

**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF
UKRAINE**

Department of General Ecology, Radiobiology and Safety of Life Activity

"APPROVED"

The Faculty of Plant Protection, Biotechnologies and Ecology

“21” May 2025

**CURRICULUM OF ACADEMIC DISCIPLINE
RADIOBIOLOGY AND RADIOECOLOGY**

Field of knowledge 10 Natural sciences

Specialty 101 Ecology

Academic programme "Ecology"

Faculty: Plant Protection, Biotechnologies and Ecology

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Description of the discipline RADIOBIOLOGY AND RADIOECOLOGY

Radiobiology, or radiation biology, is a science about effects of ionizing radiations on living organisms and their groups. During the last decades in a radiobiology next to such traditional directions as a medical radiobiology, animal radiobiology, plant radiobiology, agricultural radiobiology, radiation ecology, et al some new directions was expressly selected. They are molecular radiobiology, radiation biochemistry, radiation cytology, radiation genetics. That means that the objects of study of radiobiology are not only living organisms and their groups, but also molecules, cells and cell populations, separate processes of metabolism. And new determination of radiobiology appears. Now it is the science about effects of ionizing radiations on the living systems of all of levels of organization. This formulation is not alternative to the first are they both correct.

Academic degree, specialty, academic programme		
Academic degree	Bachelor	
Specialty	101 Ecology	
Academic programme	"Ecology"	
Characteristics of the discipline		
Type	Selective	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	3	
Form of assessment	Exam	
Indicators of the discipline for full-time and part-time forms of university study		
	Form of obtaining higher education	
	Full-time	Part-time
Year of study	3	3
Semester	1	5
Lectures	30 hours	2 hours.
Practical classes and seminars	- hours	- hours
Laboratory classes	30 hours	6 hours
Self-study	60 hours	112 hours
Number of hours per week for full-time students	4	

1. Aim, objectives, competences and expected learning outcomes of the discipline

Primary purpose of study of discipline “Radiobiology and radioecology» is a capture thorough knowledge about influence of ionizing radiations on living organisms, mastering of the applied aspects of specialty, related to radiation safety, and also practical application of knowledge, for the solving of research and applied tasks.

Acquisition of competences:

Integral competence (IC): Ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection environment and balanced environmental management, which involves the application of basic theories and methods of environmental sciences, characterized by complexity and uncertainty of conditions.

General competencies (GC):

GC1. Knowledge and understanding of the subject area and professional activity.

GC8. Ability to conduct research at an appropriate level.

Professional (special) competencies (SC):

SC5. Ability to assess the impact of technogenesis processes on the environment and identify environmental and radiation risks associated with production activities.

SC11. The ability to inform the public about the state of environmental security and balanced nature management.

Expected Learning Outcomes (ELO):

ELO9. Demonstrate skills in assessing unpredictable environmental problems and thoughtfully choosing ways to solve them.

ELO22. Participate in the development of projects and practical recommendations for environmental protection.

2. Programme and structure of the discipline

Names of content modules and topics	Number of hours												
	Full-time form							Part-time form					
	weeks	total	including					total	including				
			l	p	lab	ind	self		l	p	lab	ind	self
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Content Module 1. Introduction. Physical basics of radiobiology and radioecology													
Topic 1. Introduction to radiobiology. History	1-2	18	4		4	10		13	1		2	10	
Topic 2. Physical basics of radiobiology		16	2		4	10		10				10	
Topic 3. Sources of radioactive substances and ionizing radiation		4	2		2	-		12				12	
Total for content module 1	38		8		10	20		35	1		2	32	
Content Module 2. Biological effects of ionizing radiation													
Topic 4. Biological effects of ionizing radiation on plants and animals		14	2		2	10		13	1		2	10	
Topic 5. Radiosensitivity of plants, animals and other organisms		14	2		2	10		10				10	
Topic 6. Radiation protection and radiosensitization		4	2		2	-		10				10	
Topic 7. Post-radiation recovery of plants and animals		6	2		4	-		10				10	
Total for content module 2	38		8		10	20		43	1		2	40	
Content Module 3. Agriculture in terms of radioactive contamination													
Topic 8. Migration of		16	4		2	10		12			2	10	

radionuclides in the environment and objects of agriculture												
Topic 9. Measures to reduce the accumulation of radionuclides into crop and livestock products		18	4		4	10		10				10
Topic 10. Application of ionizing radiation in agricultural production and other fields of human activity and method of isotope indicators in biology and ecology		10	6		4	-		20				20
Total for content module 3	44		14		10	20		42			2	40
Total hours	120		30		30	60		120	2		6	112

