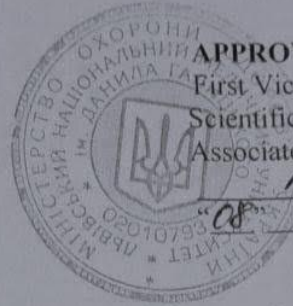


DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY

Department of Radiology and Radiation Medicine



APPROVED

First Vice-Rector for
Scientific and Pedagogical Work
Associate Professor Iryna SOLONYNKO

Iryna Solonyenko

“08” 11 2023

EDUCATIONAL PROGRAMME OF DISCIPLINE RADIOLOGY

OK 24.1

Second (master's) level of higher education
Branch of knowledge 22 “Health care”
Specialty 222 “Medicine”

Discussed and approved at the
methodical meeting of the department
of Radiology and Radiation Medicine
Protocol No 11
from April 27, 2023
Head of the Department

Igor DATS
As.Prof. Igor DATS

Approved by the profile methodical
commission
of medical disciplines
Protocol No 3
from May 04, 2023

Head of the profile methodical commission
Olena RADCHENKO
Prof. Olena RADCHENKO

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DEVELOPERS OF THE PROGRAMME:

Igor DATS - Head of the Department of Radiology and Radiation Medicine, PhD, associate professor

Yulian MYTSYK – doctor of medical sciences, professor of the Department of Radiology and Radiation Medicine

Bohdana VERVEHA - doctor of medical sciences, associate professor of the Department of Radiology and Radiation Medicine

Nataliya SKALETSKA - PhD, associate professor of the Department of Radiology and Radiation Medicine

Inna DANYLEYCHENKO - PhD, associate professor of the Department of Radiology and Radiation Medicine

Igor MAKAGONOV - PhD, associate professor of the Department of Radiology and Radiation Medicine

REVIEWERS:

Mykhailo SOROKIVSKY - PhD, associate professor, Head of the Department of Radiation Diagnostics of Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University

Nataliya VOLOD'KO - doctor of medical sciences, professor, Head of the Department of Oncology and Radiology of Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University

Head of the Department of Radiology
and Radiation Medicine

PhD, Associate Professor Igor DATS



Signature

Introduction

Programme for studying of educational discipline «Radiology»
 according to the Standard of higher education of the second (master's) level
 field of knowledge 22 “Health Care”
 specialty 222 “Medicine”
 educational program of the master of medicine

Description of educational discipline

Radiology is one of the fundamental natural sciences in the system of higher medical education, the knowledge of which is necessary for the high-quality training of specialists in the field of health care. This is due to the fact that radiological research methods occupy a leading place in the diagnosis of most diseases. In recent decades, medical radiology has been replenished with new research methods (computed tomography and magnetic resonance imaging, ultrasound, positron and single-photon emission tomography, interventional methods), and only 40% of radiological diagnostics is left to traditional radiology. The state standards of higher medical education also provide that a clinician should be able to evaluate the possibilities of various methods of radiation therapy and choose the optimal one for the treatment of tumor and non-tumor diseases.

Knowledge of radiology will allow the future specialist to choose the optimal research method for detecting functional and morphological changes in the pathology of various organs and systems, and to interpret the data of radiological diagnostic methods in relation to clinical diagnosis, to evaluate the possibilities of various methods of radiation therapy and to choose the optimal one for the treatment of tumor and non-tumor diseases.

Structure of educational discipline	Amount of credits, hours, of them			Year of study, semester	Type of control	
	Total	Auditory				
		Lectures (hours)	Practical classes (hours)			Independent work
Name of the discipline: Radiology	4 credits / 120 hours	14	45	61	3 cours (5 and 6 semesters)	Differentiated credit
By semesters:						
Medical Radiology	2 credits/ 60 hours	6	22	32	5 semester	credit
Medical Roentgenology	2 credits/ 60 hours	8	23	29	6 semester	Differentiated credit

The subject of study of the academic discipline is:

ionizing and non-ionizing radiation, main properties of ionizing radiation, physical and technical foundations of various methods of radiation diagnostics. Radiology studies the diagnostic possibilities of using each of the radiation methods in the diagnosis of diseases of various organs and systems, indications and contraindications for their use. She studies the principles and methods of radiation therapy and their purpose for the treatment of oncological and non-oncological pathology.

Interdisciplinary connections: The study of the discipline "Radiology" is based on the knowledge of medical biology, parasitology and genetics, medical physics, biological chemistry, bioorganic chemistry, bioinorganic chemistry, physical and colloidal chemistry, human anatomy, normal physiology and is integrated with these disciplines, based on the knowledge of pathological anatomy and pathological physiology, which students receive in parallel with the study of radiology. It lays the foundations for the study of propaedeutics of internal diseases with patient care, general surgery with anesthesiology and patient care, propaedeutics of pediatrics with child care, which involves the integration of teaching with these disciplines and the formation of skills to apply radiology knowledge in the process of further education and in professional activity.

1. Aim and tasks of the discipline

1.1. The aim of teaching the educational discipline "Radiology" is the formation of the scientific outlook of students, the development of modern forms of theoretical thinking and the ability to analyze the results of radiation research, the formation of abilities and skills for the application of radiation diagnostics methods during the study of other disciplines and in future practical activities.

1.2. The main tasks of teaching the academic discipline "Radiology" is to teach students to use the methods of radiation diagnostics and radiation therapy in the diagnosis and treatment of oncological and non-oncological pathology of various organs and systems to solve specific tasks in the field of health care in accordance with modern needs.

1.3 Competencies and learning outcomes, the formation of which is facilitated by the discipline (relationship with the normative content of the training of higher education applicants, formulated in terms of learning outcomes in the Higher Education Standard).

– integral competencie

The ability to solve complex tasks, including those of a research and innovation nature in the field of medicine.

The ability to continue learning with a high degree of autonomy.

According to the requirements of the Higher Education Standard, the discipline ensures that students acquire the following **competencies**:

-general competencies (CG):

GC1. Ability to abstract thinking, analysis and synthesis;

GC2. Ability to learn and master modern knowledge;

GC3. Ability to apply knowledge in practical situations;

GC4. Knowledge and understanding of the subject area and understanding of professional activity;

GC5. Ability to adapt and act in a new situation;

GC6. Ability to make informed decisions;

GC7. Ability to work in a team;

GC8. Ability to interpersonal interaction;

GC10. Ability to use information and communication technologies;

GC11. Ability to search, process and analyze information from various sources

GC12. Determination and persistence in relation to assigned tasks and assumed responsibilities;

GC13. Awareness of equal opportunities and tender issues;

GC14. The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine;

GC15. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place

in the general system of knowledge about nature and society and in the development of society, technology and technology, use different types and forms of motor activities for active recreation and leading a healthy lifestyle.

- special (professional, subject) competences (PC):

- PC1.** Ability to collect medical information about the patient and analyze clinical data;
- PC2.** Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results;
- PC3.** Ability to establish a preliminary and clinical diagnosis of the disease;
- PC4.** The ability to determine the necessary regime of work and rest in the treatment and prevention of diseases;
- PC5.** The ability to determine the nature of nutrition in the treatment and prevention of diseases;
- PC6.** Ability to determine the principles and nature of treatment and prevention of diseases;
- PC7.** Ability to diagnose emergency conditions;
- PC8.** The ability to determine the tactics of providing emergency medical care;
- PC9.** Ability to conduct medical evacuation measures;
- PC10.** Ability to perform medical manipulations;
- PC11.** Ability to solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility;
- PC15.** The ability to conduct an examination of working capacity;
- PC16.** Ability to maintain medical documentation, including electronic forms;
- PC17.** Ability to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population;
- PC20.** Ability to conduct epidemiological and medical-statistical research on the health of the population; processing of social, economic and medical information;
- PC21.** It is clear and unambiguous to convey one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to persons who are studying;
- PC24.** Adherence to ethical principles when working with patients and laboratory animals;
- PC25.** Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results.

Detailing of competencies in accordance with the NQF descriptors in the form of the "Matrix of competences".

Matrix of competences

№	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
Integral competence					
The ability to solve complex tasks, including those of a research and innovation nature in the field of medicine. Ability to continue learning with a high degree of autonomy.					
General competencies (GC)					
GC-1	Ability to abstract thinking, analysis and synthesis	To own an abstract thinking, analysis and synthesis	Ability to abstract thinking, analysis and synthesis	The ability to effectively use the results of abstract thinking	To be responsible for the results of abstract thinking, analysis and synthesis

Nº	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
GC-2	Ability to learn and master modern knowledge	Have modern knowledge	Ability to learn and master modern knowledge. Have modern knowledge	Ability to use modern knowledge	To be responsible for the results of using modern knowledge
GC-3	Ability to apply knowledge in practical situations	To have specialized conceptual knowledge acquired in the learning process	To be able to solve complex tasks and problems that arise in professional activity	Clear and unambiguous presentation of one's own conclusions, knowledge and explanations, which justify them to specialists and non-specialists	To be responsible for making decisions in difficult conditions
GC-4	Knowledge and understanding of the subject area and understanding of professional activity	To have in-depth knowledge of the structure of professional activity	To be able to carry out professional activities that require updating and integration of knowledge	The ability to effectively form a communication strategy in professional activities	To be responsible for professional development, the ability for further professional training with a high level of autonomy
GC-5	Ability to adapt and act in a new situation	To have deep knowledge of adaptation and action in a new situation	To be able to use the acquired knowledge to adapt and act in a new situation	Communicate effectively in a new situation	To be responsible for actions in a new situation
GC-6	Ability to make informed decisions.	To have deep knowledge to justify the decision	Be able to make informed decisions based on knowledge	To use acquired knowledge to justify a decision	To be responsible for informed decisions
GC-7	Ability to work in a team	To know teamwork methods Have searching, processing and analyzing information from various sources	to make informed decisions based on knowledge	To use acquired knowledge in teamwork	To be responsible for working in a team
GC-8	Ability to interpersonal interaction	To have interpersonal skills	To be able to work in a team	To use acquired knowledge for interpersonal interaction	To be responsible for interpersonal interaction
GC-10	Ability to use information and communication technologies	To have deep knowledge in the field of information and communication technologies used in professional activities	To be able to use information and communication technologies in a professional field that requires updating and integration of knowledge	To use information and communication technologies in professional activities	To be responsible for the development of professional knowledge and skills

№	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
GC-11	Ability to search, processing and analysis of information from various sources	To have searching, processing and analyzing information from various sources	To be able use the results search, processing and analysis of information	To use the results search, processing and analysis of information in professional activity	To be responsible for the results search, processing and analysis of information
GC-12	Determination and persistence in relation to assigned tasks and assumed responsibilities	Possess persistence in relation to assigned tasks and assumed responsibilities	To be able persevere in performing assigned tasks and responsibilities	To communicate with those around him in the performance of assigned tasks and duties	To be responsible for the performance of one's duties and assigned tasks
GC-13	Awareness of equal opportunities and gender issues	To have gender issues	To be able use knowledge of opportunities and gender issues	To use the results of knowledge in professional activity	To be responsible for using knowledge of opportunities and gender issues
GC-14	The ability to realize one's rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine	To have skills in to realize their rights and responsibilities as a member of society, to be aware of the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine	To be able use their rights and responsibilities as a member of society	To use acquired knowledge, rights and obligations in professional activity	To be responsible for the realization of one's rights and duties as a member of society
GC-15	The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle	To have the ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle	To be able use moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle	To use moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology. Use various types and forms of motor activity for active recreation and leading a healthy lifestyle	To be responsible for the preservation and multiplication of moral, cultural, scientific values and achievements of society on the basis of understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology

