

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
Educational Institution
BELARUSIAN STATE MEDICAL UNIVERSITY

Контрольный
экземпляр

APPROVED

by First Vice-Rector, Professor

I.N.Moroz



16.11.2022

Res. # UD-4.702/2223/edu.

RADIATION MEDICINE AND ECOLOGY

**Curriculum of higher educational institution
in the academic discipline for the specialty:**

1-79 01 07 «Dentistry»

Curriculum is based on the educational program «Radiation Medicine and Ecology», approved 16.11.2022, registration # УД-Л.702/2223/уч.; on the educational plan in the specialty 1-79 01 07 «Dentistry», approved 18.05.2022, registration # L 79-1-7/2223/mf.

COMPILERS:

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RECOMMENDED FOR APPROVAL:

by the Department of Radiation Medicine and Ecology of the educational institution «Belarusian State Medical University»
(protocol # 2 of 14.09.2022);

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»
(protocol # 9 of 16.11.2022)

EXPLANATORY NOTE

«Radiation Medicine and Ecology» - is the academic discipline of the Medical-Prophylactic Module containing systematized scientific knowledge about the impact of environmental factors, including ionizing radiation, on the state of public health, the formation of radiation and environmentally caused pathology.

The goal of the the discipline «Radiation Medicine and Ecology» is the formation of basic professional competencies to ensure environmental and radiation safety in order to preserve and improve public health.

The objectives of the discipline «Radiation Medicine and Ecology» are to form students' scientific knowledge about the patterns of the impact of environmental factors on human health, the risks of development and pathogenetic mechanisms of the formation of radiation- and environmentally conditioned pathology, methods for individual and population prevention of diseases and pathological conditions, caused by chronic low-dose exposure to physical, chemical and biological factors; skills and abilities required for:

- reducing the impact of environmental factors on public health;
- prevention of environmentally related diseases.

The knowledge, proficiency and skills gained in the process of study of the «Radiation Medicine and Ecology» discipline are demanded for the successful study of the following disciplines: «Radiodiagnostics and Radiotherapy», «Internal Diseases».

A student who has mastered the content of the educational material of the academic discipline shall gain the following basic professional competencies:

BPC 1. Use knowledge about the patterns of the impact of environmental factors on human health, apply methods of hygienic assessment of the human environment to develop basic preventive measures that save health.

BPC 2. Use knowledge about the risks of developing pathology, which is caused by radiation and environmental factors, apply methods to reduce radiation and environmental stress on the population.

As a result of studying the discipline «Radiation Medicine and Ecology» discipline the student should

know:

mechanisms of influence of natural and anthropogenic environmental factors on human health;

principles of origin and diminution of radiation exposure to the population due to the impact of natural and man-made sources of ionizing radiation;

a set of measures to protect the population in case of radiation accidents;

principles of adhering the healthy lifestyle and rational behavior in the relevant radiation and environmental situation;

be able to:

promote among the population a way of life, that is adequate to the ecological situation;

evaluate radiation dose burden on different categories of exposed individuals under normal operation of ionizing radiation sources and in the event of a radiation accident, to interpret the evaluation results;

master:

methodology of assessment of health risks from the exposure to environmental factors;

methods for reducing dose burden on the population exposed to radiation;

approaches to a healthy lifestyle principles implementation and rational behavior in the relevant radiation and environmental situation.

As a part of the educational process in this academic discipline, the students shall acquire not only theoretical knowledge and skills in the specialty, but also develop the personal values, spiritual potentials, mold the traits of a patriot and citizen, prepared to actively participate in economic, industrial, social cultural and social life of the country.

Total number of hours for the study of the discipline is 58 academic hours. Classroom hours according to the types of studies: lectures - 18 hours (including 6 hours of supervised student independent work), practical classes - 18 hours, student independent work (self-study) - 22 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit in 4th semester.

