NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Radiobiology and Radioecology Department

"CONFIRMED"
Acting Dean of Faculty of Plant Protection,
Biotechnology and Ecology
_____ J.V. Kolomiets
"___" _____ 2020

CONSIDERED AND APPROVED
at the meeting of Radiobiology and Radioecology Department
Protocol №_12_ from "_17_" _June___2020 p.
Head of the Department
_____ A.V. Klepko

CURRICULUM WORKING PROGRAM

"ASSESSMENT OF RADIATION RISKS FOR HUMANS AND ENVIRONMENT"

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

Kyiv – 2020

1. PURPOSE AND OBJECTIVE OF THE DISCIPLINE

The purpose of teaching the discipline "Assessment of radiation risks for humans and environment" is the formation of students' knowledge and skills for a comprehensive assessment of the impact on human health and the quality of the environment, objects of economic activity that use sources of ionizing radiation (NPP construction projects, operation of existing nuclear reactors, the Exclusion Zone, places of temporary localization of nuclear waste, etc.) in the scale of the chosen territory, provides skills for preliminary checking of compliance of projects with current legislation and safety requirements, guarantee of minimization of radioactive isotopes' intake to the human body with food products, skills in control and management of actions in the event of radiation accidents in order to assess the extent of pollution and radiation risks.

The task is to provide opportunities for using the acquired knowledge and skills for the description, analysis and prediction of radiation risks during the use of ionizing radiation sources under the conditions of limited information, as well as for the implementation of the master's thesis.

2. AFTER FINISHING OF COURSE STUDENTS HAVE TO

The student should know the characteristics of various types of ionizing radiation and the features of their interaction with living matter, the unit of measurement of radioactivity and doses of ionizing radiation, the basis of statistical processing of experimental data, sources of ionizing radiation in Ukraine and in the world.

Student should be able to:

- measure the specific, volume radioactivity for α-, β-, γ-radionuclides;
- use modern software packages (ERICA, Crom) to assess radiation risks, predict the level of pollution of the territory as a result of a radiation accident;
- conduct a comprehensive radioecological assessment of the territory;
- determine the level of risk for the population and the environment from the construction of objects using sources of ionizing radiation;
- formulate logical conclusions.

3. DISCIPLINE CONTENT AND TYPES OF EDUCATIONAL WORK

Types of educational activity	Total hours
The total laboriousness of the discipline	126
Lectures	20
Practical training	20
Independent student work	86
Type of final control	Exam

4. CONTENTS OF DISCIPLINE MODULES AND TYPES TO WORK

№	Topic	The topic content, recommended literature	Types of educational activity, hours.		
			lectures	practical training	independent work
		Module 1. Ecological and radiation risk			
1.1.	Scientific fundamentals of estimation and standardization of the effects of man-made systems on the environment	An ecological approach to the assessment of the state and regulation of the quality of the environment. Threshold and non-threshold concept. Environmental and sanitary regulation. Toxicological regulation of chemicals. Limit-permissible concentrations. Limit-permissible environmental load. Fields of influence; fields of concentration. *Literature: 1-7, 9, 10*	2	2	10
1.2	Ecological risk and basic principles of environmental safety.	Natural and man-made catastrophic processes. The role of radiation factors in environmental risk for the population. Geochemical factors of ecological risk. Features of ecological risk and criteria for its assessment. An economic approach to security issues; cost estimation of risk;	2	2	10