№	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
Special (professional) competies					
PC-1	Ability to collect medical information about the patient and analyze clinical data	To have in-depth knowledge of interviewing and clinical examination of the patient	To be able to use knowledge for interviewing and clinical examination of the patient	To use the acquired knowledge for interviewing and clinical examination of the patient	To be responsible for the interview and clinical examination of the patient
PC-2	Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results	To have in-depth knowledge of laboratory and instrumental research and evaluation of their results	To be able to use laboratory and instrumental research	To use acquired knowledge to evaluate laboratory and instrumental research	To be responsible for the assessment of laboratory and instrumental studies
PC-3	Ability to establish a preliminary and clinical diagnosis of the disease	To have special knowledge before establishing a preliminary and clinical diagnosis of the disease	To be able to establish a preliminary and clinical diagnosis of the disease	To substantiate the establishment of a preliminary and clinical diagnosis of the disease	Be responsible for establishing a preliminary and clinical diagnosis of the disease
PC-4	The ability to determine the necessary regime of work and rest in the treatment and prevention of diseases	To have the knowledge to determine the necessary regime of work and rest in the treatment of diseases	To be able to prescribe the necessary regime of work and rest in the treatment of diseases	To substantiate the necessary mode of work and rest during the treatment of diseases	To be responsible for prescribing the necessary regime of work and rest during the treatment of diseases
PC-5	The ability to determine the nature of nutrition in the treatment and prevention of diseases	To have knowledge to determine the nature of nutrition in the treatment of diseases	To be able to prescribe the necessary diet for the treatment of diseases	To justify the necessary diet in the treatment of diseases	To be responsible for the prescribed diet during the treatment of diseases
PC-6	Ability to determine the principles and nature of treatment and prevention of diseases	To have knowledge to determine the principles and nature of treatment of diseases	To be able to prescribe the appropriate treatment of diseases	To justify the appropriate treatment of diseases	To be responsible for the prescribed treatment. Be responsible for diagnosing emergency conditions
PC-7	Ability to diagnose emergency conditions	To have special knowledge to diagnose emergency conditions	To be able to diagnose emergency conditions	To substantiate the diagnosis of emergency conditions.	To be responsible for determining the tactics of providing emergency medical care
PC-8	The ability to determine the tactics of providing emergency medical care	To have specialized knowledge to determine the tactics of providing emergency medical care.	To be able to determine the tactics of providing emergency medical care	To justify the tactics of providing emergency medical aid	To be responsible for the prescribed treatment. Be responsible for diagnosing emergency conditions. To be responsible for determining the tactics of providing emergency medical care

№	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
PC-9	Ability to carry out medical evacuation measures	To have knowledge of medical evacuation measures	To be able carry out medical evacuation measures	To substantiate the conduct of medical evacuation measures	To be responsible for carrying out medical evacuation measures
PC-10	Ability to perform medical manipulations	Have knowledge to perform medical manipulations	To be able perform medical manipulations	To use acquired knowledge to perform medical manipulations	To be responsible for performing medical manipulations
PC-11	Ability to solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	To have knowledge to solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	To be able solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	To use acquired knowledge to solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	To be responsible for solving medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility
PC-15	The ability to conduct an examination of working capacity	To have knowledge for carrying out an examination of working capacity	To be able to perform examination of working capacity	To use acquired knowledge to carry out an examination of working capacity	To be responsible for the conducted examination of working capacity
PC-16	Ability to maintain medical documentation, including electronic forms	To have knowledge of medical documentation management, including electronic forms	To be able to maintain medical documentation, including electronic forms	To use acquired knowledge when maintaining medical documentation, including electronic forms	To be responsible for maintaining medical documentation, including electronic forms
PC-17	The ability to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population	To have knowledge to assess the influence of the environment, socio-economic and biological determinants on the state of health of an individual, family, population	To be able to assess the influence of the environment, socio-economic and biological determinants on the state of health of the individual, family, population	To use the acquired knowledge to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population	To be responsible for assessing the impact of the environment, socio-economic and biological determinants on the state of health of the individual, family, population
PC-20	Ability to conduct epidemiological and medical-statistical research on the health of the population; processing of social, economic and medical information	To have knowledge for conducting epidemiological and medical-statistical studies of the health of the population; processing of social, economic and medical information	To be able to conduct epidemiological and medical-statistical studies of the health of the population; processing of social, economic and medical information.	To use the acquired knowledge to conduct epidemiological and medical-statistical research on the health of the population; processing of social, economic and medical information	To be responsible for conducting epidemiological and medical-statistical researches on the health of the population; processing of social, economic and medical information

№	Competencie	Knowledge	Skills	Comunication	Autonomy and responsibilities
PC-21	It is clear and unambiguous to convey one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to people who are studying	To have skills to clearly and unambiguously convey one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to people who are studying	To be able clearly and unambiguously convey one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to people who are studying	To use acquired skills to clearly and unambiguously communicate one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to students	To be responsible for clearly and unambiguously conveying one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists, in particular to people who are studying.
PC-24	Adherence to ethical principles when working with patients and laboratory animals	To have skills of observing ethical principles when working with patients and laboratory animals..	To be able adhere to ethical principles when working with patients and laboratory animals.	To use acquired skills to observe ethical principles when working with patients and laboratory animals.	To be responsible for compliance with ethical principles when working with patients and laboratory animals..
PC-25	Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results.	To have skills to observe professional and academic integrity, bear responsibility for the reliability of the obtained scientific results.	Be able to observe professional and academic integrity, to be responsible for the reliability of the obtained scientific results.	To use the acquired skills to maintain professional and academic integrity, bear responsibility for the reliability of the obtained scientific results.	To be responsible for observe professional and academic integrity, bear responsibility for the reliability of the obtained scientific results.

Results of study:

Integrative final program learning outcomes, the formation of which is facilitated by the study discipline "Radiology":

1. Evaluate the results of radiological studies and parameters characterizing pathological changes in the functions of systems and organs.
2. Determine the necessary additional radiological methods in the treatment of the disease.
3. Determine the principles and nature of treatment (conservative, operative) of the disease.
4. Determine the tactics of providing emergency medical care based on the diagnosis of an emergency.
5. Identify negative environmental factors; to analyze the state of health of a certain contingent; determine the existence of a connection between the state of the environment and the state of health of a certain contingent; develop preventive measures based on data on the relationship between the state of the environment and the state of health of a certain contingent.

Results of study of "Radiology" discipline:

To know:

1. To know methods and means of protection against ionizing radiation;
2. To know the main properties of ionizing radiation;
3. To know radioactivity, its units and doses;
4. To know the structure of radiometers and dosimeters;
5. To know radiomodifying agents;
6. To know the basic principles and tasks of radiation therapy;

7. To know indications and contraindications for radiation therapy;
8. To know the algorithms of radionuclide diagnostics of different organs and systems, the basics of X-ray semiotics;
9. To know methods of contact radiation therapy;
10. To know hepatobiliary nuclear medicine imaging;
11. To know renal imaging in nuclear medicine;
12. To know radiopharmaceuticals used for renal scintigraphy and for hepatobiliary scintigraphy;
13. To know the role and place of ultrasound diagnostics in the complex of diagnostic radiology;
14. To know gallbladder radionuclide scan;
15. To know radionuclide diagnostics of diseases of the thyroid gland, hepatobiliary and cardiovascular systems;
16. To know tumor-tropic radiopharmaceuticals;
17. To know the biological effect of ionizing radiation;
18. To know the classification and characteristics of tumor markers;
19. To know methods of "in vivo" and "in vitro" diagnostics;
20. To know local radiation reactions and complications, clinic, treatment, prevention;
21. To know how to make a clinical and radiological diagnosis;
22. To know the chest X-ray anatomy and radiological methods of assessing of the lungs;
23. To know X-ray methods of imaging of the heart and large vessels;
24. To know the radiological features of diseases of salivary gland;
25. To know radiological signs of gallbladder, liver and biliary tract diseases;
26. To know X-ray anatomy and physiology of the urinary system;
27. To know radiological signs of pathology of the reproductive system and mammary glands;
28. To know radiographic findings of the bones and joints associated with aging;
29. To know radiographic signs of diseases and injuries of the bones and joints;
30. To know the radiological signs of pathology of the skull and spine, brain and spinal cord;
31. To know the radiological signs of diseases signs of diseases in otorhinolaryngology and ophthalmology;
32. To know modern diagnostic imaging such as Computed Tomography scans and Magnetic Resonance Imagine;
33. To know the radiological features of the diagnosis of viral pneumonias, including atypical pneumonia due to SARS-CoV-2;
34. To know radiological semiotics of foreign bodies.

To be able:

1. To be able to choose a method of radiation therapy for tumors and non-tumor diseases;
2. To be able to determine the radiotherapeutic interval;
3. To be able to choose the optimal radiological examination to detect functional and morphological changes in the pathology of different organs and systems;
4. To be able to interpret a hepatogram;
5. To be able to interpret a renogram;
6. To be able to choose the field of irradiation;
7. To be able to interpret the chest X-ray;
8. To be able to evaluate the X-ray image of the heart and large vessels;
9. To be able to draw up a radiation treatment plan for oncological diseases;
10. To be able to carry out a radiological examination of the lung;
11. To be able to conduct a radiological examination of the heart and large vessels;
12. To be able to conduct a radiological examination of the gastro-intestinal tract;
13. To be able to conduct a radiological examination of the hepatobiliary system;
14. To be able to conduct a radiological investigation of the urinary system;

15. To be able to conduct a radiological investigation of the reproductive system and mammary glands;
16. To be able to conduct a radiological examination of the bone-joint system;
17. To be able to conduct a radiological examination of the central nervous system;
18. To be able to conduct a radiological examination in otorhinolaryngology and ophthalmology;
19. To be able to describe radiological features of atypical pneumonia due to SARS-CoV-2.

Results of studying:

Integrative final program learning outcomes, the formation of which is facilitated by the educational discipline: conformity of learning outcomes and competencies defined by the standard

Results of discipline	Code of programmatic result of study	Code of competencies
To have thorough knowledge of the structure of professional activity. To be able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy.	PRS 1	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, GC10, GC11, GC12, GC13, GC14, GC15.
Understanding and knowledge of basic and clinical biomedical sciences, at a level sufficient for solving professional tasks in the field of health care.	PRS 2	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, GC10, GC11, GC12, GC13, GC14, GC15.
Specialized conceptual knowledge that includes scientific achievements in the field of health care and is the basis for conducting research, critical understanding of problems in the field of medicine and related interdisciplinary problems.	PRS 3	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, GC10, GC11, GC12, GC13, GC14, GC15.
To isolate and identify the leading clinical symptoms and syndromes according to standard methods, using the previous data of the patient's history, the data of the patient's examination, knowledge about the person, his organs and systems, to establish a preliminary clinical diagnosis of the disease.	PRS 4	GC1, GC2, GC3, GC6, GC7, GC8; PC1, PC2, PC3, PC24, PC25
To collect complaints, anamnesis of life and diseases, evaluate the psychomotor and physical development of the patient, the state of organs and systems of the body, based on the results of laboratory and instrumental studies, evaluate information about the diagnosis, taking into account the age of the patient.	PRS 5	GC1,GC, GC3, GC6,GC, GC8; PC1, PC2, PC24, PC25
To establish the final clinical diagnosis by making a reasoned decision and analyzing the received subjective and objective data of clinical, additional examination, differential diagnosis, observing the relevant ethical and legal norms, under the control of the head physician in the conditions of the health care institution.	PRS 6	GC1, 3K2, 3K3, 3K6, 3K7, 3K8; PC1, PC2, PC3, PC24.
To assign and analyze additional (mandatory and optional) examination methods (laboratory, functional and/or instrumental) of patients with diseases of organs and body systems for differential diagnosis of diseases.	PRS7	GC1, GC2, GC3, GC4, , GC6, PC2.

Results of discipline	Code of programmatic result of study	Code of competencies
To determine the main clinical syndrome or what causes the severity of the victim/victim's condition (according to list 3) by making a reasoned decision and assessing the person's condition under any circumstances (in the conditions of a health care facility, outside its borders), including in conditions of emergency and hostilities, in field conditions, in conditions of lack of information and limited time.	PRS8	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC1,PC3, PC7, PC8, PC9, PC10, PC11.
To determine the nature and principles of treatment (conservative, operative) of patients with diseases (according to list 2), taking into account the age of the patient, in the conditions of the health care institution, outside its borders and at the stages of medical evacuation, including in field conditions, on the basis of a preliminary clinical diagnosis, observing the relevant ethical and legal norms, by making a reasoned decision according to existing algorithms and standard schemes, in case of the need to expand the standard scheme, be able to justify personalized recommendations under the control of the head physician in the conditions of a medical institution.	PRS9	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC1,PC3, PC6, PC7, PC8, PC9, PC10, PC11.
To determine the necessary mode of work, rest and nutrition on the basis of the final clinical diagnosis, observing the relevant ethical and legal norms, by making a reasoned decision according to existing algorithms and standard schemes.	PRS 10	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC1,PC3, PC4, PC6, PC7, PC8, PC9, PC10, PC11, PC24.
To determine tactics and provide emergency medical care in emergency situations (according to list 3) in limited time conditions according to existing clinical protocols and standards of treatment.	PRS 14	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC7, PC8, PC9, PC10.
To organize the provision of medical aid and medical evacuation measures to the population and military personnel in emergency situations and hostilities, including in field conditions.	PRS 15	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC6-PC10.
To form rational medical routes for patients; organize interaction with colleagues in their own and other institutions, organizations and institutions; to apply tools for the promotion of medical services in the market, based on the analysis of the needs of the population, in the conditions of the functioning of the health care institution, its division, in a competitive environment.	PRS 16	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8, PC6, PC7, PC8, PC9, PC11, PC17.
To perform medical manipulations (according to list 5) in the conditions of a medical institution, at home or at work based on a previous clinical diagnosis and/or indicators of the patient's condition by making a reasoned decision, observing the relevant ethical and legal norms.	PRS 17	GC1, GC2, GC3, GC4, GC5, GC6, PC10, PC24.

