first atomic bomb was tested in ……. year.
11.	Radiodekorporants are ……..
12.	Please select the stochastic types of radiobiological effects? a) Radiation stimulation; b)Morphological changes; c)Acute radiation syndrome (ARS); d)Genetic effects; e) The acceleration of aging and reduction in life expectancy; f)Radiation induced death
13.	Please, decipher abbreviation IAEA ……..
14.	Combined in the correct sequence the group of radiotoxicity and isotopes: 1. group A — a) ^{3}H, ^{7}Be, ^{14}C, ^{15}O, ^{40}K 2. group B — b) ^{90}Sr, ^{106}Ru, ^{131}I, $^{134,137}Cs$, $^{233\text{-}238}U$ 3. group C — c) ^{210}Pb, ^{210}Po, ^{211}At, ^{226}Ra, ^{239}Pu 4. group D — d) $^{22,24}Na$, ^{32}P, ^{35}S, ^{60}Co
15.	Limiting intake of radionuclides with food and water; Blocking processes of radionuclide absorption in the gastrointestinal tract and deposition in specific organs; Accelerating excretion of radionuclides which were included into tissue (incorporated radionuclides) are principles of a) minimizing the income and accumulation of radionuclides in the human body b) maximizing of useful properties c) ALARA d) ICRP
16.	Hematopoietic, gastrointestinal, neurovascular are symptoms of …….
17.	What are the units for surface radioactivity? a) Bq/kg b) Bq/m^2 c) Ci d) Sv/m^2 e) Gy/m^2
18.	Changes that occur in the living organism during the ontogeny are inherited? a) genetic b) ontogenetic c) somatic d) stochastic
19.	Please, decipher abbreviation ICRP ……..
20.	Is there a completely safe dose of ionizing radiation? (True/False)
21.	Which organization approved PL-2006? a) NCRP, b) Cabinet of Ministers, c) ICRP, d) Ministry of Health.
22.	How do you deactivate hair contaminated by radioactive substances? a) water and shampoo with 3% solution of citric acid, b) with soap and water, c) solution of potassium permanganate, d) 5% solution of sodium sulfate.
23.	From what age persons are allowed to work with sources of ionizing radiation? a) 16 years, b) 21 years, c) 18 years, d) 25 years.
24.	How many classes of work with radioactive substances are regulated by the Basic Sanitary Regulations? a) 5, b) 2, c) 4, d) 3.
25.	Is it allowed to carry out the same radiation diagnostic procedures several times? (True/False).
26.	What is the maximum permissible dose rate of γ-radiation in projected accommodation (μR / h)? a) 30, b) 50, c) 20, d) 70.
27.	What is the permissible content of ^{137}Cs in drinking water, according to PL-2006 (Bq/l)? a) 2, b) 5, c) 10, d) 20.

28.	Is it introduced restriction on the consumption of local food products in the late phase of a radiation accident? (True/False).
29.	What type of detergents is Trilon B used to remove the residual activity of radioactive substances as a result of their reaction with skin proteins a) weak acid solutions, b) adsorbents, c) complexing agents.
30.	What is the maximum annual effective dose during the preventive screening of the population (fluorography), mSv? a) 1, b) 5, c) 10, d) 0,1.

9. Teaching methods

The main form of knowledge control is to conduct modular tests and tests. Based on the results of modular tests, the main score is derived, which is translated into rating points. To them are added points for oral knowledge in each content module.

10. Forms of assessment

According to the "Regulations on examinations and assessments at the National University of Bioresources and Nature Management of Ukraine", approved by the academic council of the National University of Bioresources and Nature Management of Ukraine on April 26, 2023, protocol No. 10, the types of knowledge control of higher education students are current control, intermediate and final attestation.

Current control of the discipline is carried out during practicals, and aims to check the level of preparedness of higher education applicants to perform a specific job.

Intermediate attestation is conducted after studying the program material and should determine the level of knowledge of higher education students in the program material obtained during all types of classes and independent work.

Form of intermediate certification - testing,

The assimilation of the program material by the student of higher education is considered successful, if its rating is at least 60 points on a 100-point scale.

Semester certification is conducted in the form of a semester exam.

Applicants of higher education are required to take exams and tests in accordance with the requirements of the working curriculum within the time limits provided by the schedule of the educational process. The content of the exam is determined by the working curriculum of the discipline.

11. Distribution of points received by students

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 26.04.2023)

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Not passed

In order to determine the rating of a student (listener) in the discipline $\mathbf{R_{dis}}$ (up to 100 points), the rating from the exam $\mathbf{R_{ex}}$(up to 30 points) is added to the rating of a student's academic work $\mathbf{R_{aw}}$ (up to 70 points): $\mathbf{R_{dis} = R_{aw} + R_{ex}}$.

12. Educational and methodological support.

1. International Atomic Energy Agency Safety Standards Series No. RS-G-1.8, Environmental and Source Monitoring for Purposes of Radiation Protection for protecting people and the environment, Safety Guide, IAEA, VIENNA, 2005, p.119.
2. Salbu, B. Fractionation of radionuclide species in the environment. Journal of Environmental Radioactivity, 100 (4), 2009, p. 283-289.

13. RECOMMENDED LITERATURE

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4. Chernobyl: 30 Years of Radioactive Contamination Legacy. Report. Lead writer and coordination of report: Prof. Valerii Kashparov, Kyiv, 2016, 59 p.

5. Climate change and nuclear power. International Atomic Energy Agency, VIENNA, 2005, 112 p.
6. Natural and induced radioactivity in food. International Atomic Energy Agency, VIENNA, 2002, 136 p.
7. Gleyzes, C., Tellier, S. & Astruc, M. Fractionation studies of trace elements in contaminated soils and sediments: a review of sequential extraction procedures. Trac-Trends in Analytical Chemistry, 21 (6-7), 2002, p. 451-467.
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14. Моисеев А.А., Иванов В.И. Справочник по дозиметрии и радиационной гигиене. - М.: Энергоатомиздат, 1990. - 252с.
15. НРБУ-97/2000
16. Пристер Б.С., Лощилов Н.А., Немец О.Ф., В.А. Поярков. Основы сельскохозяйственной радиологии. - К.: -Урожай, 1991.- 472с.
17. Хомутінін Ю.В., Кашпаров В.О., Жебровська К.І. Оптимізація відбору і вимірювань проб при радіоекологічному моніторингу, Монографія. – К.: Український науково–дослідний інститут сільськогосподарської радіології, 2002, 160 с.
18. Радиационный мониторинг облучения населения в отдаленный период после аварии на Чернобыльской АЭС, Рабочий Документ: ТС проект RER/9/074, Вена, Австрия, 2006, 81с.
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4. https://www.iaea.org/newscenter/news/fukushima-nuclear-accident-update-log-15
5. http://www.unscear.org/docs/reports/2008/11-80076_Report_2008_Annex_C.pdf
6. https://www.wright.edu/sites/www.wright.edu/files/page/attachments/radiation-safety-biological-effects-of-ionizing-radiation.pdf
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