		acceptable level of risk. Connection of the level of security with the economic opportunities of society. Social aspects of risk; perception of risks and society's reaction to them. *Literature: 7, 9-11, 17*			
1.3	The main directions and methods of reducing the environmental risk	Environmental safety policy. Reducing the effects and compensating for the damage. Environmental Risk and Public Interaction. Placement of industrial facilities and environmental protection. Development and implementation of new technologies. Ecologically safe use of biotechnology. *Literature: 1, 4-8, 16, 21*	2	4	10
		Module 2. Theoretical and methodological bases of analysis and risk assessment			
2.1	Conceptually-methodical apparatus for analysis and risk assessment	Concepts of analysis and risk assessment. Methods of analysis and risk assessment. Models of analysis and risk assessment. *Literature: 4-7, 21, 22*	2	2	10
2.2	Formal means of constructing risk assessment models	System analysis. Expert methods and decision-making systems. Stochastic Modeling Techniques. Logic-probabilistic methods of safety research. Markov process. Poisson process. Method of statistical simulation of Monte Carlo. *Literature: 7, 21, 22*	2	2	10
2.3	Assessment of the risk related to the influence of ionizing radiation	Estimation of the dose absorbed by man due to the influence of ionizing radiation. Average doses of radiation of thyroid gland of children and adolescents of different regions of Ukraine. Radiation risk assessment. *Literature: 7, 16-19, 21, 22*	2	2	12
		Module 3. The use of information technology for the assessment and prediction of radiation risks			
3.1	Assessment of radiological	General information about COSYMA (Code System from MARIA). Three	2	2	6

	consequences of accidents using the COSYMA system	basic parts: the module for submitting input data, a software package and a module for submitting the results. Quantitative and qualitative characteristics of the incident. Calculation of individual and collective doses. Primary parameters groups: meteorological conditions, dispersion, parameters of sedimentation of radioactive particles, characteristics of the source of emissions, population density, consumption of products that may be contaminated, countermeasures, dose estimation and influence on public health, calculation of economic losses. *Literature: 7, 10-14, 18, 19, 21*			
3.2	Analysis of the distribution of emissions (discharges) of toxic and radioactive contaminants in the environment using the MEPAS system	MEPAS - "Integrated Environmental Pollution Assessment System". Integral risk assessment for human health and the environment. Creating a plausible basis for optimizing (by economic indicators) measures that reduce risk and risk. Conducting an analysis of the feasibility of practical implementation (using available resources) of the measures provided for rehabilitation of the territories. Planning of rational actions and measures for prevention and restoration of the environment and reducing the negative impact on human health. *Literature: 7, 10-14, 18, 19, 21*	2	-	6
3.3	Features of the ERICA software package	Simplification for dose estimation of ionizing radiation. Concept for determining the dose for animals and humans. List of radioactive isotopes for which an assessment can be made. Assessment of doses from internal and external radiation. *Literature: 7, 10-14, 18, 19, 21*	2	2	6
3.4	Modeling, forecasting and	Methodological basis of the program. Choice of model parameters:	2	2	6

risk assessment using the CROM software package	radioactive isotopes, radiation from radionuclides in air, soil, water, internal radiation due to consumption of contaminated food, due to inhaling radioactive isotopes with air. Prediction of the level of pollution of the territory at different distances from the source of emissions. *Literature: 7, 10-14, 18, 19, 21*			
	Total:	**20**	**20**	**86**

5. STUDENT RATINGS

5.1 Criteria for calculating the maximum number of points in conditions of rating by hours:

Lectures - for each hour of listened and recapitulated lecture – 0.5 points.

Practical classes - for every hour of completed and assigned task of practical classes - 1 point.

Independent work - for every hour of self-prepared and assigned task - 0.5 points.

Rating (maximum) of the student by modules considering hours as a criterion

Module	**$R_{e.w.}$**	**Credits**	**Lectures**	**Practice sessions**	**Independent work**	**Total**
1	M_1	1,33	6 · 0,5 = 3	8 · 1 = 8	30 · 0,5 = 15	26
2	M_2	1,33	6 · 0,5 = 3	6 · 1 = 6	32 · 0,5 = 16	25
3	M_3	1,33	8· 0,5 = 4	6 · 1 = 6	24 · 0,5 =12	22
	Total	4,0	10	20	43	**73**

Rating of educational work $\mathbf{R_{e.w.}}$ = 70 %, and rating of exam $\mathbf{R_{exam}}$ = 30 % from the total number of points (according to the Regulations).

In case of 100% mastering of discipline the student can get $\mathbf{R_{e.w.}}$ - 51 points, and $\mathbf{R_{exam}}$ - 22 points.