Results of discipline	Code of programmatic result of study	Code of competencies
To determine the state of functioning and limitations of a person's vital activities and the duration of incapacity for work with the preparation of relevant documents, in the conditions of a health care institution, based on data about the disease and its course, peculiarities of a person's professional activity, etc. Maintain medical documentation regarding the patient and the contingent of the population on the basis of regulatory documents.	PRS 18	GC1, GC2, GC3, GC4, GC5, GC6, GC7, GC8,; PC11,PC15,PC16, PC25.
To search for the necessary information in the professional literature and databases of other sources, analyze, evaluate and apply this information.	PRS 21	GC1, GC2, GC3, GC4, GC6, GC10;GC11,GC12; PC21, PC25.
To apply modern digital technologies, specialized software, and statistical data analysis methods to solve complex healthcare problems.	PRS 22	GC1, GC2, GC3, GC4, GC5, GC6,GC10; PC21, PC25.
To assess the impact of the environment on human health in order to assess the morbidity of the population.	PRS 23	GC1, GC2, GC3, GC4, GC5, GC6,GC10; PC17, PC21, PC25.
To organize the necessary level of individual safety (own and the persons he cares for) in case of typical dangerous situations in the individual field of activity.	PRS 24	GC1, GC2, GC3, GC4, GC5, GC6, GC10,GC12;
It is clear and unambiguous to convey one's own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists.	PRS 25	GC1, GC2, GC3, GC4, GC5, GC6; PC21.
To communicate freely in the national and English languages, both orally and in writing to discuss professional activities, research and projects.	PRS 27	GC1, GC2, GC3, GC5, GC6, GC11, GC12. PC21, PC25.

2. Information volume of the academic discipline

4.0 ECTS credit / 120 hours is assigned to the study of the academic discipline.

Topic 1. Organization of the radiological service. Peculiarities of the radiotherapy departments organization. Methods and means of protection against ionizing radiation. Basic Sanitary Rules for Radiation Safety of Ukraine (OSPU-2000). The norms of radiation safety of Ukraine (NRSU). Basic properties of ionizing radiation. The mechanism of action on healthy and pathologically changed cells. Radioactivity and dose. Dosimetry. Units of radioactivity and radiation doses. Structure of radiometers and dosimeters.

Types of radiotherapy departments. Features of radiological departments for diagnosis and treatment of somatic and oncological diseases. Radiodiagnostic laboratory: its structure and equipment. X-ray departments. Methods and means of protection when working with sources of ionizing radiation (open and closed): time, distance, screen. Basic sanitary rules for working with sources of ionizing radiation (OSPU-2000) and the norms of radiation safety of Ukraine (NRSU). Permissible radiation doses when working with sources of ionizing radiation. Radiodiagnostic categories of patients and permissible radiation doses. Disposal of radioactive waste. Radiotoxicity. Metabolism of radiopharmaceuticals (RFP) in the body. Psychological aspects of the work of medical personnel when using open and closed sources of radiation.

Types of radiation used in medical practice. Ionizing and non-ionizing radiation. Physics of ionizing radiation. Sources of radiation. Penetrating ability of ionizing radiation. Biological effect of radiation. Effect of ionizing radiation on the cell. Somatic, genetic and stochastic effects of ionizing radiation. Individual and population radiation dose. Species, individual, tissue differences in radiosensitivity. Mechanisms of radiation damage to tumor cells. Radiosensitivity of tumors.

Problems of clinical dosimetry of ionizing radiation. Radioactivity, units of radioactivity and methods of their determination. Determination of radioactivity in the sample—in vitro diagnostics. Dose of ionizing radiation. Units of exposure, absorbed, equivalent, effective doses. Types of dosimeters. Structure and principle of operation of scintillation, ionization, thermo- and photoluminescence dosimeters. Dose distribution in individual organs and tissues. Maximum permissible radiation exposure dose for different categories of the population and in emergency situations. Limits of radiation exposure doses. Maximum permissible radiation exposure dose for different categories of patients. Local and general exposure.

Topic 2. Basic principles and tasks of radiation therapy. Radiotherapy interval. Radiomodifying agents. Radiotherapy for malignant tumors and for non-neoplastic diseases. Selection of radiation sources. Indications and contraindications for radiation therapy.

Radiotherapeutic interval and means of its distribution (oxygenation and hypoxia; synchronization of cell division cycles; hyperthermia, etc.). Radiomodifying agents (radiosensitizers and radioprotectors). Bergognier-Tribando rule.

Basic principles of radiation therapy. Classification of radiation therapy methods. Radical, palliative, symptomatic treatment. Choice of focal dose, rhythm, irradiation fields. General and local radiation reactions with different methods of radiation therapy. Means of their prevention. Closed and open sources of ionizing radiation. External and internal exposure.

Long- and short-range methods of external irradiation. The main methods of contact radiation therapy: application, intracavity, intratissue, method of selective accumulation of radionuclides. Use of high energy sources for the treatment of malignant tumors (betatron, linear and cyclic accelerators). Rationale for radiation therapy of non-neoplastic diseases. Indications and contraindications for radiation therapy. Selection of radiation sources. Radiation treatment plan for oncological diseases. Basics of radiation therapy of tumors on the example of: tumors of the lungs, esophagus, stomach, colon, mammary glands, uterus.

Topic 3. Types of external beam radiotherapy. X-ray therapy of malignant tumors and non-neoplastic lesions. Long-distance gamma therapy. Radiotherapy with high energy sources. The methods of contact radiation therapy. Treatment with incorporated radionuclides.

The basics of radiation therapy for non-neoplastic diseases, for example: radiculitis, inflammatory diseases of the rectum, fingers and hand, skin and subcutaneous tissue, osteomyelitis. Anti-inflammatory, analgesic, antispastic effects of radiation therapy.

Radiotherapy. Dosimetric characteristics of the source of X-ray radiation. Purpose of tubes and filters. Remote X-ray therapy of inflammatory, dystrophic processes and malignant tumors. Near-distance X-ray therapy of non-cancerous diseases and malignant tumors. Reactions and complications during X-ray therapy. General reactions during X-ray therapy, clinic, treatment, prevention. Local radiation reactions and complications, clinic, treatment, prevention. X-ray therapy of malignant tumors and non-neoplastic lesions. Method of treatment with incorporated radionuclides. Treatment of thyrotoxicosis, cancer of the thyroid gland and its metastases, and multiple bone metastases of other tumors.

Long-distance gamma therapy. Devices. Dosimetric characteristics of the source of gamma radiation. Use of high energy sources for the treatment of malignant tumors (betatron, linear and cyclic accelerators). Reactions and complications during long-distance gamma therapy. General reactions during radiation therapy, clinic, treatment, prevention. Local radiation reactions and complications, clinic, treatment, prevention.

Topic 4. The role and place of ultrasound diagnostics in the complex of diagnostic radiology. Biological effects of ultrasound.

The structure and principle of operation of the equipment for ultrasonography - research. Ultrasound studies

(ultrasound) are the main methods. Advantages and disadvantages of each ultrasound technique. Indications and contraindications for their implementation. Dopplerography. Normal ultrasound anatomy. Ultrasound tomography: semiotics of diseases of internal organs. Principles of image acquisition with ultrasonic research methods (radiation source and detector); natural and artificial contrast; assignment of methods - study of morphology or (and) function; contraindications to performance; sections of the study.

Topic 5. Radionuclide methods in endocrinology. The radiopharmaceuticals used for the evaluation of the thyroid function. Assessing of the thyroid gland function by means of ^{131}I , $^{99\text{m}}\text{Tc}$ - intake tests. Radioimmunoassay – estimation of T3, T4, TSH. Radionuclide visualisation of the thyroid gland: scanning, scintigraphy. Thyroid disease diagnostic algorithm, diagnostic value.

The use of iodine-absorbing and technetium-absorbing radiometric tests for the diagnosis of thyroid gland diseases. Gamma-topography of the thyroid gland to determine the size, position, shape and function of the organ, the presence of diffuse and local disorders of RFP accumulation. RIA method for determining the levels of thyroid hormones in the blood - T4, TZ and TSH and the level of the tumor marker for thyroid cancer - thyroglobulin. The principle of conducting iodine-accumulating and technetium-accumulating studies, routes of administration and principles of RFP selection. Interpretation of the results of a radiometric study of thyroid function. Gamma-topography technique, description of thyroid scintigram.

Topic 6. Radionuclide methods of assessing hepatic and biliary system. Radiopharmaceuticals and radionuclide diagnostic procedures for evaluating function of the polygonal hepatic cells: hepatography, hepatobiliscintigraphy. Evaluating function of the reticular-endothelium system, radionuclide visualisation of the liver: scanning, scintigraphy. Radionuclide diagnostic of the gall bladder motor function. Diagnostic algorithm, diagnostic value.

Principles of radiometric study of biliary and phagocytic function of the liver, interpretation of study results. Routes of introduction and principles of RFP selection. Gamma topography technique, description of liver scintigram.

RFP, which are used when examining the liver and biliary tract. Algorithms for examination of the biliary and phagocytic function of the liver and the diagnostic value of the tests. RFP and radionuclide methods of studying the function of polygonal liver cells: hepatography and hepatobilicystography. Study of the eticuloendothelial system function of the liver, radionuclide imaging of the liver: scanning, scintigraphy. Radionuclide methods of researching the motor function of the gallbladder. Examination algorithms and diagnostic cost of tests. Principles of liver scintigram description. A tumor marker of liver cancer is α -fetoprotein.

Topic 7. Radionuclide methods of assessing kidneys. Radiopharmaceuticals which are used for evaluation of urinary system. Radionuclide tubular and glomerular renography. Radionuclide visualisation of the kidneys: scanning, scintigraphy. Diagnostic algorithm, diagnostic value.

Principles of radionuclide tubular renography, radionuclide glomerular renography, renoscintigraphy, interpretation of research results. Routes of introduction and principles of RFP selection. Indications and contraindications for radionuclide studies of the kidneys. Interpretation of renograms. Phases of the renal curve. Types of pathological renal curves and their clinical significance. Principles of radionuclide imaging of kidneys - scanning, scintigraphy, interpretation of research results. Routes of introduction and principles of RFP selection. Indications and contraindications for radionuclide studies of the kidneys. The sensitivity of RFP to different structures of the kidney. Principles of scintigram interpretation. Algorithm for describing renal gamma-topographic images and diagnostic value of tests.

Topic 8. Radionuclide methods in oncology. Tumor-tropic radiopharmaceuticals. Positive and negative scanning and scintigraphy. Diagnostic of the malignant tumors with radioactive phosphor. Methods of the positive visualisation of the liver, lungs, bone, thyroid gland, brain, retroperitoneal and soft tissue tumors.

Principles of conducting radionuclide research in oncological diseases - radiometry, radiography, scanning, scintigraphy, SPECT, PET, interpretation of research results. Routes of introduction and

principles of RFP selection. Indications and contraindications for radionuclide studies. Methods of determining tumor markers in the patient's blood and their clinical significance. Methods of positive visualization of tumors of the liver, lungs, bones, brain, thyroid gland, retroperitoneal space, soft tissue formations. Algorithm for describing gamma topographic images and diagnostic value of tests. Interpretation of levels of tumor markers and differential diagnosis of tumor and non-tumor diseases.

Topic 9. Radionuclide diagnostics of the cardiovascular system. Radiocardiography, myocardium visualisation.

Myocardioscintigraphy, as a method of radionuclide research of the blood supply of the myocardium of the left ventricle of the heart. Principles of radionuclide imaging of the heart and blood vessels - radiocardiography, imaging of the myocardium, interpretation of research results. Routes of introduction and principles of RFP selection. Indications and contraindications for radionuclide studies of the heart and blood vessels. Methods of introduction of RFP. Principles of scintigram interpretation. Algorithm for describing gamma topographic images and diagnostic value of tests. Variants of heart and blood vessel dysfunction and their reflection in the results of radionuclide studies.

