

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

Department of General Ecology, Radiobiology and Safety of Life Activity

APPROVED

Faculty of Plant Protection, Biotechnology and Ecology

“21” May 2026

**CURRICULUM OF ACADEMIC DISCIPLINE
RADIOBIOLOGY AND RADIOECOLOGY**

Field of knowledge 10 Natural sciences

Specialty E2 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 | <i>Bachelor</i> | |
| Specialty | <i>E2 Ecology</i> | |
| Academic programme | <i>"Ecology"</i> | |
| Characteristics of the discipline | | |
| Type | Selective | |
| Total number of hours | 120 | |
| Number of ECTS credits | 4 | |
| Number of modules | 3 | |
| Form of assessment | <i>Exam</i> | |
| 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 | <i>30 hours</i> | <i>2 hours.</i> |
| Practical classes and seminars | <i>- hours</i> | <i>- hours</i> |
| Laboratory classes | <i>30 hours</i> | <i>6 hours</i> |
| Self-study | <i>60 hours</i> | <i>112 hours</i> |
| 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.

List of courses that must be completed prior to studying ‘Radiobiology and radioecology’ (where applicable) foreign language

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 | | | | |
| | | | 1 | p | lab | ind | self | | 1 | 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 | |

| | | | | | | | | | | | | |
|---|-----|----|----|--|----|----|--|-----|---|--|---|-----|
| 2 | | | | | | | | | | | | |
| Content Module 3. Agriculture in terms of radioactive contamination | | | | | | | | | | | | |
| Topic 8. Migration of radionuclides in the environment and objects of agriculture | | 16 | 4 | | 2 | 10 | | 12 | | | 2 | 10 |
| 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 lectures

| No | 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

| No | 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 | 4 |

| | | |
|---|--|----|
| | and agricultural products using the RUB-01-P6 radiometer | |
| 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 | 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 | ELO9, ELO22. Know the main stages of development of world and domestic radiobiology | 6 |
| Topic 2. Physical foundations of radiobiology | 2/4 | Understand the basic physical processes of interaction of ionizing radiation with substances of living cells | 7 |
| Topic 3. Sources of | 2/2 | Distinguish between natural and artificial | 7 |

| | | | |
|---|-----|--|------------|
| radioactive substances and ionizing radiation | | radionuclides; family-forming and non-family | |
| 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 | ELO9, ELO22. Analyze radiobiological effects, distinguish between somatic and genetic, near and far, deterministic and stochastic Know the levels of semi-lethal doses for different species of organisms: plants and animals, humans, protozoa, bacteria and viruses | 5 |
| Topic 5. Radiosensitivity of plants, animals and other organisms | 2/2 | Understand and know the basic means of physical and chemical-pharmacological means of radiation protection | 5 |
| Topic 6. Radiation protection and radiosensitization | 2/4 | Distinguish the main ways of post-radiation recovery of the organism. | 6 |
| Topic 7. Post-radiation recovery of plants and animals | 2/2 | | 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 | ELO9, ELO22. Know the trophic chains of radionuclides in plants, animals and humans Know the basic measures to minimize the entry of radionuclides into the human body at all stages of the food chain | 6 |
| Topic 9. Measures to reduce the inflow of radionuclides into crop and livestock products | 4/4 | Know the basic techniques and technologies for the use of ionizing radiation in agriculture, medicine, food industry and other areas of the economy. | 7 |
| 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 | | 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. Кіцно 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. 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.
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., Феценко 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.

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APPROVED

by the Dean of Plant Protection, Biotechnology and
Ecology Faculty
_____ (Kolomiets J.V.)
“ ____ ” _____ 2026

APPROVED

at the meeting of the Department of General
Ecology, Radiobiology and Safety of Life Activity
Minutes No9 of “14” May 2026
Head of the Department _____ (Klepko A.V.)

REVIEWED

Guarantor of the AP “Ecology”
_____ (Bogolubov V.M.)

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