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures (including supervised independent work)	supervised student independent work	laboratory studies (practical classes and seminars)		
1-79 01 07 «Dentistry»	4	58	36	18	6	18	22	credit

THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	practical
1. Ecological Medicine	8	8
1.1. Basics of ecological medicine. Environmental factors	2	2
1.2. Environmental and medical consequences of biosphere pollution	4	4
1.3. Monitoring of the environment and the health status of the population	2	2
2. Radiation Medicine	10	10
2.1. Fundamentals of ionizing radiation action	2	2
2.2. Levels of exposure of humans to ionizing radiation. Radiation background of the Earth	2	2
2.3. Health and biological consequences of exposure to ionizing radiation	2	2
2.4. Control of radiation safety	2	2
2.5. Reduction in radiation burden on population	2	2
Total hours	18	18

CONTENT OF THE EDUCATIONAL MATERIAL

1. Ecological Medicine

1.1. Basics of ecological medicine. Environmental factors

Environmental Medicine (medical environment): definition, goals, objectives. The history of the development of environmental medicine. The concept of «environmental illness». Methods of studying the influence of the environment on human health. Contribution of various factors and possible mechanisms of environmentally related diseases. Environmentally sensitive public health. Effect of chronic exposure to subthreshold values of environmental factors on the environmentally sensitive morbidity. Sensitive approach to the diagnosis, treatment and prevention of disease from the standpoint of environmental medicine.

Role of Environmental Medicine in the formation of physicians for preventive health care needs of the Republic.

Environmental factors: basic concepts, classification. Characteristics of abiotic and biotic environmental factors. Mechanisms of action of environmental factors and the human population. Human adaptation to environmental factors. Specific and nonspecific mechanisms of protection against the adverse effects of environmental factors. Environmental factors and human health.

Chronobiology and chronomedicine. The influence of the visible region of the solar spectrum and the light on the person. Biological rhythms. Prevention and treatment of «winter depression (seasonal affective disorder)». Effect of ultraviolet

radiation (UVR) per person, the mechanisms of natural protection from the damaging effect of UV radiation, the effects of UVR on human action. Geomagnetic factors: characteristics, human reaction to the action of geomagnetic factors, prevention of their adverse effects. Meteosensitivity: definition, classification of severity of clinical manifestations and types of meteoropatic reactions.

Pathogenetic mechanisms of action of chemical factors on the human body. Foreign chemicals (xenobiotics): definition, classification, general characteristics. Properties of xenobiotics determining their toxicity. Mechanisms of toxic action. Toxicokinetics: resorption of xenobiotics, distribution in the body, metabolism of xenobiotics excretion.

Effectors of the endocrine system: definition, classification, properties, metabolism and mechanism of action, the consequences of long-term intake of a person.

Multiple chemical sensitivity: concept, the reasons for the development, clinical manifestations, diagnosis, treatment tactics. Ecotoxicology.

Pathogenetic mechanisms of action of biological factors on the human body.

The role of genetic factors in the occurrence of environmentally sensitive human pathology. Frequency of mutations. Mechanisms of genotoxicity of xenobiotics. Mutations at the chromosomal level. Meaning of genomic instability in occurrence of diseases in humans. Somatic mutations and tumor oncogenes role and tumor repressor genes. DNA repair processes. Determination of mutation spectrum - screening of genotoxic xenobiotics in the environment.

1.2. Environmental and medical consequences of biosphere pollution

Environmental and medical consequences of atmosphere pollution.

Chemical conversion of nitrogen oxides, sulfur and carbon in the atmosphere. Smog: concept, types, conditions of development. Photochemical smog; effects of photochemical oxidants in the human body.

Ozone Layer: characteristic, protective function. The problem of ozone depletion. Environmental and health effects of reducing the total amount of stratospheric ozone.

«Greenhouse effect»: the notion of reason. Environmental and health effects of the global rise in temperature on the planet.

Environmental and medical consequences of hydrosphere pollution.

Hydrosphere: concept, characteristics. Eutrophication: the concept, the causes of the consequences.

Characteristics and features of action of xenobiotics, ingested with water, including particularly neurotoxicity and nephrotoxicity.

Environmentally sensitive public health. Drinking water quality criteria: epidemiological safety, safety in chemical composition, good organoleptic properties, radiation safety.

The impact of lithosphere condition and food quality on the human health.

Geomedicine - the field of environmental medicine. The concept of the essential and non-essential elements, and their role in causing disease in humans.

Migration of xenobiotics in the biosphere. Features of the toxic effect of xenobiotics with ingestion in humans.

Endemic pathology in Belarus. Norms of iodine intake for various groups of the population. Epidemiological criteria of iodine supply of the population. Iodine deficiency disorders in the population. Conditions and factors contributing to the formation of endemic goiter, the effect of xenobiotics on thyroid function. Nonspecific and specific prevention of endemic goiter. Side effects specific iodine prophylaxis. Medical monitoring of the effectiveness of iodine prophylaxis.