Topic 10. Radionuclide diagnostics of the lungs: assessing of the ventilatory function, pulmonary blood circulation, pulmonary visualization.

Methods of radionuclide lung diagnostics of the lungs. Principles of radionuclide lung imaging - radiopulmonography, radiopulmonary scintigraphy, interpretation of research results. Routes of introduction and principles of RFP selection. Indications and contraindications for radionuclide studies of the lungs. Evaluation of the ventilation capacity of the lungs, regional pulmonary blood flow, visualization of the lungs. Algorithm for describing gamma topographic images of lungs and diagnostic value of tests. Variants of violation of RFP accumulation in the lungs and their possible causes.

Topic 11. Radionuclide diagnostics of the musculoskeletal system and central nervous system.

Osteoscintigraphy as a method of radionuclide imaging of the musculoskeletal system using osteotropic RFP. The advantages of scintigraphy over other methods of anatomical and topographic visualization. Indications for radionuclide examination of the central nervous system. Scintigraphy of the brain in two modes - dynamic (encephaloangiostintigraphy) and static (encephaloscintigraphy). Principles of radionuclide imaging of the musculoskeletal system and central nervous system, interpretation of research results. Routes of introduction and principles of RFP selection. Indications and contraindications for radionuclide studies of bones and nervous system. Differential diagnosis of osteolytic and osteoblastic bone tumors. Radioencephalography, encephaloangiostintigraphy., encephaloscintigraphy, myeloscintigraphy, PET, SPECT. Algorithm for describing gamma topographic images of bones, brain and diagnostic value of tests. Variants of RFP accumulation in bones and brain and their possible causes.

Topic 12. X-ray methods of imaging (source of radiation, object of the study, detector of the radiation). Artificial contrasting of the object. Basic and special methods of the X-ray studies.

The structure and principle of operation of equipment for X-ray, CT, MRI. Radiation used in these studies. Advantages and disadvantages of each of the methods. Indications and contraindications. Means of obtaining diagnostic information, its processing and presentation. X-ray methods of imaging: X-ray, planar tomography, fluorography, computed tomography (CT). Advantages and disadvantages of each of the methods. Indications and contraindications for this or that x-ray research method. Principles of image acquisition in x-ray methods (radiation source and detector); assignment of methods - study of morphology or (and) function; contraindications to performance: projections and sections of the study. Basics of X-ray science. Natural and artificial contrast. Contrast agents. Indications for their use. Building a clinical and radiological diagnosis.

Topic 13. X-ray methods of the lung assessment, normal X-ray anatomy of the lung. Basic X-ray symptoms of the lung pathology. X-ray semiotics of the lung diseases (acute and chronic pneumonia, pulmonary artery thrombosis, chronic bronchitis, emphysema, limited nonspecific pneumosclerosis, tuberculosis, primary and metastatic cancer, pleuritis). Algorithm for X-ray

examination of the organs of the chest.

Radiological methods of research of respiratory organs and their characteristics: methods of studying morphological changes of respiratory organs (fluoroscopy, radiography, fluorography, linear tomography, computer tomography, ultrasound examination, magnetic resonance imaging, bronchography, angiopulmonography, bronchial arteriography, CT and MR angiography) ; methods of studying lung function (inhalation and perfusion scintigraphy, fluoroscopy), functional tests and their significance for studying lung function. The principle of obtaining an image, indications and sequence of application of radiographic research methods. Selection of X-ray contrast substances and RFP. Age-specific features of the use of lung radiography methods. Radiological anatomy and physiology of respiratory organs: thorax, tracheobronchial tree, lung roots and pulmonary pattern, their morphological substrate. Age-related features of radiological anatomy and physiology of the lungs. The plan of radiation research. Indications and contraindications for carrying out this or that radiation method of research of respiratory organs.

Radiological signs of diseases of the respiratory organs: darkening of the lung field or part of it, lightening of the lung field or part of it, changes in the lung pattern and the root of the lung, displacement of mediastinal organs. Characteristics of eclipses by size, number, intensity, shape, structure, contours. Symptoms of impaired ventilation and lung perfusion. A plan for studying the X-ray examination of the chest cavity, building an algorithm for further radiological examination of the patient.

Additional techniques: linear tomography, computer tomography, ultrasound, magnetic resonance imaging. Special techniques: bronchography, angiopulmonography, bronchial arteriography, CT and MRI angiography.

X-ray semiotics of lung and mediastinal pathology - inflammatory, tumor diseases, violations of bronchial patency, cavity formations, disseminated and interstitial processes in the lungs, hydrothorax, pneumothorax. The main radiological syndromes of lung and mediastinal pathology, their morphological substrate. Magnetic resonance tomographic semiotics of lung and mediastinal pathology, inflammatory, tumor diseases, violations of bronchial patency, cavity formations, hydrothorax, pneumothorax. The main magnetic resonance tomographic syndromes of lung and mediastinal pathology, their morphological substrate.

Algorithm of X-ray examination of the organs of the chest cavity. Lung: fluorography, radiography, radiography, tomography, computer tomography, magnetic resonance imaging, perfusion and inhalation scintigraphy, sonography. Principles of image acquisition (radiation source and detector); natural and artificial contrast; designation of methods for studying morphology or (and) function; contraindications to performance; projections and sections of the study. CCS: radiography, radiography, magnetic resonance imaging, myocardial scintigraphy, radionuclide ventriculography, SPECT, PET, angiocardiology, echocardiography, coronary angiography. Principles of image acquisition (radiation source and detector); natural and artificial contrast; purpose of methods — study of morphology or (and) function; biological action, contraindications to performance; projections and sections of the study.

Topic 14. X-ray methods of imaging of the heart and great vessels. Features of visualization in norm according to the age and constitution of the patient. X-ray semiotics of diseases of the heart and large vessels (ischemic heart disease, myocardial infarction, hypertensive heart disease, congenital and acquired defects, aneurysms, nonspecific inflammatory processes, tumors).

X-ray methods of imaging of the heart, blood vessels and mediastinal organs and their characteristics (radiography, echocardiography, Doppler echocardiography, radiocardiography, radioventriculography, myocardial scintigraphy, computer tomography, magnetic resonance imaging, angiocardiology, ventriculography, coronary angiography, aortography, cavography). Classification of diagnostic methods according to sequence (primary, additional), invasiveness (non-invasive, invasive), obtained information (morphological, functional). The principle of obtaining an image and indications for the use of radiological methods for the study of the heart, mediastinum and blood vessels. Radiologic Examinations of the heart and blood vessels using Contrast Media. The concept of X-ray endovascular interventions and indications for their use.

Age features of the use of radiological research methods. Radiological anatomy of the mediastinum, heart and main vessels: X-ray, ultrasound and CT anatomy in standard projections. The main morphometric parameters of the unchanged heart and main vessels. Evaluation of the results of radiographic examination of heart function: M-mode, doppler echocardiography, dynamic radiocardiography, radionuclide angiocardiography, perfusion scintigraphy. Age-related features of the radiological anatomy and physiology of the heart and main vessels. Classification of mediastinal lymph nodes.

The plan of X-ray methods of imaging. Indications and contraindications for radiological studies. Radiological signs of lesions of the mediastinum, heart and blood vessels. Changes in the position of the heart: oblique, vertical, horizontal, dextroposition. Extracardiac causes of changes in the position of the heart. Changes in the shape of the heart (mitral, aortic, trapezoidal), causes of their formation. Changes in the size of heart chambers, methods of determination. Violation of heart contraction, assessment methods. Algorithms of X-ray research and the main X-ray symptoms in some heart diseases: coronary disease and its complications, acquired (mitral, aortic) and congenital (with impoverished, enhanced and unchanged pulmonary circulation) heart defects, myocarditis, pericarditis. Algorithms of X-ray research and the main X-ray symptoms of vessel stenoses and occlusions, aneurysms, varicose veins (aorta, vena cava, vessels of limbs).

Topic 15. X-ray examination of salivary glands and gastrointestinal tract. X-ray signs of salivary gland diseases. X-ray semiotics of diseases of the gastrointestinal tract. Emergency radiology (trauma, bleeding, pain syndrome, obstruction).

X-ray examination of the gastrointestinal tract and salivary glands. The plan of X-ray examination. Indications and contraindications for X-ray examination of the gastrointestinal tract and salivary glands. Radiologic Examinations of the salivary glands and gastrointestinal tract using Contrast Media.

Ultrasound, CT, MRI of the digestive tract. Preparation of the patient. Normal radiological anatomy of the gastrointestinal tract and salivary glands. Location and anatomical structure of esophagus, stomach, small and large intestine. Radiation physiology of digestive organs: secretion, tone, peristalsis and evacuation.

The plan of radiation research. Indications and contraindications for carrying out this or that radiation method of gastrointestinal tract research. Radiation methods of salivary gland research: x-ray, radionuclide. Normal radial anatomy and physiology of salivary glands. RFP, which are used in conducting radionuclide studies of salivary glands. Sialoscintigraphy. Radionuclide methods of salivary gland research. Radiological signs of inflammatory and tumor lesions of the salivary glands. Xerostomia. Radiological methods of research of the alimentary canal: x-ray, radio-nuclide. X-ray methods for the study of the esophagus, stomach, small and large intestines: inspection X-rays and X-rays, artificial contrast of organs using X-ray positive and X-ray negative contrast substances. Oral contrast, irrigoscopy, transcatheter contrast, parietography, angiography. Radionuclide methods of research of organs of the alimentary canal: esophagoscintigraphy, gastroscintigraphy, scintigraphy of intestines. The use of in vitro radionuclide methods for the diagnosis of digestive tract function disorders. Ultrasound, CT, MRI of digestive organs. Preparation of the patient. Indications and contraindications for radiation examination. Normal radiological anatomy of the organs of the alimentary canal: location and anatomical structure of the esophagus, stomach, small and large intestines. Radiation physiology of organs of the alimentary canal: secretory function, tone, peristalsis and evacuation.

Radiation symptoms of diseases of the gastrointestinal tract. The main radiological signs of the pathology of the alimentary canal: free gas in the abdominal cavity, areas of intestinal distention, shadows of foreign bodies and calculi, narrowing (diffuse, local, symmetrical, asymmetric), expansion (diffuse, local, symmetrical, asymmetrical), irregularity of the contour (straightening, "niche", filling defect), changes in the mucous membrane (rearrangement of relief, "niche", filling defect). Radiation syndromes of foreign bodies: esophagus, stomach, intestines - their complications. Algorithms of X-ray examination for perforation of a hollow organ in the abdominal cavity, tumors of the esophagus, stomach, and intestines. Conductive radiation syndromes of achalasia (dilation) of the esophagus, cicatricial strictures. Leading radiation syndromes of diseases of the alimentary canal: "acute abdomen"; inflammation (esophagitis, gastritis, enteritis, colitis); peptic ulcer disease of the stomach and duodenum and its complications; malignant (cancer); benign (polyps) tumors; developmental defects; functional disorder (atonia, hypotension, hypertension, reflux); intestinal obstruction.

X-ray, radionuclide, ultrasound, magnetic resonance imaging signs of emergency conditions - myocardial infarction, pulmonary edema, hydropericardium, hydrothorax, pneumothorax, pulmonary embolism, foreign bodies in the bronchi, alimentary canal, intestinal obstruction, perforation of a hollow organ to the abdominal cavity, traumatic damage. The choice of the method of radiation examination for the purpose of diagnosing a certain emergency condition.

Topic 16. Radiological examination of the hepatobiliary system. Radiological signs of pathology of the gallbladder, liver and biliary tract diseases.

Radiological examination of the liver and biliary tract: ultrasound, x-ray (cholecystography, cholangiography), radionuclide (hepatography, hepatobiliscintigraphy, hepatoscintigraphy with colloids, SPECT of the liver), CT and MRI. Radiopaque and radioactive pharmaceutical preparations. Radiological anatomy and physiology of the liver and biliary tract. Radiopaque substances and radiopharmaceuticals. Preparation of patients for research. Indications and contraindications for radiation examination. Radiation methods of functional research of the liver and gall bladder. Radiological signs of tumor (primary and secondary) and cystic lesions of the liver, hepatitis, cirrhosis. Calculous cholecystitis: radiological research methods and radiological signs.

Topic 17. X-ray examination of the urinary system. X-ray anatomy and physiology of the urinary system. Radiological signs of urinary tract pathology.