3. Topics of lections

№	Topic title	Hours
1	Introduction to radiobiology. History	4
2	Physical basics of radiobiology	2
3	Sources of radioactive substances and ionizing radiation	2
4	Biological effects of ionizing radiation on plants and animals	2
5	Radiosensitivity of plants, animals and other organisms	2
6	Radiation protection and radiosensitization	2
7	Post-radiation recovery of plants and animals	2
8	Migration of radionuclides in the environment and objects of agriculture	2
9	Measures to reduce the accumulation of radionuclides into crop and livestock products	4
10	Application of ionizing radiation in agricultural production and other fields of human activity and method of isotope indicators in biology and ecology	4

4. Topics of laboratory classes

№	Topic title	Number of hours
1	Radiation safety standards and basic sanitary rules of radiation protection	4
2	Determination of the flow of β -particles from the radiation source	2
3	Determination of the β -radiation half-attenuation layer	2
4	Determination of the dose rate of γ -radiation created by the reference source ^{137}Cs through protective materials	2
5	Measurement of the γ -background in the premises and on the territory using the SRP-68-01 radiometer	4
6	Measurement of the specific and volume activity of β -emitting radionuclides using the "Beta" radiometer	4
7	Express determination by γ -radiation of cesium radionuclides in water, soil, food and agricultural products using the RUB-01-P6 radiometer	4
8	Determination of ^{137}Cs contamination of the territory using the RUB-01-P6 radiometer	4

9	Determination of the content of ^{137}Cs in the human body using the RUB-01-P6 radiometer	4
In total		30

5. Topics for self-study

No	Topic title	Number of hours
1	Classification and purpose of dosimetric control devices, their components. Devices of individual dosimetric control.	10
2	Preparation for operation of general dosimetric control devices - X-ray and radiometers	10
3	Units of measurement of doses and radioactivity, their relationship and conversion	10
4	Sampling of environmental objects and their preparation for radiometry	10
5	Calculation of the level of ^{137}Cs contamination of plant products	10
6	Calculation of the level of ^{137}Cs contamination of animal husbandry products	10
In total		60

6. Tools for assessing expected learning outcomes:

- oral or written questioning;
- interview;
- testing;
- defence of laboratory, calculation/graphic works, projects;
- peer assessment, self-assessment.

7. Teaching methods:

- the method of problem-based learning;
- method of practice-oriented learning;
- case method;
- method of learning through research;
- method of educational discussions and debates;
- method of teamwork, brainstorming.

8. Assessment of learning outcomes:

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades of the current Exam and Credit Regulations at NULES of Ukraine.

8.1. Distribution of points received by students

Topic	Hours (lectures/ practical works)	Results of study	Task	Evaluation
Module 1. Introduction. Physical foundations of radiobiology and radioecology				
Delivery of all practical works and performance of independent works takes place including in the elearn platform				
Topic 1. Introduction to radiobiology. History	2/4	Know the main stages of development of world and domestic radiobiology	Assess the contribution of Ukrainian radiobiologists to world radiobiology and radioecology	6
Topic 2. Physical foundations of radiobiology	2/4	Understand the basic physical processes of interaction of ionizing radiation with substances of living cells	Solving problems on the translation of radioactivity units and doses in the SI system and non-system units	7
Topic 3. Sources of	2/2	Distinguish between	Analyze the	7

radioactive substances and ionizing radiation		natural and artificial radionuclides; family-forming and non-family	contribution of various sources in the formation of the radiation background of the environment	
Total module 1				20
Module 2. Biological effect of ionizing radiation on living organisms				
Delivery of all practical works and performance of independent works takes place including in the elearn platform				
Topic 4. Biological effects of ionizing radiation on plants and animals	2/2	Analyze radiobiological effects, distinguish between somatic and genetic, near and far, deterministic and stochastic	Justify the stochasticity of certain radiobiological effects	5
Topic 5. Radiosensitivity of plants, animals and other organisms	2/2	Know the levels of semi-lethal doses for different species of organisms: plants and animals, humans, protozoa, bacteria and viruses	Give examples of calculation of LD50 and LD100	5
Topic 6. Radiation protection and radiosensitization	2/4	Understand and know the basic means of physical and chemical-pharmacological means of radiation protection	Give examples of CCU and FZD evaluation for the most effective radioprotectors	6
Topic 7. Post-radiation recovery of plants and animals	2/2	Distinguish the main ways of post-radiation recovery of the organism.	Evaluate the comparative contribution of individual pathways of post-radiation recovery to the overall recovery of higher plants and animals.	4
Total module 2				20
Module 3. Agriculture in the conditions of radionuclide contamination				
Delivery of all practical works and performance of independent works takes place including in the elearn platform				
Topic 8. Migration of radionuclides in the environment and agricultural facilities	4/2	Know the trophic chains of radionuclides in plants, animals and humans	Assess the contribution of individual routes of radionuclides to the human body in different periods of the Chernobyl accident	6
Topic 9. Measures to reduce the inflow of radionuclides into crop and livestock products	4/4	Know the basic measures to minimize the entry of radionuclides into the human body at all stages of the food chain	To evaluate the comparative effectiveness of individual methods of reducing the supply of radionuclides in crop and livestock products on the formation of the	7