The main sources and effects of soil contamination. Environmental and health consequences of intensive agro-technical and agrochemical measures, soil contamination from sewage, exhaust gases, radioactive elements, waste production and consumption.

Nitrites and nitrates: chemical characteristics, sources of the human body, metabolism, mechanism of the damaging effect, the health consequences of their getting into the organism, their role in childrens pathology development. N-nitroso compounds: chemical characteristics, sources of income, mechanisms of action, the health consequences of exposure.

Characteristics of food: composition; main xenobiotics ingested with food (pesticides, mycotoxins, fertilizers, salts of heavy metals, carcinogens, radionuclides et al.); compound forming of the organoleptic quality of the products; biologically active substances. Features of hepatotoxicity of xenobiotics entering getting into the organism with food.

Genetically modified organisms and food: the concept, the possible risks to the environment and human health, biosafety.

Prevention of possible adverse effects of xenobiotics supplied with food into the human organism.

Detoxification of xenobiotics: concept phase. Chemical modification of xenobiotics. Microsomal oxidation system. Cytochrome P-45Q. The main pathways of oxidation of hydrophobic substrates. The concept of metabolic activation. Inhibitors and inducers of microsomal oxidation. Conjugation of xenobiotics; enzymes involved in conjugation reactions, regulation of their activity.

Medical aspects of indoor environment influence on population health.

Ecological characteristics of the environment of residential and public buildings. Physical, chemical, biological factors of the indoor environment, affecting human health.

Characteristics of non-ionizing electromagnetic radiation (NIEMI). International Classification of electromagnetic waves in frequency. The use of nonionizing electromagnetic radiation in medicine. Mechanisms of interaction between non-ionizing electromagnetic radiation with biological structures.

Medical aspects of exposure to non-ionizing electromagnetic radiation on the human body. Electro-: definition, prevalence among the population, the Clinical manifestations. The consequences of actions of NIEMI on the nervous, endocrine, immune and reproductive systems. Electromagnetic fields (Electrosmog): concept, sources, characteristics, reducing the adverse effects of its impact on the population. Radiotelephone. Mobile communication: principles, particularly the influence of pulsating radiation on the human body. Electromagnetic compatibility.

Features rationing NIEMI impact on the population.

Ionization of indoor air.

«Sick Building Syndrome»: concept, the reasons for the development of clinical manifestations (sensory irritation, skin irritation, asthenia and specific reactions), medical-diagnostic tactics.

1.3. Monitoring of the environment and the health status of the population

Monitoring: concept, types. System of global and local monitoring. National Environment Monitoring System (NSMGS). Public health monitoring (SHM): definition, goals, objectives, milestones.

Analysis of the received information in the course of monitoring, forecasting possible developments.

Study of the influence of environmental factors on human health: modeling method on animals, monitoring the population (questionnaire, questionnaire method, processing of statistical data, epidemiological studies), health risk assessment under the influence of environmental factors.

Legal and regulatory framework for the protection of the environment. The basic principles of environmental law. Environmental and natural resources legislation: Constitution of the Republic of Belarus, the laws of the Republic of Belarus «On Environmental Protection», «On State Ecological Expertise» and others. The right of citizens to health, a healthy environment and to compensation for the harm caused by violation of this right. Responsibility for violation of environmental law.

2. Radiation Medicine

2.1. Fundamentals of ionizing radiation action

Nuclear medicine: definition, objectives, goals, methods. The role of the radiation factor in human life and society. History of Radiation Medicine. The role of Radiation Medicine in the formation of the medical staff for the needs of preventive health of the Republic. Relationship of Radiation Medicine with Nuclear Physics, General Biology, Biochemistry, Cytology, Genetics, Radiobiology, Radiation Hygiene, clinical disciplines. Natural and artificial sources of ionizing radiation.

Classification of ionizing radiation and its properties.

The essence of the phenomenon of radioactivity. Radioactivity units. Types of radioactive decay of nuclei. The law of radioactive decay. The interaction of charged particles with matter. The concept of linear energy transfer (LET). The interaction of electromagnetic radiation with matter. Features of the interaction of neutrons with matter. The phenomenon of induced radioactivity.