Radiological examination of the kidneys and urinary tract: ultrasound (B-method, Doppler sonography, duplex sonography), X-ray (survey X-ray, excretory urography, micturition cystography, ascending (retrograde) pyelography, angiography, CT), radionuclide (renography, dynamic and static renoscintigraphy, SPECT), MRI. Types of renographic curves. Radiopaque and radioactive pharmaceutical preparations. Classification of RFP. Radiological anatomy and physiology of kidneys and urinary tract. Preparation of patients for research. Indications and contraindications for radiation examination. Algorithm of X-ray examination for kidney and urinary tract pathology: malformations, inflammatory diseases, urolithiasis, renal colic, tumors and cysts, kidney injuries, arterial hypertension.

Topic 18. X-ray examination of the reproductive system and mammary glands. Radiological signs of pathology of the reproductive system and mammary glands.

Radiological examination of the reproductive system and mammary gland: ultrasound, x-ray, radionuclide (in vitro and in vivo), CT, MRI. Radiological anatomy of genital organs and mammary gland. Possibilities and main indications and contraindications for radiation examination. Radiation semiotics of genital organs and mammary gland. Radiation semiotics of genital tumors. X-ray diagnostics of pregnancy, diseases of pregnancy and the postpartum period.

Topic 19. X-ray examination of the bones and joints. Radiographic findings of the bones and joints associated with aging. The types of bone remodeling. Radiological signs of diseases and injuries of the bones and joints. X-ray semiotics of benign and malignant tumors of the bone and joint in adults and children.

Radiological signs of diseases of the musculoskeletal system: changes in the shape, size, position of bones; changes in contours (periostitis, periostoma), changes in structure (osteoporosis, osteosclerosis, destruction, osteonecrosis, osteolysis, atrophy), changes in the joint space (narrowing, disappearance, densification of joint surfaces, marginal bone growth, mismatch of joint ends). X-ray diagnostics of certain diseases of the musculoskeletal system. Radiation signs of traumatic injuries of bones and joints. Radiographic picture of normal fracture healing. Complication of fracture healing. Radiological signs of inflammatory lesions of the musculoskeletal system: arthritis, osteomyelitis, tuberculous lesions of bones and joints. Radiological signs of bone tumors: benign (chondromas, osteomas, osteochondromas), osteoblastoclastomas, malignant (osteogenic sarcoma, Ewing's sarcoma, metastases). Radiological signs in rheumatoid arthritis, collagenosis, aseptic arthrosis. Algorithm of ray research.

X-ray, radionuclide, ultrasound, CT, MRI. X-ray methods of bone and joint research: X-ray, tomography, fistulography, pneumoarthrography, angiography, densitometry. Normal radiological anatomy and the basics of the physiology of bones and joints: structure in the X-ray image, age-related features of the structure of the skeleton.

Procedure for studying and describing the results of X-ray examination of bones and joints. Radionuclide methods of bone and joint research: planar osteoscintigraphy, SPECT scintigraphy. Basic principles of radionuclide research of the musculoskeletal system, RFP, used for osteoscintigraphy. Radionuclide semiotics of tumor damage to bones and joints (primary and secondary), inflammatory processes, traumatic damage, degenerative-dystrophic changes of the musculoskeletal system. Possibilities of ultrasound, CT, MRI in the study of the musculoskeletal system, indications for their use. Basic indications and contraindications for X-ray examination of bones and joints.

Topic 20. X-ray examination of the central nervous system. Radiological signs of pathology of the skull, spine, brain and spinal cord.

Radiological examination of the central nervous system. X-ray techniques for studying the skull and brain (cranial X-ray, ventriculography, cisternography). Angiographic methods of CNS research. CT and MRI of the brain and spinal cord. Radiological anatomy of the skull and brain. Radiological anatomy of the spine and spinal cord. Algorithm of application of radiation research methods in oncology. Ultrasound semiotics of tumors. The main radiological signs of CNS pathology: traumatic damage to the skull, brain, spine and spinal cord; vascular diseases of the brain (disorders of cerebral circulation, stroke, intracerebral hematomas); vertebrogenic pain syndrome; infectious and inflammatory diseases of the brain; hypertensive syndrome. Radiation signs of brain tumors. Pituitary tumors. Interventional neuroradiology. Radionuclide studies of the central nervous system (static scintigraphy, SPECT, PET studies). RFPs used for radionuclide research of the central nervous system.

Topic 21. X-ray studies in otorhinolaryngology and ophthalmology. Radiological signs of diseases in otorhinolaryngology and ophthalmology.

Radiological examination (x-ray, tomography, computer tomography, magnetic resonance imaging, carotid angiography, thermography) and their importance in the general complex of studies in otorhinolaryngology. Radiological semiotics of diseases of the ear and temporal bone: congenital anomalies of development (anomalies of the semicircular canals, anomalies of the cochlea, atresia of the external auditory canal, maxillofacial dysostosis), traumatic injuries (fractures of the temporal bone and middle ear), inflammatory diseases (acute otitis media, acute mastoiditis, chronic otitis media), benign and malignant tumors. Radiation semiotics of diseases of the nose and paranasal sinuses: congenital anomalies and malformations, traumatic injuries (bone fractures), inflammatory diseases (acute sinusitis, chronic hyperplastic sinusitis), cysts, benign and malignant tumors. Radiation semiotics of diseases of the nasopharynx, oral cavity and oropharynx (adenoid hyperplasia, malignant tumors). Radiation semiotics of diseases of the larynx (anomalies and malformations, traumatic injuries and foreign bodies, functional disorders, inflammatory diseases, tumors and cysts). Methods of radiographic research and their importance in the general complex of studies of the orbit, eye and its appendages. Radiation semiotics of diseases of the orbit, eye and its appendages (eyelids, lacrimal and motor apparatus): congenital anomalies of development, traumatic injuries and foreign bodies, inflammatory diseases, tumors.

Topic 22. Computed tomography scans and magnetic resonance imaging are modern diagnostic methods.

Construction scheme and principle of operation of a computer tomograph. Features of visualization of organs and tissues on computer tomograms. The method of "amplification" of the image. New directions of improvement and development of computer tomography. The essence of the phenomenon of nuclear magnetic resonance and its physical characteristics. Construction scheme and principle of operation of the equipment for magnetic resonance research. Methods of magnetic resonance research: magnetic resonance spectroscopy and magnetic resonance tomography, magnetic resonance angiography. Features of visualization of organs and tissues during magnetic resonance studies. Magnetic resonance imaging (MRI). Basics of MRI diagnostics. Use of contrast agents. Advantages and disadvantages of this method. Indications and contraindications for MRI. Principles of image acquisition with magnetic resonance research methods (radiation source and detector); natural and artificial contrast; assignment of methods - study of morphology or (and) function; contraindications to performance; sections of the study. Character of the cell in magnetic resonance imaging - signal intensity in the magnetic field (hypo-, hyper-, iso-, an-).

3. The structure of the academic discipline

Topic	Lectures	Practical classes	Independent work of students	Individual work
Medical radiology				
<p>1. Lecture 1. Basic principles and methods of radiation therapy. Physical and biological foundations of radiation therapy. Selected radiation therapy schemes for malignant tumors and non-neoplastic diseases.</p> <p>Practical lesson 1. Organization of the radiological service. Peculiarities of the radiotherapy departments organization. Methods and means of protection against ionizing radiation. Basic Sanitary Rules for Radiation Safety of Ukraine (OSPU-2000). The norms of radiation safety of Ukraine (NRSU). Basic properties of ionizing radiation. The mechanism of action on healthy and pathologically changed cells. Radioactivity and dose. Dosimetry. Units of radioactivity and radiation doses. Structure of radiometers and dosimeters.</p> <p>IWS. Biological effect of ionizing radiation.</p>	2	2	3	
<p>2. Lecture 2. Diagnostic Ultrasound imaging in medicine. Principle of the method, structure and types of devices. Ultrasound examination of the internal organs and the thyroid gland. Application of diagnostic Ultrasound in obstetrics (to diagnose pregnancy and its terms, to identify fetal abnormalities) and in gynecology (detection of the inflammatory processes, tumors, and female genital tract anomalies).</p> <p>Practical lesson 2. Basic principles and tasks of radiation therapy. Radiotherapy interval. Radiomodifying agents. Radiotherapy for malignant tumors and for non-neoplastic diseases. Selection of radiation sources. Indications and contraindications for radiation therapy.</p> <p>IWS. Radiotherapy equipment, their advantages. Determination of the irradiation field.</p>	2	2	3	
<p>3. Lecture 3. The science of Medical Radiology. Characteristics of methods of radionuclide diagnostics. The indications and contraindications for radionuclide diagnostics. Radionuclide diagnosis of diseases of the thyroid gland, the hepatobiliary system, the cardiovascular system, the respiratory system, the kidney, and the malignant tumors.</p> <p>Practical lesson 3. Types of external beam radiotherapy. X-ray therapy of malignant tumors and non-neoplastic lesions. Long-distance gamma therapy. Radiotherapy with high energy sources. The methods of contact radiation therapy. Treatment with incorporated radionuclides.</p> <p>IWS. Radiation therapy of thyroid cancer.</p>	2	2	3	-
<p>4. Practical lesson 4. The role and place of ultrasound diagnostics in the complex of diagnostic radiology. Biological effects of ultrasound.</p> <p>IWS. Dopplerography. Determination of blood flow parameters in the extremity vessels.</p>	-	2	3	
<p>5. Practical lesson 5. Determination of types of radiopharmaceuticals and calculation of activities. Disposal of radioactive waste. Basic principles of radionuclide diagnostics. Scheme of the assessing of the scannogram. Radionuclide methods in endocrinology. The radiopharmaceuticals used for the evaluation of the thyroid function. Assessing of the thyroid gland function by means of ¹³¹I, ^{99m}Tc - intake tests. Radioimmunoassay – estimation of T3, T4, TSH. Radionuclide visualisation of the thyroid gland: scanning, scintigraphy. Thyroid disease diagnostic algorithm, diagnostic value.</p> <p>IWS. Radionuclide diagnostics in endocrinology (pancreas, adrenal glands, pituitary gland).</p>	-	2	3	

<p>6. Practical lesson 6. Radionuclide methods of assessing hepatic and biliary system. Radiopharmaceuticals and radionuclide diagnostic procedures for evaluating function of the polygonal hepatic cells: hepatography, hepatobiliscintigraphy. Evaluating function of the reticular-endothelium system, radionuclide visualisation of the liver: scanning, scintigraphy. Radionuclide diagnostic of the gall bladder motor function. Diagnostic algorithm, diagnostic value.</p> <p>IWS. Diagnosis of malignancies of the hepatobiliary system.</p>	-	2	3	
<p>7. Practical lesson 7. Radionuclide methods of assessing kidneys. Radiopharmaceuticals which are used for evaluation of urinary system. Radionuclide tubular and glomerular renography. Radionuclide visualisation of the kidneys: scanning, scintigraphy. Diagnostic algorithm, diagnostic value.</p> <p>IWS. Radioimmunological analysis in uronephrology. Vasorenal hypertension. Diagnostic methods "in vivo" and "in vitro".</p>	-	2	3	
<p>8. Practical lesson 8. Radionuclide methods in oncology. Tumor-tropic radiopharmaceuticals. Positive and negative scanning and scintigraphy. Diagnostic of the malignant tumors with radioactive phosphor. Methods of the positive visualisation of the liver, lungs, bone, thyroid, brain, retroperitoneal and soft tissue tumors.</p> <p>IWS. Classification and characteristics of tumor markers.</p>	-	2	3	
<p>9. Practical lesson 9. Radionuclide diagnostics of the cardiovascular system. Radiocardiography, myocardium visualisation.</p> <p>IWS. Sonographic diagnosis of congenital heart disease.</p>	-	2	3	
<p>10. Practical class 10. Radionuclide diagnostics of the lungs: assessing of the ventilatory function, pulmonary blood circulation, pulmonary visualisation.</p> <p>IWS. Imaging of occupational lung disease.</p>	-	2	2	
<p>11. Practical lesson 11. Radionuclide diagnostics of the musculoskeletal system and central nervous system.</p> <p>IWS. Radionuclide semiotics of tumor lesions of bones and joints.</p>	-	2	3	
Total:	6	22	32	
Medical roentgenology				
<p>1. Lecture 1. Basic methods of the image obtaining in medical radiology (X-rays, CT, MRI). Defence principles from the radiation exposure of the patients and labour-protective measures for radiological units personnel. Indications and contraindications for radiological studies, dose limitation for the X-ray procedure. Basic and additional methods of the X-ray examination for the evaluation of the respiratory system. Peculiarities of the visualizing according to the age and constitutional normal range. X-ray semiotics of the respiratory tract diseases.</p> <p>Practical session 1. X-ray research method (radiation source – research object – radiation receiver). Artificial contrast of the research object. General and special methods of X-ray examination.</p> <p>IWS. Main and special methods of x-ray examination of lungs in pediatrics. X-ray semiotics of occupational lung diseases.</p>	2	2	3	-
<p>2. Lecture 2. X-ray examination of the heart and large vessels. Peculiarities of the visualizing according to the age and constitutional normal range. X-ray semiotics of the heart and large vessels pathology (coronary heart disease, myocardial infarction, arterial hypertension, congenital and acquired valve diseases, aneurisms, non-specific inflammatory diseases, tumours).</p>	2	-	-	

