

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

Department of General Ecology, Radiobiology and Safety of Life Activity



**"APPROVED"**

Dean of the Faculty of Veterinary Medicine  
(Tsvilikhovsky M.I.)

"\_\_" May 2024

**"APPROVED"**

at the meeting of General Ecology, Radiobiology  
and Safety of Life Activity Department  
Minutes № 11 of "22" May 2024

Head of the Department

Alla KLEPKO

**"REVIEWED"**

Guarantor of the AP "Veterinary Medicine"

Nataliia GRUSHANSKA

**CURRICULUM OF ACADEMIC DISCIPLINE**

**Veterinary Radiobiology**

Field of knowledge 21 Veterinary Science

Specialty 211 Veterinary Medicine

Academic programme " Veterinary Medicine "

Faculty (Education and Research Institute) Faculty of Veterinary Medicine

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(position, academic degree, academic title)

## Description of the discipline Veterinary Radiobiology

(name)

| <b>Academic degree, specialty, academic programme</b>   |                                |              |
|---|--------------------------------|--------------|
| Academic degree   | <i>master's</i>                |              |
| Specialty   | <i>211 Veterinary Medicine</i> |              |
| Academic programme  | <i>" Veterinary Medicine "</i> |              |
| <b>Characteristics of the discipline</b>  |                                |              |
| Type  | compulsory                     |              |
| Total number of hours   | 120                            |              |
| Number of ECTS credits  | 4                              |              |
| Number of modules   | 3                              |              |
| Course project (work) (if any)  |                                |              |
| Form of assessment  | <i>exam</i>                    |              |
| <b>Indicators of the discipline<br/>for full-time and part-time forms of university study</b> |                                |              |
|   | Full-time                      | Part-time    |
| Year of study   | 4                              |              |
| Semester  | 7                              |              |
| Lectures  | <i>15 hours</i>                | <i>hours</i> |
| Practical classes and seminars  |                                | <i>hours</i> |
| Laboratory classes  | <i>30 hours</i>                | <i>hours</i> |
| Self-study  | <i>75 hours</i>                | <i>hours</i> |
| Number of hours per week for full-time students   | <i>3 hours</i>                 |              |

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

The aim of studying the discipline "Veterinary Radiobiology" is to train a specialist who will be able to highly assess the radiation situation and develop measures to ensure the safety of animal husbandry in contaminated areas and obtaining "clean" from radionuclides livestock products.

The objectives of the discipline "Veterinary Radiobiology" are to form specialists capable of:

- independently assess the existing radiation situation and in cases of incidents related to the contamination of the environment with radioactive substances, the emergency radiation situation;
- conduct radiometric examination of objects of the environment of agricultural products, food products;

- predict the levels of possible entry of certain radionuclides into livestock and food products;
- develop measures to minimize the entry of radionuclides into livestock products.

**Acquisition of competences:**

Integral competence (IC): ability to solve complex tasks and problems in the field of veterinary medicine, which involves research and/or innovation and is characterised by uncertainty of conditions and requirements.

General competencies (GC):

GC03. Knowledge and understanding of the subject area and profession.

GC09. Ability to make informed decisions.

Special (professional) competences (SC):

SC16. Ability to protect the environment from contamination by livestock waste, as well as materials and veterinary products.

SC21. Ability to develop and implement measures to manage and prevent radiation damage and contamination of domestic animals and census in general with radionuclides.

Expected Learning Outcomes (ELO):

ELO10. Propose and use appropriate innovative methods and approaches to solving problem situations of professional origin.

ELO21. Develop measures to prevent radiation damage and contamination of livestock and census with radionuclides.