Methods for the detection of ionizing radiation: physical, chemical, biological. Characteristics of ionization, scintillation, photographic, chemical, thermoluminescence methods for detecting ionizing radiation. Their use in radiation medicine and hygiene. Biological dosimetry. Reconstruction of received doses by man.

Dosimetry. Doses: exposure, absorbed, equivalent and effective; Unit dose ratio between traditional and system units. Collective doses. Calculation of doses from external and internal exposure of the body due to the Chernobyl release of radionuclides. General and individual dosimetry.

Radiometry. Principles of radiometric studies. Control of internal radiation doses of the population. Methods of measurement of absorbed radio-caesium.

The stage of formation of radiation damage. Direct and indirect effects of

ionizing radiation. Radiolysis of water, the main products of radiolysis. The influence of oxygen on the course of radiolysis. Oxygen effect. The role of water radiolysis products in the inactivation of macromolecules and cell death. Radiotoxins. Radiation biochemistry of nucleic acids. DNA repair. Changing the supramolecular structures of chromatin. Chromosomal aberrations. Radiation biochemistry of proteins, lipids and carbohydrates. Effects of ionizing radiation on the cell membrane structure. Violation of lipid, carbohydrate, water and mineral metabolism in the irradiated organism. Types of cell response to radiation. Modern views on the mechanisms of interphase and mitotic cell death. Radiation recovery'.

2.2. Levels of exposure of humans to ionizing radiation. Radiation background of the Earth

Background radiation of the Earth, its components. The contribution of different components of the radiation background to the formation of the average mean annual effective dose on the population. Natural background radiation, characteristics of natural sources of ionizing radiation of terrestrial and extraterrestrial origin. Radionuclides are radioactive series, which form the main dose burden on the human body: U-238, Th-232, Ra-226, Rn-222, Po-210, Pb-210, Bi-210. Radon and its sources, the formation of exposure doses on population due to radon. Optimization of radiation dose due to radon and its decay products. Natural radionuclides are not included in radioactive ranks. The role of K-40 in the formation of radiation dose on the population of the Republic of Belarus. The value of optimizing radiation dose due to background radiation for the residents of the Republic of Belarus.

Man-made (artificial) radiation background, its components and their contribution to the formation of public exposure. Global fallout radionuclides due to nuclear weapon tests and the process of work of a nuclear reactor. Stage of the nuclear fuel cycle; radionuclides generated during the work of a nuclear reactor; formation of doses to the population in normal plant operation. Contribution to medical ionizing radiation sources in the formation of doses in residents of the Republic of Belarus.

Radiation situation in Belarus before the accident at the Chernobyl nuclear power plant.

2.3. Health and biological consequences of exposure to ionizing radiation

Radiosensitivity issue - the central problem of Radiobiology and Radiation Medicine. Molecular basis of radiosensitivity. Radiosensitivity of cells, organs and tissues. Rule Bergonie - Tribondo. The action of ionizing radiation on various organs and systems. Individual and age differences in radiosensitivity. Effects of radiation on the embryo and fetus.

Modification of radiosensitivity.

Radiation injuries to humans Factors determining the defeat of the body. The concept of «critical organ»

Radiation syndromes: bone marrow, gastrointestinal, cerebral, - dose dependent characteristics, causes of death of the organism.

Deterministic and stochastic consequences of exposure to ionizing radiation. Deterministic effects of radiation: the concept of dose-dependent characteristic effects. Stochastic effects of radiation: the concept of dose-dependent characteristic effects. Somato-stochastic and genetic effects. The concept of «low-dose ionizing radiation»

Possible options for the dose dependence of stochastic effects at low doses of ionizing radiation on the human body. Radiation hormesis.

Expected health effects of the particular individual and overall human population under long-term low-dose exposure.

2.4. Control of radiation safety

International and national regulatory authorities and management in the field of radiation safety. Basic principles of radiation safety.

General characteristics of the main documents regulating the work with sources of ionizing radiation: the law of the Republic of Belarus «On Radiation Safety», radiation safety standards, basic sanitary rules of radiation safety.

The concept of open and closed sources of ionizing radiation. Methods of protection against ionizing radiation, «the amount of protection», «time to protect», «protection of distance», «protection screens» Radiation safety personnel and the public during normal work of ionizing radiation sources.

The concept of radiation accidents. Limitation of public exposure in a radiation accident. The criteria for a decision to protect the population in radiation accidents.