<p>Practical session 2. X-ray methods of lung research, normal X-ray anatomy of respiratory organs, Main X-ray symptoms of pathological changes in the lungs. X-ray semiotics of respiratory diseases (acute and chronic pneumonia, pulmonary embolism, chronic bronchitis, pulmonary emphysema, limited non-specific pneumosclerosis, tuberculosis, primary and metastatic cancer, pleurisy). Algorithm of radiation examination of chest organs.</p> <p>IWS. X-ray features of viral pneumonia diagnosis.</p>		2	3
<p>3. Lecture 3. X-ray examination of the gastrointestinal tract, urinary tract, liver and bile ducts. X-ray semiotics of the gastrointestinal tract, urinary tract, liver and bile ducts diseases. X-ray examination in the emergency cases (injuries, haemorrhages, pain syndrome, obstruction).</p> <p>Practical session 3. Radiation methods of heart and blood vessel research. Features of visualization are normal, taking into account the age and constitution of the patient. X-ray semiotics of diseases of the heart and large vessels (ischemic heart disease, myocardial infarction, hypertension, congenital and acquired defects, aneurysms, nonspecific inflammatory processes, tumors).</p> <p>IWS. Special methods of X-ray examination of the heart and large vessels. X-ray semiotics of diseases of the heart and large vessels in pediatrics.</p>	2	3	3
<p>4. Lecture 4. Methods of the X-ray examination of the bones and joints. Age peculiarities of the bones and joints visualizing. X-ray semiotics of the diseases and injuries of the bones and joints. X-ray examination of the central nervous system. X-ray semiotics of the skull, spine, brain and spinal cord injuries. X-ray studies and X-ray semiotics of the main diseases in otolaryngology and ophthalmology. X-ray diagnostic of emergency cases.</p> <p>Practical lesson 4. Radiological methods of research of salivary glands, alimentary canal. Radiation signs of salivary gland diseases. X-ray semiotics of diseases of the gastrointestinal tract. X-ray examination in urgent conditions (injury, bleeding, pain syndrome, obstruction).</p> <p>IWS. Special methods of examination of the large intestine.</p>	2	2	3
<p>5. Practical lesson 5. X-ray examination of the hepatobiliary system. Radiological signs of pathology of the gallbladder, liver, biliary tract.</p> <p>IWS. Special methods of X-ray examination of the liver and biliary tract.</p>	-	2	3
<p>6. Practical lesson 6. X-ray examination of the urinary system. X-ray anatomy and physiology of the urinary system. Radiological signs of diseases of the kidneys and urinary tract.</p> <p>IWS. X-ray semiotics of diseases of the urinary system in pediatrics..</p>	-	2	3
<p>7. Practical lesson 7. X-ray examination of the reproductive system and mammary glands. Radiation signs of pathology of the reproductive system and mammary glands.</p> <p>IWS. X-ray semiotics of genital tumors.</p>	-	2	2
<p>8. Practical lesson 8. X-ray study of the locomotor system. Age-related features of radiographic imaging of bones and joints. Types of bone remodeling. Radiation signs of diseases and injuries of the musculoskeletal system. X-ray semiotics of benign and malignant bone and joint tumors in adults and children.</p> <p>IWS. Age features of X-ray imaging of bones and joints in pediatrics. X-ray features of fractures in children (epiphysiolyis, osteoepiphysiolyis, subclavian fracture), congenital hip dislocation.</p>	-	2	3
<p>9. Practical lesson 9. X-ray examination of the central nervous system. Radiological signs of pathology of the skull and spine, brain and spinal cord.</p> <p>IWS. X-ray diagnosis of damage to the skull and spine. Pneumoencephalography.</p>	-	2	2

10. Practical lesson 10. X-ray research in otorhinolaryngology and ophthalmology. Radiation signs of diseases of ENT organs and diseases in ophthalmology. IWS. X-ray semiotics of benign and malignant tumors in otorhinolaryngology and ophthalmology.	-	2	2
11. Practical lesson 11. CT, MRI - modern methods of radiation diagnostics. IWS. Computed tomography of the pathology of the bone and joint apparatus (diagnosis of tumors)	-	2	2
Total:	8	23	29
Total amount of hours 120 / 4 credits ECTS	14	45	61
Final control: differentiated credit			

4. Thematical plan of lectures

№	Topic	Amount of hours
Medical Radiology		
1.	Basic principles and methods of Radiation therapy. Physical and biological bases of Radiation Therapy. Selected radiation therapy schemes for malignant tumors and non-neoplastic diseases.	2
2.	Diagnostic Ultrasound imaging in medicine. Principle of the method, structure and types of devices. Ultrasound examination of the internal organs and the thyroid gland. Application of diagnostic Ultrasound in obstetrics (to diagnose pregnancy and its terms, to identify fetal abnormalities) and in gynecology (detection of the inflammatory processes, tumors, and female genital tract anomalies).	2
3.	The science of Medical Radiology. Characteristics of methods of radionuclide diagnostics. The indications and contraindications for radionuclide diagnostics. Radionuclide diagnosis of diseases of the thyroid gland, the hepatobiliary system, the cardiovascular system, the respiratory system, the kidney, and the malignant tumors.	2
Total		6
Medical Roentgenology		
4.	Basic methods of the image obtaining in medical radiology (X-rays, CT, MRI). Defence principles from the radiation exposure of the patients and labour-protective measures for radiological units personnel. Indications and contraindications for radiological studies, dose limitation for the X-ray procedure. Basic and additional methods of the X-ray examination for the evaluation of the respiratory system. Peculiarities of the visualizing according to the age and constitutional normal range. X-ray semiotics of the respiratory tract diseases.	2
5.	X-ray examination of the heart and large vessels. Peculiarities of the visualizing according to the age and constitutional normal range. X-ray semiotics of the heart and large vessels pathology (coronary heart disease, myocardial infarction, arterial hypertension, congenital and acquired valve diseases, aneurisms, non-specific inflammatory diseases, tumours).	2
6.	X-ray examination of the gastrointestinal tract, urinary tract, liver and bile ducts. X-ray semiotics of the gastrointestinal tract, urinary tract, liver and bile ducts diseases. X-ray examination in the emergency cases (injuries, haemorrhages, pain syndrome, obstruction).	2
7.	Methods of the X-ray examination of the bones and joints. Age peculiarities of the bones and joints visualizing. X-ray semiotics of the diseases and injuries of the bones and joints. X-ray examination of the central nervous system. X-ray semiotics of the skull, spine, brain and spinal cord injuries. X-ray studies and X-ray semiotics of the main diseases in otolaryngology and ophthalmology. X-ray diagnostic of emergency cases.	2
Total		8
Together		14

5. Thematical plan of practical classes

№	Topic	Amount of hours
Medical Radiology		
1.	Organization of the radiological service. Peculiarities of the radiotherapy departments organization. Methods and means of protection against ionizing radiation. Basic Sanitary Rules for Radiation Safety of Ukraine (OSPU-2000). The norms of radiation safety of Ukraine (NRSU). Basic properties of ionizing radiation. The mechanism of action on healthy and	2

	pathologically changed cells. Radioactivity and dose. Dosimetry. Units of radioactivity and radiation doses. Structure of radiometers and dosimeters.	
2.	Basic principles and tasks of radiation therapy. Radiotherapy interval. Radiomodifying agents. Radiotherapy for malignant tumor and for non-neoplastic diseases. Selection of radiation sources. Indications and contraindications for radiation therapy.	2
3.	Types of external beam radiotherapy. X-ray therapy of malignant tumors and non-neoplastic lesions. Long-distance gamma therapy. Radiotherapy with high energy sources. The methods of contact radiation therapy. Treatment with incorporated radionuclides.	2
4.	The role and place of ultrasound diagnostics in the complex of diagnostic radiology. Biological effects of ultrasound.	2
5.	Determination of types of radiopharmaceuticals and calculation of activities. Disposal of radioactive waste. Basic principles of radionuclide diagnostics. Scheme of the assessing of the scannogram. Radionuclide methods in endocrinology. The radiopharmaceuticals used for the evaluation of the thyroid function. Assessing of the thyroid gland function by means of ¹³¹ I, ^{99m} Tc - intake tests. Radioimmunoassay – estimation of T3, T4, TSH. Radionuclide visualisation of the thyroid gland: scanning, scintigraphy. Thyroid disease diagnostic algorithm, diagnostic value.	2
6.	Radionuclide methods of assessing hepatic and biliary system. Radiopharmaceuticals and radionuclide diagnostic procedures for evaluating function of the polygonal hepatic cells: hepatography, hepatobiliscintigraphy. Evaluating function of the reticular-endothelium system, radionuclide visualisation of the liver: scanning, scintigraphy. Radionuclide diagnostic of the gall bladder motor function. Diagnostic algorithm, diagnostic value.	2
7.	Radionuclide methods of assessing kidneys. Radiopharmaceuticals which are used for evaluation of urinary system. Radionuclide tubular and glomerular renography. Radionuclide visualisation of the kidneys: scanning, scintigraphy. Diagnostic algorithm, diagnostic value.	2
8.	Radionuclide methods in oncology. Tumor-tropic radiopharmaceuticals. Positive and negative scanning and scintigraphy. Diagnostic of the malignant tumors with radioactive phosphor. Methods of the positive visualisation of the liver, lungs, bone, thyroid, brain, retroperitoneal and soft tissue tumors.	2
9.	Radionuclide diagnostics of the cardiovascular system. Radiocardiography, myocardium visualisation.	2
10.	Radionuclide diagnostics of the lungs: assessing of the ventilatory function, pulmonary blood circulation, pulmonary visualisation.	2
11.	Radionuclide diagnostics of the musculoskeletal system and central nervous system.	2
Total		22
Medical Roentgenology		
1.	X-ray methods of imaging (source of radiation, object of the study, detector of the radiation). Artificial contrasting of the object. Basic and special methods of the X-ray studies.	2
2.	X-ray methods of the lung assessment, normal X-ray anatomy of the lung. Basic X-ray symptoms of the lung pathology. X-ray semiotics of the lung diseases (acute and chronic pneumonia, pulmonary artery thrombosis, chronic bronchitis, emphysema, limited nonspecific pneumosclerosis, tuberculosis, primary and metastatic cancer, pleuritis). Algorithm for X-ray examination of the organs of the chest.	2
3.	X-ray methods of imaging of the heart and great vessels. Features of visualization in norm according to the age and constitution of the patient. X-ray semiotics of diseases of the heart and large vessels (ischemic heart disease, myocardial infarction, hypertensive heart disease, congenital and acquired defects, aneurysms, nonspecific inflammatory processes, tumors).	3
4.	X-ray examination of salivary glands and gastrointestinal tract. X-ray signs of salivary gland diseases. X-ray semiotics of diseases of the gastrointestinal tract. Emergency radiology (trauma, bleeding, pain syndrome, obstruction).	2
5.	Radiological examination of the hepatobiliary system. Radiological signs of gallbladder, liver and biliary tract diseases.	2
6.	X-ray examination of the urinary system. X-ray anatomy and physiology of the urinary system.	2

	Radiological signs of kidney and urinary tract pathology.	
7.	X-ray examination of the reproductive system and mammary glands. Radiological signs of pathology of the reproductive system and mammary glands.	2
8.	X-ray examination of the bones and joints. Radiographic findings of the bones and joints associated with aging. The types of bone remodeling. Radiological signs of diseases and injuries of the bones and joints. X-ray semiotics of benign and malignant tumors of the bone and joint in adults and children.	2
9.	X-ray examination of the central nervous system. Radiological signs of pathology of the skull, spine, brain and spinal cord.	2
10.	X-ray studies in otorhinolaryngology and ophthalmology. Radiological signs of diseases in otorhinolaryngology and ophthalmology.	2
11.	Computed tomography scans and magnetic resonance imaging are modern diagnostic methods.	2
Total		23
Together		45