**2. Programme and structure of the discipline for:**

– full-time (part-time) form of study

| Modules and topics  | Number of hours |       |           |   |     |     |      |           |           |    |     |     |          |  |
|---|-----------------|-------|-----------|---|-----|-----|------|-----------|-----------|----|-----|-----|----------|--|
|   | full-time       |       |           |   |     |     |      | part-time |           |    |     |     |          |  |
|   | weeks           | total | including |   |     |     |      | total     | including |    |     |     |          |  |
|   |                 |       | l         | p | lab | ind | s.st |           | l         | p  | lab | ind | s.s<br>t |  |
| 2   | 3               | 4     | 5         | 6 | 7   | 8   | 9    | 10        | 11        | 12 | 13  | 14  |          |  |
| <b>Module 1. Introduction. Physical foundations of radiobiology</b>       |                 |       |           |   |     |     |      |           |           |    |     |     |          |  |
| Topic 1. Introduction Radiobiology and radioecology as a complete science | 1               | 9     | 2         |   | 2   |     | 5    |           |           |    |     |     |          |  |
| Topic 2. Radioactivity, types of ionising radiation and their dosimetry   | 2               | 17    | 3         |   | 4   |     | 10   |           |           |    |     |     |          |  |
| Topic 3. Sources of ionising radiation on the Earth                       | 3               | 7     |           |   | 2   |     | 5    |           |           |    |     |     |          |  |
| Topic 4. Physical basis of interaction                                    | 4               | 7     |           |   | 2   |     | 5    |           |           |    |     |     |          |  |

|  |       |    |   |    |   |    |    |  |  |  |  |  |  |  |
|--|-------|----|---|----|---|----|----|--|--|--|--|--|--|--|
| ionising radiation with substances of cells of living organisms  |       |    |   |    |   |    |    |  |  |  |  |  |  |  |
| Total for module 1   | 40    | 5  |   | 10 |   | 25 |    |  |  |  |  |  |  |  |
| <b>Module 2. Effects of ionising radiation on living organisms</b>   |       |    |   |    |   |    |    |  |  |  |  |  |  |  |
| Topic 1. Biological effects of ionising radiation in plants and animals  | 5     | 14 | 2 |    | 2 |    | 10 |  |  |  |  |  |  |  |
| Topic 2. Radiosensitivity of plants, animals and other organisms   | 6     | 9  | 2 |    | 2 |    | 5  |  |  |  |  |  |  |  |
| Topic 3. Anti-radiation biological protection and radiosensitisation   | 7     | 10 | 2 |    | 2 |    | 6  |  |  |  |  |  |  |  |
| Topic 4. Methods of protecting agricultural animals from the effects of ionising radiations  | 8-9   | 8  |   |    | 4 |    | 4  |  |  |  |  |  |  |  |
| Total for module 2   | 41    | 6  |   | 10 |   | 25 |    |  |  |  |  |  |  |  |
| <b>Module 3. Migration of radionuclides in the environment in the environment. Conducting livestock farming in areas contaminated with radionuclides territories</b> |       |    |   |    |   |    |    |  |  |  |  |  |  |  |
| Topic 1. Atmosphere and soil as initial links in the migration of radionuclides in the natural environment   | 10    | 7  | 2 |    |   |    | 5  |  |  |  |  |  |  |  |
| Topic 2. Uptake of radionuclides from soil into plants and animals, biological effect  | 10-12 | 11 | 2 |    | 4 |    | 5  |  |  |  |  |  |  |  |

|   |    |     |    |   |    |  |    |  |  |  |  |  |  |
|---|----|-----|----|---|----|--|----|--|--|--|--|--|--|
| of incorporated radionuclides   |    |     |    |   |    |  |    |  |  |  |  |  |  |
| Topic 3. Measures to reduction of intake of radionuclides in products livestock   | 13 | 7   |    |   | 2  |  | 5  |  |  |  |  |  |  |
| Topic 4. Cleaning of products livestock products from radionuclides by means of primary technological processing  | 14 | 7   |    |   | 2  |  | 5  |  |  |  |  |  |  |
| Topic 5. The use of of ionising radiation in the biological and natural sciences human activity and method of isotopic indicators in biology and ecology. | 15 | 7   |    |   | 2  |  | 5  |  |  |  |  |  |  |
| Total for module 3  |    | 39  | 4  |   | 10 |  | 25 |  |  |  |  |  |  |
| Total hours   |    | 120 | 15 |   | 30 |  | 75 |  |  |  |  |  |  |
| Course project (work)   |    |     |    |   |    |  |    |  |  |  |  |  |  |
| (if included in the curriculum)   |    |     | -  | - | -  |  | -  |  |  |  |  |  |  |
| Total hours   |    | 120 | 15 |   | 30 |  | 75 |  |  |  |  |  |  |