5.2 Rating of attestation for discipline

National score	**ECTS**	**Definition ECTS**	**$R_{dis.}$, points**	**$R_{dis.}$, actual points for discipline**
Excellent	A	***Excellent*** - perfectly performance, with only a small number of errors.	(0,9 – 1,0) · $R_{dis.}$	66 – 73
Good	B	***Very good*** - above average level with several mistakes	(0,82 – 0,89) · $R_{dis.}$	60 – 65

	C	***Good*** - generally correct with some mistakes	$(0{,}75 – 0{,}82) \cdot R_{dis.}$	55 – 59
Satisfactory	D	***Satisfactory*** - not bad, but with a significant number of shortcomings	$(0{,}66 – 0{,}74) \cdot R_{dis.}$	48 – 54
	E	***Enough*** - execution satisfies the minimum criteria	$(0{,}60 – 0{,}65) \cdot R_{dis.}$	44 – 47
Unsatisfactory	FX	***Unsatisfactory*** - you need to work before getting a score (positive rating)	$(0{,}35 – 0{,}59) \cdot R_{dis.}$	26 – 43
	F	***Unsatisfactory*** - serious further work is needed	$(0{,}01 – 0{,}34) \cdot R_{dis.}$	1 – 25

5.3 Discipline rating

$$R_{dis.} = R_{e.w.} + R_{exam} + R_{add.w.} – R_{penal}$$

Assume that the student scored only 55 points, which is 75% of 4.0 credits or $\mathbf{R_{dis.}}$ of student is 3.0 credit.

6. EXAMPLE OF CONTROL TASKS

<table>
<tr><td colspan="4">National University of Life and Environmental Sciences of Ukraine</td></tr>
<tr><td>Master 2st year study
Specialty
Radioecology</td><td>Radiobiology and Radioecology Department
2019/2020 study year</td><td>Test № __
from the course
Assessment of radiation risks for humans and environment</td><td>Approved
Head of department

Gudkov I.M.</td></tr>
<tr><td colspan="4">Questions</td></tr>
<tr><td colspan="4">1. Ways of radionuclide uptake to the organism of animals and humans.</td></tr>
<tr><td colspan="4">2. Comparative penetrating ability of various types of ionizing radiation.</td></tr>
<tr><td colspan="4">Tests</td></tr>
<tr><td>1.</td><td colspan="3">The probability that a person or their offspring will have a harmful effect as a result of exposure is:
a) Radiation risk; b) Oxygen effect; c) Radiobiological paradox; d) Probability theory</td></tr>
<tr><td>2.</td><td colspan="3">1 Sievert is equal to ... ber</td></tr>
<tr><td>3.</td><td colspan="3">The bulk of the radionuclides came to the human body in April-May 1986 through …
a) The skin; b) Lenses; c) Gastrointestinal tract; d) Wound surface</td></tr>
<tr><td>4.</td><td colspan="3">Exposure dose in the SI system is measured in units
a) Bq; b) Sv; c) C/kg; d) R</td></tr>
<tr><td>5.</td><td colspan="3">An equivalent dose in the SI system is measured in units …</td></tr>
<tr><td>6.</td><td colspan="3">The half-life of ^{137}Cs is ... years
a) 20; b) 30; c) 40; d) 50</td></tr>
<tr><td>7.</td><td colspan="3">Incorporated radionuclides are such that ...
a) Got on the skin; b) Got in gastrointestinal tract; c) Included in the tissues and organs;
d) Get to the ecosystem</td></tr>
<tr><td>8.</td><td colspan="3">The positively charged heavy nuclear particles forming the basis of atomic nuclei are called …</td></tr>
<tr><td>9.</td><td colspan="3">What statements are correct for β-particles:
a) Have ‘- ‘ charge; b) Consists of 2 protons and 2 neutrons; c) Is a nuclei of helium; d) Is the most harmful for organism</td></tr>
<tr><td>10.</td><td colspan="3">High-energy radiation, under the influence of which electrically neutral atoms turn into positively and negatively charged ions, is called ...</td></tr>
</table>

7. RECOMMENDED LITERATURE

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