6. Thematical plan of independent work of students

№	Topic	Amount of hours
Medical Radiology		
1.	Biological effect of ionizing radiation.	3
2.	Radiotherapy equipment, their advantages. Determination of the irradiation field.	3
3.	Radiation therapy of thyroid cancer.	3
4.	Dopplerography. Determination of blood flow parameters in the extremity vessels.	3
5.	Radionuclide diagnostics in endocrinology (pancreas, adrenal glands, pituitary gland).	3
6.	Diagnosis of malignancies of the hepatobiliary system.	3
7.	Radioimmunological analysis in uronephrology. Vasorenal hypertension. Diagnostic methods "in vivo" and "in vitro".	3
8.	Classification and characteristics of tumor markers.	3
9.	Sonographic diagnosis of congenital heart disease.	3
10.	Imaging of occupational lung disease.	2
11.	Radionuclide semiotics of tumor lesions of bones and joints.	3
Total		32
Medical Roentgenology		
1.	Basic and special methods of the X-ray studies of the respiratory system in paediatrics. X-ray semiotics of the professional lung diseases.	3
2.	Radiographic features of viral pneumonia.	3
3.	Special methods of X-ray examination of the heart and great vessels. X-ray semiotics of diseases of the heart and great vessels in paediatrics	3
4.	Special methods of X-ray examination of the large intestine	3
5.	Special methods of X-ray examination of the liver and bile ducts.	3
6.	X-ray semiotics of diseases of the urinary tract in children.	3
7.	X-ray semiotics of genital tumors.	2
8.	Radiographic age peculiarities of the bones and joints in paediatrics. X-ray peculiarities of the bone fractures in kids (epiphysiolysis, subperiosteal fracture), inborn hip dislocation.	3
9.	X-ray examination for evaluating injuries of the skull and spine. Pneumoencephalography.	2
10.	X-ray semiotics of the benign and malignant tumours otorhinolaryngology and ophthalmology.	2
11.	Computed tomography of the pathology of the bone and joints (diagnosis of tumors).	2
Total		29
Together		61

7. Individual tasks (disease histories, forensic medical reports, toxicological research reports, course and diploma, master's theses) are not provided for in the curriculum.

8. Methods of study

Types of educational activities of students according to the curriculum are: lectures, practical classes and independent work of students (IWS), in the organization of which teachers' consultations play a

significant role.

In the process of studying the discipline "Radiation Medicine", the following methods of teaching students are used:

- by type of cognitive activity:
 - explanatory and illustrative;
 - reproductive;
 - problematic presentation;
 - logics of knowledge:
 - analytical;
 - inductive;
 - deductive
- by the main stages of the process:
 - formation of knowledge;
 - formation of abilities and skills;
 - application of knowledge;
 - generalization;
 - fixing;
 - verification;
- according to the system approach:
 - stimulation and motivation;
 - control and self-control;
- by sources of knowledge:
 - verbal - lecture, explanation;
 - visual - demonstration, illustration;
- by the level of independent mental activity:
 - problematic;
 - partially searchable;
 - research;
 - method of problem-based teaching

9. Methods of control

Current control is carried out at each practical lesson in accordance with specific goals, during the individual work of the teacher with the student for those topics that the student works on independently and which are not included in the structure of the practical lesson. Objective (standardized) control of theoretical and practical training of students is applied.

The following means of diagnosing the level of students' training are used: testing, solving situational problems, conducting a description of radiological studies and interpreting and evaluating their results, control of practical skills.

At each practical lesson, the student answers 20 questions (tests on the topic of the practical lesson, standardized questions, the knowledge of which is necessary to understand the current topic, questions of the lecture course and independent work related to the current lesson; demonstrates knowledge and skills of practical skills in accordance with the topic of the practical lesson).

The form of **final control** when studying "Radiology" is a differentiated assessment. Students who have completed all types of work provided for in the initial program, completed all training sessions, and scored at least the minimum number of points for the disciplines studied are admitted to the final examination.

Methods and means of standardized assessment when compiling the final control

The regulation of the semester differentiated credit

The form of final control is standardized, includes control of theoretical and practical training.

The final control consists of the following stages:

I stage - a written answer to the test tasks of format A (form with computer check).

The student answers the test package. Each package contains 66 A-format tests on the topics of each content module, and is valued at 1 point for each correct answer.

II stage - a written answer to 7 situational problems, to which the student must answer in writing. Each correct answer is valued at 2 points.

10. Current control is carried out during training sessions and is aimed at checking students' assimilation of educational material. Forms of assessment of current educational activities are standardized and include control of theoretical and practical training.

Assessment of current educational activities. During the evaluation of the mastery of each topic for the current educational activity, the student is assigned a 4-point (national) grade. At the same time, all types of work provided for by the discipline program are taken into account. The student must receive a grade on each topic for further conversion of grades into points on a multi-point (200-point) scale.

Test control of theoretical training is conducted by writing a test of 20 questions, the correct answer to questions 1–18 is assessed at 1 point, questions 19 and 20 are assessed at 2 points. The maximum number of points for the entire test is 22 points, the minimum number of points that a student must score to pass the theoretical part of the practical lesson is 9 points (50% of correct answers). At each practical lesson, the teacher evaluates the knowledge of each student on a four-point scale.

Excellent ("5") - The student correctly answered 90-100% of tests of format A. Correctly, clearly and logically and completely answers all standardized questions of the current topic, including questions of the lecture course and independent work. Closely links theory with practice and correctly demonstrates performance (knowledge) of practical skills. Solves situational problems of increased complexity, knows how to summarize the material. Completed planned individual work.

Good ("4") - The student correctly answered 70-89% of tests of format A. Correctly and essentially answers the standardized questions of the current topic, lecture course and independent work. Demonstrates performance (knowledge) of practical skills. Correctly uses theoretical knowledge when solving practical tasks. Able to solve situational problems of easy and medium complexity. Possesses the necessary practical skills and methods of their implementation in an amount that exceeds the required minimum.

Satisfactory ("3") - The student correctly answered 50-69% of tests of format A. Incompletely, with the help of additional questions, answers standardized questions of the current topic, lecture course and independent work. Cannot independently construct a clear, logical answer. During the answer and demonstration of practical skills, the student makes mistakes. The student solves only the easiest problems.

Unsatisfactory ("2") - The student answered less than 50% of tests of format A. Does not know the material of the current topic, cannot construct a logical answer, does not answer additional questions, does not understand the content of the material. During the response and demonstration of practical skills, he makes significant, gross mistakes. At each practical lesson, the student's knowledge is evaluated according to the four-point system "5",

Control of solving situational problems is carried out in a practical session by assessing the quality and completeness of their implementation, the ability to interpret the obtained results. For the practical part of the lesson, the student can gain:

4 points if the work is completed in full and the student freely and correctly explains the situational task and gives an assessment;

2 points if the work is completed with some errors, the student cannot fully explain the situational task and give an assessment;

0 points if the work is not completed or the student cannot explain the situational task and give an assessment.

The final grade for the class is determined by the sum of the results of the test control and the performance of practical work as follows:

Sum of points	Grade according 4-score scale
from 22 to 26	5
from 17 to 21	4
from 11 to 16	3
< 9 points for test control or 0 points for the practical part	2

The material for students' independent work, which is provided in the topic of the practical lesson simultaneously with the classroom work, is evaluated during the current control of the topic in the corresponding classroom lesson. Evaluation of topics that are assigned to independent study and are not included in the topics of classroom training sessions are monitored during the final control.

11. The form of final control of study success in the study of "Radiology" is a differentiated assessment.

Semester graded assessment is a form of final control, which consists in evaluating the student's learning of learning material from the academic discipline based on current control and completed individual test tasks in the last lesson.

The form of final control is standardized, includes control of theoretical and practical training.

The final control consists of the following stages:

I stage - a written answer to the test tasks of format A (form with computer check).

The student answers the test package. Each package contains 66 A-format tests on the topics of each content module, and is valued at 1 point for each correct answer.

II stage - a written answer to 7 situational problems, to which the student must answer in writing. Each correct answer is valued at 2 points.

12. The scheme of accrual and distribution of points received by students:

The maximum number of points that a student can score for the current educational activity for admission to differentiated credit is 120 points.

The minimum number of points that a student must score for the current educational activity for admission to differentiated credit is 72 points.

The calculation of the number of points is carried out on the basis of the grades received by the student on a 4-point (national) scale during the study of the discipline, by calculating the arithmetic mean (AM), rounded to two decimal places. The obtained value is converted into points on a multi-point scale as follows: $X = \frac{AM \times 120}{5}$

5

For convenience, a calculation table is given on a 120-point scale:

Recalculation of the average grade for the current activity into a multi-point scale for disciplines ending with a differentiated assessment

4- score scale	120- score scale	4- score scale	120- score scale	4- score scale	120- score scale	4- score scale	120- score scale
5	120	4,45	107	3,91	94	3,37	81
4,95	119	4,41	106	3,87	93	3,33	80
4,91	118	4,37	105	3,83	92	3,29	79
4,87	117	4,33	104	3,79	91	3,25	78
4,83	116	4,29	103	3,74	90	3,2	77
4,79	115	4,25	102	3,7	89	3,16	76
4,75	114	4,2	101	3,66	88	3,12	75
4,7	113	4,16	100	3,62	87	3,08	74
4,66	112	4,12	99	3,58	86	3,04	73
4,62	111	4,08	98	3,54	85	3	72
4,58	110	4,04	97	3,49	84	Less than 3	Insufficient amount
4,54	109	3,99	96	3,45	83		
4,5	108	3,95	95	3,41	82		

Independent work of students is evaluated during the current control of the topic in the corresponding lesson. The learning of topics that are assigned only to independent work is controlled during the final control.

The maximum number of points that a student can score when taking a differentiated assessment is 80.

The minimum number of points for the differential assessment is at least 50.

The grade for the discipline, which ends with a differentiated assessment, is defined as the sum of the points for the current educational activity (at least 72) and the points for the differentiated assessment (at least 50).

Points from the discipline are independently converted both to the ECTS scale and to the 4-point (national) scale. Points from the ECTS scale are not converted into a 4-point scale and vice versa.

Points of students studying in one specialty, taking into account the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Assesment ECTS	Statistical indicator
A	The best 10 % of students
B	Next 25 % of students
C	Next 30 % of students
D	Next 25 % of students
E	Last 10 % of students

Ranking with the assignment of grades "A", "B", "C", "D", "E" is carried out for students of this course who are studying in one specialty and have successfully completed the study of the discipline. Students who receive grades of FX, F ("2") are not listed as ranked students. Students with an FX grade automatically receive an "E" grade after retaking.

Discipline points for students who have successfully completed the program are converted to a traditional 4-point scale according to the absolute criteria, which are shown in the table below:

Points from the discipline	Assesment according 4-point scale
From 170 to 200 points	5
From 140 to 169 points	4
From 139 points to minimal amount of points which is necessary to get by student	3
Lower than minimal amount of points which is necessary to get by student	2

The ECTS grade is not converted to the traditional scale, as the ECTS scale and the four-point scale are independent.

The objectivity of the evaluation of students' educational activity is checked by statistical methods (correlation coefficient between the ECTS grade and the grade on the national scale).

13. Methodical materials

The list and content of initial methodological support for the study of the discipline "Radiology" includes:

- synopsis or extended plan of lectures on the course of radiation medicine;
- thematic plans of lectures, practical classes, independent work of students;
- assignments for practical classes and independent work;
- questions, problems, tasks for current and final control of students' knowledge and skills.

The list of standardized theoretical questions concluding (final) module control.

1. The history of the discovery of radioactivity: the main stages of the development of radiology.
2. Nature and properties of ionizing radiation: α -, β -, γ -, X-ray, neutrons and protons.
3. Features of the organization of radiological departments for work with open and closed radioactive substances. Types of radiological departments.
4. Basic regulatory documents regulating the work of radiological departments (NRBU-1997, OSPU-2000).
5. Methods and means of protection when working with sources of ionizing radiation.
6. Methods of disposal of radioactive waste.
7. Biological action of ionizing radiation at all levels of the body's organization.
8. Direct and indirect effects of ionizing radiation on living organisms.
9. Species, individual and age varieties of radiosensitivity.
10. Mutagenic effect of radiation.
11. The influence of external conditions on the radiosensitivity of organisms.
12. Radioactivity - units of radioactivity. Types of radioactive decay.
13. Isotopes. Basic characteristics of radioactive isotopes. Characteristics of radioactive isotopes: ^{60}Co , ^{32}P , ^{123}I , ^{125}I , ^{131}I , $^{99\text{m}}\text{Tc}$, ^{198}Au , ^{111}In .
14. RFP: obtaining and basic requirements.
15. Metabolism of RFP in the body. Critical organs.
16. Maximum permissible doses of exposure to humans and different categories of personnel.
17. Categories of patients referred for radionuclide studies. Permissible doses of their exposure.
18. Exposure, absorbed, equivalent and integral doses of ionizing radiation. Non-systemic and systemic units of determination of doses.
19. Methods of dose determination. Types of dosimeters.
20. Characteristics of ionization and scintillation methods of dose determination.
21. Chemical methods of dose determination. The device and principle of operation of the

photochemical dosimeter.