			human radiation dose.	
Topic 10. Application of ionizing radiation in agricultural production and other spheres of human activity and method of isotopic indicators in biology and ecology.	6/4	Know the basic techniques and technologies for the use of ionizing radiation in agriculture, medicine, food industry and other areas of the economy.	To analyze the current opportunities and prospects of Ukraine for the widespread introduction of radiation and biological technologies in various sectors of the economy.	7
Total module 3				20
Additional points				10
Total for the semester				70
Exam				30
Total for the course				100

8.2. Scale for assessing students 'knowledge and skills

Student's rating, points	National grading of exams and credits
90-100	excellent
74-89	good
60-73	satisfactorily
0-59	unsatisfactorily

8.3. Assessment policy

Deadlines and exam retaking policy:	Works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g., a sick leave).
Academic integrity policy:	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance policy:	Attendance is compulsory. For good reasons (e.g., illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids

1. <https://elearn.nubip.edu.ua/enrol/index.php?id=835> Radiobiology and Radioecology
2. Gudkov I. M. Radiobiology and Radioecology (in English): Textbook for students of higher educational institutions. Вид. 2-е, переробл. та допов. К.: НУБіП України, Житомирська політехніка, 2019. 384 с.
3. Gudkov I. M. Radiobiology and Radioecology / I. M. Gudkov, M. M. Vinichuk. – К. : NAUU, 2006. – 295 p.
4. Choppin G. R., Liljenzin J.-O., Rydberg J. Radiochemistry and nuclear chemistry. 4th ed., Academic Press, 2013, 858 p.

10. Recommended sources of information

1. Chernobyl: 30 Years of Radioactive Contamination Legacy. Report. Lead writer and coordination of report: Prof. Valerii Kashparov, Kyiv, 2016, 59 p.
2. Climate change and nuclear power. International Atomic Energy Agency, VIENNA, 2005, 112 p.
3. Natural and induced radioactivity in food. International Atomic Energy Agency, VIENNA, 2002, 136 p.
4. 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.
5. 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.
6. Radiation biology: a handbook for teachers and students. International Atomic Energy Agency, VIENNA, 2010, 150 p.
7. Гродзинський Д.М. Радіобіологія. – К.: Либідь, 2000. – 448 с.
8. Гудков І.М. Радіобіологія: підручник. – Херсон : Олді-Плюс, 2016. – 504 с.
9. Гудков І.М., Гайченко В.А., Кашпаров В.О. Сільськогосподарська радіоекологія: підручник. – К.: Ліра-К, 2017. – 268 с.
10. Кічно В.О., Поліщук С.В., Гудков І.М. Основи радіобіології та радіоекології. – К.: Хай-Тек Прес, 2008 (2009). – 316 с.
11. НРБУ-97/2000.
12. Хомутинін 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.
13. Паренюк О.Ю., Ілленко В.В., Гудков І.М. Мікрофлора забруднених радіонуклідами ґрунтів. – К.: Вид-во НУБіП України, 2018. – 198 с.
14. Бондар О.І., Фещенко В.П., Гудков І.М., Гуреля В.В. Радіоекологічний термінологічний словник (україно-англійсько-російський). – Житомир: ПП Експертний центр Укреколбіокон, 2018. – 254 с.
15. Якість ґрунту. Методи відбору проб ґрунту для радіаційного контролю, СОУ 74.14-37-425:2006.
16. Якість ґрунту. Визначення щільності забруднення території сільськогосподарських угідь радіонуклідами техногенного походження, СОУ 74.14-37-424:2006
17. Якість продукції рослинництва. Методи відбору проб для радіаційного контролю, СОУ 01.1-37-426:2006.
18. Якість продукції тваринництва. методи відбору проб для радіаційного контролю, СОУ 01.2-37-427:2006.
19. Якість продукції тваринництва. Проведення прижиттєвого контролю тварин на територіях, забруднених радіонуклідами, СОУ 01.2-37-428:2006.