2.5. Reduction in radiation burden on population

Unified state system of control and determination of individual doses.

Reducing radiation dose in the population when using sources of ionizing radiation in medicine: the normative documents regulating the exposure of patients; justification of the need for X-ray and radiodiagnostic studies; categories of subjects requiring radiological assistance of varying degrees; dose reference levels for patients with X-ray and radiodiagnostic studies; forms of individual doses determining of patients; organization, methodological and technical measures reducing the dose received by the patient Protection of patients during radiotherapy.

Principles of reducing annual effective dose, which is formed by the accidental release of radionuclides. Reduction of the annual effective dose of external radiation: decontamination of the territory and of the environment; evacuation, relocation and resettlement, etc. Reduced annual effective internal dose: a balanced diet; limit intake of radionuclides in the body; limited intake of radionuclides in the gastrointestinal tract; accelerate removal of radionuclides from the body; decrease of the damaging effects of radionuclides; increasing the adaptive-compensatory capacity of the organism, including optimization of physical activity.

Principles of the population residing in contaminated areas.

ACADEMIC DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	number of hours				Self-studies	Form of control
		lectures (including supervised student independent work)	supervised student independent work	practical			
1	Ecological Medicine	8	2	8	10		
<i>1.1.</i>	Basics of ecological medicine. Environmental factors Practical works: «Assessment of the risk of seasonal emotional disease». «Evaluation of the type of skin sensitivity to UV radiation. Assessment of risk for skin malignancy»	2	0.5	2	2	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests	
<i>1.2.</i>	<i>Environmental and medical consequences of biosphere pollution</i>	4	1	4	6		
	Environmental and medical consequences of biosphere pollution. Environmental and medical consequences of atmosphere pollution. Environmental and medical consequences of hydrosphere pollution	2	0.5	-	1	Interviews	
	Environmental and medical consequences of biosphere pollution. Environmental and medical consequences of atmosphere pollution. Environmental and medical consequences of hydrosphere pollution Practical works:	-	-	2	3	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting	

	<p>«Assessment of ozone level in ambient air».</p> <p>«Evaluation of the composition of food products»</p> <p>Environmental and medical consequences of biosphere pollution. The impact of lithosphere condition and food quality on the human health</p> <p>Environmental and medical consequences of biosphere pollution. The impact of lithosphere condition and food quality on the human health</p> <p>Practical work:</p> <p>«Evaluation of the composition of food products»</p>	2	0.5	-	1	and defense of the essays, problem solving, electronic tests
		-	-	2	3	Interviews
						Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests
1.3.	<p>Monitoring of the environment and the health status of the population</p> <p>Practical work:</p> <p>«Assessment of the environmental cancer risk»</p>	2	0.5	2	2	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests
2	Radiation Medicine	10	4	10	12	
2.1.	<p>Fundamentals of ionizing radiation action</p> <p>Practical works:</p> <p>«Calculation of the percentage of radionuclides after an accidental release»/ «Calculation of the time required to achieve a given activity in environmental objects»</p>	2	1	2	2	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests
2.2.	<p>Levels of exposure of humans to ionizing radiation.</p> <p>Practical work:</p> <p>«Evaluation of the ambient dose equivalent rate of roentgen and gamma radiation by the MKC-6130A dosimeter-radiometer»</p>	2	1	2	2	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests

2.3.	<p>Health and biological consequences of exposure to ionizing radiation</p> <p>Practical work: «Calculation the annual effective dose from external exposure of humans to radionuclides of the Chernobyl NPP accidental release»</p>	2	0.5	2	2	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests
2.4.	<p>Control of radiation safety</p> <p>Practical work: «Calculation of the human annual effective dose incurred from internal exposure to radionuclides of the Chernobyl NPP accidental release (oral and inhalation routes of intake considered), assessment of the result obtained»</p>	2	0.5	2	3	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests
2.5.	<p>Reduction of radiation loads on the population</p> <p>Practical work: «A set of measures to diminish the annual effective dose from external and internal exposure»</p>	2	1	2	3	Interviews, quizzes, written reports on practical work, reports on classroom practical exercises with their oral defense, reporting and defense of the essays, problem solving, electronic tests. Credit
		18	6	18	22	

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic (relevant):