22. Biological and computational methods of dose determination.
23. Methods of determining radioactivity. Types of radiometers.
24. Physical and biological bases of radiation therapy.
25. Mechanism of radiation damage to tumor cells.
26. Radiotherapy interval and radiomodifying factors.
27. Classification of radiation therapy methods.
28. Interaction of ionizing radiation with substances. Variants of radiation dose distribution in time and space.
29. Basic principles of radiation therapy.
30. General, local reactions and complications during radiation therapy.
31. Characteristics of the method of long-distance X-ray therapy. Devices. Indications and contraindications for use.
32. Types of long-distance X-ray therapy. Physical and technical conditions of operation of devices. Purpose of tubes and filters.
33. Indications for radiation therapy in non-tumor diseases (inflammatory, dystrophic).
34. Mechanism of anti-inflammatory effect of ionizing radiation.
35. Characteristics of the close-focus X-ray therapy. Devices. Indications and contraindications for use.
36. Characteristics of the long-distance gamma therapy. Devices. Indications and contraindications for use.
37. Characteristics of the intracavitary method of radiation therapy. Structure and forms of radiation sources. Indications and contraindications for use.
38. Characteristics of the interstitial method of radiation therapy. Structure and forms of radioactive preparations. Indications and contraindications for use.
39. Radiotherapy of breast cancer. Doses and radiation fields.
40. Techniques of combined, complex methods of treatment and connective-radiation method of treatment of diseases for malignant tumors. Radiation therapy programs.
41. Selection of the focal dose of irradiation of malignant tumors.
42. Use of ^{131}I for the treatment of thyrotoxicosis and thyroid cancer metastases.
43. Use of ^{32}P and ^{89}Sr for treatment cancer metastases to bones.
44. Prevention of radiation reactions and injuries.
45. Classification of methods of radionuclide diagnostics.
46. Radionuclide method "in vitro".
47. Characteristics of radionuclide diagnostic methods "in vivo": radiometry, radiography, scanning, scintigraphy.
48. Means of obtaining diagnostic information during radionuclide diagnostics.
49. Scanning, principle of the method and interpretation of the obtained results.
50. Gamma scintigraphy, principle of the method, processing of the obtained results.
51. Study of the iodine-accumulating function of the thyroid gland.
52. Formation and main properties of X-ray.
53. X-ray Tube Working Principle and Its Construction.
54. Basic methods of X-ray examination: radiography and fluoroscopy, their advantages and disadvantages.
55. Patterns of X-ray image formation and properties. Fluorography: principles of the technique, diagnostic possibilities.
56. The principle and application of X-ray tomography.

57. Protection of personnel and patients from the action of ionizing radiation during X-ray examinations
58. Classification of contrast media, their use in radiological diagnostics. Complications arising from the use of contrast media. Physical and technical foundations of computer tomography, diagnostic capabilities of the method.
59. Physical and technical foundations of magnetic resonance imaging, diagnostic capabilities of the method. Classification of radionuclide diagnostic methods.
60. X-ray methods of the lung assessment.
61. Normal X-ray anatomy of the lung. Segmental anatomy of the lung
62. Lung pattern, its substrate. Changes in the pulmonary pattern.
63. Assessment of pulmonary hila on chest X-ray.
64. Bronchial Obstruction: its causes and value of chest radiography in diagnosis.
65. X-ray semiotics of the lung diseases.
66. Round shadows on chest x-ray, their differential diagnosis.
67. Ring shadows on chest x-ray, their differential diagnosis.
68. Detection of Pneumonia in chest X-ray images
69. X-ray diagnosis of pleurisy.
70. Classification of pulmonary tuberculosis.
71. X-ray diagnosis of children's forms of pulmonary tuberculosis.
72. X-ray diagnosis of diffuse dissemination in the lungs.
73. Classification of lung cancer. X-ray diagnosis of various forms of lung cancer. Central lung cancer, radiological imaging and differential diagnosis, complications.
74. X-ray methods of imaging of the heart and great vessels
75. Normal X-ray anatomy of the heart and large vessels. Arcs of the heart in a direct frontal projection.
76. The main X-ray signs of aortic defects of the heart.
77. X-ray classification of congenital heart defects.
78. Basic X-ray signs of mitral heart defects
79. General principles of X-ray examination of the gastrointestinal tract.
80. Methods of X-ray examination of the esophagus and its normal X-ray picture.
81. X-ray diagnostics of esophageal diverticula and their complications.
82. X-ray picture of esophageal cancer, differential diagnosis with achalasia.
83. Methods of X-ray examination of the stomach and its normal X-ray picture.
84. X-ray diagnosis of peptic ulcer disease of the stomach and duodenum.
85. X-ray signs of complications of gastric ulcer.
86. Stomach cancer, classification, clinical and radiological signs.
87. Chronic gastritis, classification, x-ray signs.
88. Methods of X-ray examination of the small intestine.
89. Methods of X-ray examination of the large intestine, normal X-ray anatomy of the large intestine.
90. X-ray picture of non-specific colitis / non-specific ulcerative colitis and granulomatous colitis.
91. X-ray signs of colon tumors.
92. X-ray diagnosis of intestinal obstruction, causes, differential diagnosis.
93. X-ray diagnosis of diverticular disease of the intestine, its complications.
94. Radiological examination of the liver, gall bladder, bile ducts and pancreas.
95. Study of the iodine-accumulating function of the thyroid gland.
96. Scanning and scintigraphy of the thyroid gland.
97. The value of radioimmunological analysis (RIA) in the complex radiation diagnosis of diseases of the thyroid gland.
98. X-ray examination of salivary glands.

99. Radionuclide methods of studying the hepatobiliary system.
100. Complex radiation diagnosis of gallstone disease.
101. Radionuclide methods of studying the reticulo-endothelial system of the liver.
102. Complex radiodiagnosis of diffuse and focal lesions of the liver.
103. Methods of radiation diagnosis of kidney, ureter, bladder diseases.
104. Methods of radiation diagnosis of diseases of the genital organs.
105. Radionuclide methods of kidney research.
106. Radionuclide renography and dynamic renoscintigraphy.
107. Characteristics of tumorotropic and glomerulogroup RFP.
108. Static radionuclide methods of kidney research. Nephroscintigraphy, scanning.
109. Complex radiation diagnosis of urolithiasis.
110. The value of RIA in complex radiodiagnosis of diffuse and focal kidney lesions.
111. Methods of radiation diagnosis of diseases of bones and joints.
112. X-ray signs of bone fractures.
113. X-ray signs of traumatic joint damage.
114. Features of X-ray imaging of bones in children. Age characteristics of fractures.
115. Stages of bone callus development in an X-ray image. Complication of fracture healing.
116. X-ray semiotics of bone and joint diseases.
117. X-ray diagnosis of osteomyelitis. X-ray diagnosis of primary chronic forms of osteomyelitis.
118. X-ray diagnosis of tuberculosis of bones and joints. Tuberculous spondylitis, its X-ray diagnosis.
119. Classification and X-ray diagnosis of bone tumors.
120. Methods of radiation examination of the thyroid gland, the sequence of their use, indications.
121. The value of radioimmunological analysis (RIA) in complex radiation diagnosis of thyroid gland diseases.
122. Classification of RFP used in oncology. their properties.
123. Characteristics of tumor-tropic RFP: ^{32}P , $^{99\text{m}}\text{Tc}$ -pertechnetate, $^{99\text{m}}\text{Tc}$ -pyrophosphate, $^{99\text{m}}\text{Tc}$ -tetrafosmin, ^{85}Sr -chloride, ^{67}Ga -citrate, ^{75}Se -methionine.
124. Negative scintigraphy in oncology.
125. Positive scintigraphy in oncology.
126. Use of ^{32}P for differential diagnosis of tumors.
127. The value of RIA for the differential diagnosis of tumors.
128. Classification and characteristics of tumor markers.
129. SPECT and PET in brain research.
130. Radiation diagnostics of emergency conditions.
131. Selection of the most informative methods of radiation examination for the diagnosis of emergency conditions.

14. Recommended literature.

Basic:

1. Myagkov O.P., Myagkov S.O. Atlas of radiation diagnostics of bone and soft tissue tumors. - Zaporizhzhia. - Shamrai G.S. - 2017. - 296 p.
2. Kravchuk S. Yu. Radiology [Text]: textbook /S. Yu. Kravchuk. - K.: Medicine, 2019. - 296 p.
3. Kovalsky O.V. Radiology. Radiation therapy. Radiation diagnostics [Text]: textbook /O.V. Kovalskyi, D.S. Mechev, V.P. Danylevich.-2nd ed.-Vinnitsia: New Book, 2017.-512 p.
4. Kovalsky O. Radiology. Radiotherapy. Diagnostic Imaging [Text] : textbook for students of higher med. educational establishments of IVth accreditation level/O. Kovalsky, D. Mechev, V. Danylevych.- 2nd ed.-Vinnitsia: Nova Knyha, 2017.-504 p.

5. Barannyk E.A. Girnyk S.A., Tovstyak V.V. Ultrasound Doppler methods of medical diagnostics. H.: KHNU named after V. N. Karazina. 2006. – 20 p.
6. Mathias Hofer. Computer tomography. Basic guide. - 2008
7. M. I. Spuzyak. Extended lectures on x-ray diagnostics of diseases of the support and movement system. Kharkiv. 2009. 295 p.
8. Under the editorship of A. P. Lazar. Selected lectures on radionuclide diagnostics and radiation therapy. Vinnytsia. New book. 2007. 196 p.
9. D.S. Mechev, M.I. Pylypenko. V.O. Rogozhyn European Charter of Training in Diagnostic Radiology - 2005 (translated from English) Kyiv. Medicine of Ukraine. 2007. - 124 p.

Additional:

1. Essential radiology for medical students, interns and residents //A.Ahuja.-OMF publishing.– 2017.–518 p.
2. OSPU-2000.
3. NRBU 1998.
4. Order of the Ministry of Health of Ukraine No. 340 dated November 28, 1997. "On improving the organization of the radiation diagnostics and radiation therapy service".
5. Myagkov O.P., Myagkov S.O. Atlas of radiation diagnostics of bone and soft tissue tumors. - Zaporizhzhia. – Shamrai G.S. - 2017. - 296 p.
6. Essential radiology for medical students, interns and residents//A.Ahuja.-OMF publishing. 2017. 518 p.
7. Rife, Meller. Atlas of sectional human anatomy using CT and MRI sections as an example. 2010
8. D. A. Lazar, D. S. Mechev, V. D. Rozumenko, T. I. Rozumenko, T. I. Chebotaryova / Radiotherapy of brain tumors. Kyiv. Medicine of Ukraine. 2010. 170 p.
9. O. P. Myagkov, S. O. Myagkov. Atlas of radiation diagnostics of diseases and injuries of the skull. Zaporizhzhia. Tandem. 2008. 192 p.

15. Informational resources

During discipline, studying due to the use of local and global computer networks, students use the following information resources and knowledge bases:

- Ministry of Health - <http://www.moz.gov.ua/ua/portal/>
- Wikipedia - <http://uk.wikipedia.org>
- UpToDate - <http://www.uptodate.com/home>
- Access Medicine - <http://accessmedicine.mhmedical.com>
- PubMed - <https://www.ncbi.nlm.nih.gov/pmc/>
- Order No. 51/151 dated 16.02.2017 On approval of the General rules of radiation safety for the use of ionizing radiation sources in medicine <https://ips.ligazakon.net/document/view/RE10832?an=22>
- AccessMedicine-<http://accessmedicine.mhmedical.com>
- 5.PubMed-<https://www.ncbi.nlm.nih.gov/pmc>

Electronic versions of educational and methodological support:

Methodological recommendations for practical classes and independent work in radiology for students of the III year of the medical faculty by specialty: 222 - "Medicine", fields of knowledge 22 "Health care"

Access method: <http://misa.meduniv.lviv.ua/course/index.php?categoryid=635>