### 3. Topics of laboratory classes

| № | Topic title  | Hours |
|---|--|-------|
| 1 | Radiation safety standards and sanitary rules for working with ionising radiation sources  | 4     |
| 2 | Classification of dosimetric monitoring devices and their components. Preparation for operation of general general dosimetric monitoring devices - radiometers and roentgenometers       | 2     |
| 3 | Calculations of absorbed and equivalent doses of external and internal exposure of the body of humans and animals at different levels of contamination of the territory by radionuclides | 2     |
| 4 | Determination of total $\beta$ -activity of various environmental objects and agricultural products by express methods   | 2     |

|    |   |   |
|----|---|---|
| 5  | Types of ionising radiation doses, their measurement units, calculation and application   | 2 |
| 6  | Determination of $\gamma$ -radiation dose rate on the ground, indoors, from control sources and compliance of the results with radiation safety standards (NRBU-97)   | 2 |
| 7  | Determination of the density of $^{137}\text{Cs}$ contamination of the territory  | 2 |
| 8  | Determination of $^{137}\text{Cs}$ in water, soil, feed, livestock, bee and fish products using modern radiometric equipment and compliance of the research results with the requirements of current regulatory documents | 4 |
| 9  | In vivo determination of $^{137}\text{Cs}$ content in animals and humans  | 2 |
| 10 | Forecast of contamination levels of crop and livestock products with main dose-forming radionuclides  | 8 |

#### 4. Topics for self-study

| №  | Topic title  | Hours |
|----|--|-------|
| 1  | Radiation safety standards and sanitary rules for working with ionising radiation sources in Ukraine and in developed countries  | 5     |
| 2  | The history of nuclear weapons and its consequences for the radiation state of the environment.<br>Dynamics of changes in the radiation state after nuclear tests  | 10    |
| 3  | Calculations of absorbed and equivalent doses of external and internal radiation in real conditions of radioactive contamination of the territory after the Chernobyl accident   | 10    |
| 4  | Determination of total $\beta$ -activity of various environmental objects and agricultural products by express methods   | 10    |
| 5  | Why there are several types of radiation doses in radiobiology   | 5     |
| 6  | Determination of $\gamma$ -radiation dose rate on the ground, indoors, from control sources and compliance of the results with radiation safety standards  | 10    |
| 7  | Methods for determining the density of contamination of the territory with artificial radionuclides  | 10    |
| 8  | Peculiarities of determination of $^{137}\text{Cs}$ in water, soil, feed, livestock, bee and fish products using modern radiometric installations and compliance of research results with the requirements of current regulatory documents | 10    |
| 9  | In vivo determination of $^{137}\text{Cs}$ content in animals and humans   | 5     |
| 10 | Forecast of contamination levels of crop and livestock products with main dose-forming radionuclides   | 10    |

#### 5. Tools for assessing expected learning outcomes:

- exam;
- module tests;

- calculations and graphical calculations;
- defence of laboratory works;
- esse writing.

#### 6. Teaching methods:

- verbal method (lecture);
- practical method (laboratory training, task solution);
- visual method (method of illustrations, method of demonstrations);
- video method (remote, multimedia, web-based);
- independent work (completing assignments).

#### 7. Assessment methods:

- exam;
- oral or written questionnaire;
- modular testing;
- essays and reports;
- defence of laboratory works;

#### 8. Distribution of points received by students

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

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

To determine a student's rating in the discipline  $R_{DIS}$  (up to 100 points), the received assessment rating  $R_A$  (up to 30 points) is added to the academic performance rating  $R_{AP}$  (up to 70 points):  $R_{DIS} = R_{AP} + R_A$ .

#### 9. Teaching and learning aids

1. <https://elearn.nubip.edu.ua/course/view.php?id=667> Veterinary Radiobiology
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. 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.