1. Радиационная медицина = Radiation medicine : учеб. пособие для иностр. студентов учреждений высш. образования по мед. спец. / Стожаров, Александр Николаевич [и др.] ; под ред. А. Н. Стожарова. - Минск : Новое знание, 2020. - 205 с.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allotted for independent work can be used by students for:

- preparation for lectures, laboratory classes;
- preparation for the test in the academic discipline;
- elaboration of topics (questions) submitted for independent study;
- problem solving;
- performing research and creative tasks;
- preparation of thematic reports, abstracts, presentations;
- performing practical tasks;
- taking notes of educational literature;
- compilation of a review of scientific literature on a given topic;
- design of information and demonstration materials (stands, posters, graphs, tables, newspapers, etc.);
- production of layouts, laboratory and teaching aids;
- compilation of a thematic selection of literary sources, Internet sources;
- preparation of tests for the organization of mutual control.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

Main forms of supervised student independent work:

- preparation and presentation of abstracts;
- presentation of reports;
- studying topics and problems that have not been discussed at the lectures;
- taking notes of original sources (sections of anthologies, collections of documents, monographs, textbooks);
- computer testing;
- participation in active forms of education.

Control of supervised student independent work is carried out in the form of:

- final class, colloquium in the form of an oral interview, written work, testing;
- defense of educational assignments;
- assessment of an oral reply to a question, presentation, report or problem solving;
- checking up abstracts, written reports, accounts, prescriptions;

checking up notes of original sources, monographs and articles;
individual interview.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competences assessment:

Oral form:

interviews;

Written form:

quizzes;

written reports on practical work;
credit.

Oral and written form:

reports on classroom practical exercises with their oral defense;
solving situational problems with their oral defense;
reporting and defense of the essays.

Technical form:

electronic tests.

LIST OF USED TEACHING METHODS

Traditional method (lecture, laboratory practicals);

Active (interactive) methods:

problem-based learning PBL;

team-based learning TBL ;

research-based learning RBL.

LIST OF PRACTICAL SKILLS

1. Evaluation of the safe time of ultra violet irradiation impact on human organism.
2. Evaluation of environment-associated human health risks.
3. Evaluation of the ambient equivalent dose rate.
4. Calculation and estimate of the predicted percentage of radionuclides remaining at different times after the accident.
5. Calculation of the time period required for environmental objects to reach a given activity.
6. Calculation of the human annual effective dose incurred from external exposure to radionuclides of the Chernobyl NPP accidental release (calculation grounded on the ambient dose equivalent rate), assessment of the result obtained.
7. Calculation of the human annual effective dose incurred from internal exposure to radionuclides of the Chernobyl NPP accidental release (oral and inhalation routes of intake considered), assessment of the result obtained.
8. Elaboration of a set of relevant measures to reduce human doses burden from external and internal exposure.

LIST OF EQUIPMENT USED

Photoelectric colorimeter КФК-2МР.

МКС-6130А dosimeter-radiometer.

LIST OF LECTURES

1. Basics of environmental medicine. Environmental factors.
2. Environmental and medical consequences of biosphere pollution. Environmental and medical consequences of atmosphere pollution. Environmental and medical consequences of hydrosphere pollution.
3. Environmental and medical consequences of biosphere pollution. The impact of lithosphere condition and food quality on the human health.
4. Monitoring of the environment and the health status of the population.
5. Fundamentals of ionizing radiation action.
6. Levels of exposure of humans to ionizing radiation.
7. Health and biological consequences of exposure to ionizing radiation.
8. Control of radiation safety.
9. Reduction in radiation burden on population.

LIST OF LABORATORY (PRACTICAL) STUDIES

№ lesson	Topic name
1	Practical works: «Assessment of the risk of seasonal emotional disease», «Evaluation of the type of skin sensitivity to UV radiation. Assessment of risk for skin malignancy»
2	Laboratory work: «Assessment of ozone level in ambient air»
3	Practical work: «Evaluation of the composition of food products»
4	Practical work: «Assessment of the environmental cancer risk»
5	Practical works: «Calculation of the percentage of radionuclides after an accidental release», «Calculation of the time required to achieve a given activity in environmental objects»
6	Practical work: «Evaluation of the ambient dose equivalent rate of roentgen and gamma radiation by the МКС-6130А dosimeter-radiometer»
7	Practical work: «Calculation the annual effective dose from external exposure of humans to radionuclides of the Chernobyl NPP accidental release»
8	Practical work: «Calculation of the human annual effective dose incurred from internal exposure to radionuclides of the Chernobyl NPP accidental release (oral and inhalation routes of intake considered), assessment of the result obtained»
9	Practical work: «A set of measures to diminish the annual effective dose from external and internal exposure»

THE THEMES OF ESSAYS/ABSTRACTS

Ecological Medicine

1. Biochemical mechanisms of xenobiotic detoxification (detoxification systems; cytochrome system R-450, features of the functioning of detoxification systems in the child's body).
2. The influence of geomagnetic factors on various systems of the human body, including the child. Prevention of adverse effects of geomagnetic factors.
3. General scheme of oxidative stress, prevention of its consequences.
4. Influence of environmental chemical factors on the immunological reactivity of the child's body.
5. Urbanization and population health.
6. The influence of ozone and other photochemical oxidizers on the human body, the peculiarities of their effect on the child's body.
7. Environmental problems of the Republic of Belarus.
8. Genetically modified organisms (GMOs) and genetically modified foods (concept, history, use, risks to human health and the environment, biosecurity assurance). Use of GMOs in baby food products.
9. Dietary supplements (PD). (PD, ensuring the required appearance and organoleptic properties of the product. PDs that prevent microbial or oxidative spoilage of products. PD required in the food process. Food Quality Improvers, etc. PD). Use of PD in baby food products.
10. Environmental and medical consequences of environmental pollution with metal compounds (lead, nickel, cadmium, copper, zinc, mercury, manganese, chromium).
11. Environmental and medical consequences of indoor pollution (pollutants of physical, chemical and biological origin).
12. Possible medical consequences of the use of mobile communications. Optimization of dose loads on the population.
13. Volatile organic compounds in residential areas and public health.
14. Endemic pathology in the Republic of Belarus.
- 15. Radiation Medicine**
16. Reduction of radiation loads on patients during X-ray and radiodiagnostic studies.
17. Radiation hormesis: an experiment and practical use.
18. Biomedical consequences of the Chernobyl accident.
19. Effectiveness of medical examination of the population exposed to radiation during radiation accidents.
20. Unified state system for recording population exposure doses.
21. State program for overcoming the consequences of the Chernobyl accident and rehabilitation of territories contaminated with radionuclides.
22. Modification of radiosensitivity: experiment and practical use.
23. Rational nutrition in conditions of chronic low-dose radiation-chemical exposure.
24. Development of nuclear energy in the Republic of Belarus.

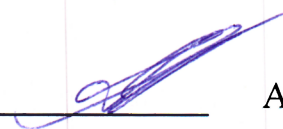
25. Organization and performance of a set of protective measures in case of radiation accidents.
26. System for implementation of basic principles for ensuring radiation safety.
27. Radiation monitoring system in the Republic of Belarus.
28. Comparative Characteristics of Human Internal Irradiation Doses during Oral and Inhalation Intake of Natural and Man-made Radionuclides.
29. Control of radiation safety of food and water.

**PROTOCOL OF THE CURRICULUM APPROVAL
BY OTHER DEPARTMENTS**

The nomination of the academic discipline to achieve a required coordination.	Department name	Suggestions for changes in the content of the curriculum of a higher education establishment in the academic discipline	Decision made by the department that developed the curriculum (the date and registered number of the Minutes included)
1. Radiodiagnosis and Radiotherapy	Radiodiagnosis and Radiotherapy	No comments or suggestions	Recommended for approval, protocol # 2 of September 14, 2022
2. Internal diseases	Internal Medicine No.1	No comments or suggestions	Recommended for approval, protocol # 2 of September 14, 2022

COMPILERS:

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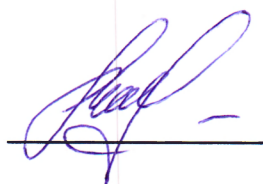
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Y.A. Siarheyeva

Curriculum content, composition and the accompanying documents comply with the
established requirements.

Dean of the Medical Faculty for
International Students of the
educational institution «Belarusian
State Medical University»

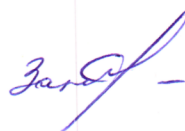
21. 11. 22



O.S. Ishutin




Methodist of the educational institution
«Belarusian State Medical University»

21. 11. 22



S.V. Zaturanova

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