

SYLLABUS

1. General information on the course

Full course name	Radiology
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Medical Institute. Department of Oncology and Radiology
Author(s)	Shevchenko Yuliia Yuriivna
Cycle/higher education level	The Second Level Of Higher Education, National Qualifications Framework Of Ukraine – The 7th Level, QF-LLL – The 7th Level, FQ-EHEA – The Second Cycle
Semester	18 weeks within 7th emesters
Workload	The volume of the course is 3 ECTS credits, 90 hours, of which 60 hours are contact work with the teacher (10 hours of lectures, 50 hours of practical classes), 30 hours of independent work
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	Krok-1, Radiology as a discipline is based on the study of anatomy, physiology, histology, microbiology, virology and immunology, pathophysiology, pathomorphology, pharmacology, propaedeutics of internal medicine, dentistry, propaedeutics of pediatrics, hygiene and ecology and integrates with these disciplines.
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

The academic discipline aims studying radiological diagnostics and radiation therapy, the effects of different types of radiation on the human body, methods of protection against ionizing radiation, understanding the possibilities of radiological research methods at various diseases, typical radiological signs of the most widespread diseases, basics of radiation diagnostics and radiation therapy and diagnostic algorithms in emergencies.

4. Contents

Module 1. Radiation therapy. General issues of diagnostic radiology.

Topic 1 The main properties of ionizing radiation and its biological action. Radioactivity and dose. Dosimetry.

History of radiology. Features of radiology departments for diagnosis and treatment of somatic and oncological diseases. Methods and means of protection from ionizing radiation. Basic sanitary rules for working with sources of ionizing and radiation safety standards. Permissible radiation doses during working with sources of ionizing radiation. Clinical dosimetry. Types of radiation used in medical practice. Ionizing and non-ionizing radiation. Physics of ionizing radiation. Biological action of radiation. The mechanism of radiation damage to cell tumors. Radiosensitivity of tumors.

Topic 2 Principles and methods of radiation therapy.

Basic principles of radiation therapy. Classification of methods of radiation therapy. Radical, palliative, symptomatic treatment. Characteristics of combined, complex methods of treatment and combined-radiation method. Determination of focal dose, rhythm, irradiation fields. General and local radiation reactions with different methods of radiation therapy. Closed and open sources of ionizing radiation. External and internal irradiation. Radiotherapy. Distance method of external irradiation. Basic methods of contact radiation therapy. Rationale for radiation therapy of non-tumor diseases.

Topic 3 Physical and technical bases of X-ray diagnostic.

Methods of X-ray examination: radiography, radioscopy, planar tomography, fluorography. Advantages and disadvantages of each method. Indications and contraindications to a particular radiological method of research. Principles of image acquisition in X-ray examination methods (radiation source and detector); purpose of methods - study of morphology or (and) function; contraindications; projection and sections of the study. Fundamentals of creation and understand of medical images using X-rays.

Topic 4 Physical and technical bases of radionuclide diagnostic.

Principles of image production by radionuclide research methods; appointment of methods; contraindications; projection and sections of the study. Methods of functional radionuclide diagnostics: clinical radiometry, clinical radiography, dynamic scintigraphy. Imaging techniques in radionuclide diagnostics: scanning, statistical scintigraphy, single-photon emission computed tomography (SPECT) and positron emission tomography (PET). Methods of radionuclide in vitro diagnostics. Advantages and disadvantages of each method. Indications and contraindications to a particular radionuclide method of diagnostic.

Topic 5 Physical and technical bases of magnetic resonance imaging (MRI).

Magnetic resonance imaging (MRI). Bases of MRI diagnostic. Use of contrast agents. Advantages and disadvantages of this method. Indications and contraindications to MRI. Principles of image acquisition by magnetic resonance imaging; natural and artificial contrast for MRI; purpose of the method; sections of the study.

Topic 6 Ultrasound diagnostic methods.

Physical and technical bases of ultrasound diagnostic (USD). Advantages and disadvantages of each ultrasound technique. Indications and contraindications to their conduct. Dopplerography. Ultrasound semiotics of diseases of internal organs. Principles of obtaining images by USD methods; natural and artificial contrast; appointment of methods; contraindications to USD.

Topic 7 Fundamentals of radiological, radionuclide CT and ultrasound and MRI semiotics of pathology of various organs and systems.

Fundamentals of radiological, radionuclide CT and ultrasound and MRI semiotics. X-ray semiotics in natural and artificial contrast. Computed tomography semiotics: density. The nature of image in the ultrasound examination - echogenicity. The nature of radionuclide semiotics, the degree of accumulation of radiopharmaceuticals. The nature of magnetic resonance imaging - the signal intensity in a magnetic field.

Topic 8 Radiological diagnostic methods and radiological anatomy of the thoracic cavity.

Radiological diagnostic methods of respiratory system and their characteristics: radiological methods of studying morphological changes of respiratory organs; methods of studying lung function, functional tests and their significance for studying lung function. The principle of obtaining images, indications and sequence of application of radiological methods. Choice of X-ray contrast agents. Age features of application of methods of radiological research of lungs. Radiological diagnostic plan. Radiological methods of the heart diagnostic, blood vessels and mediastinal organs and their characteristics. Contrast agents used in radiological examination of the heart and blood vessels. The concept of X-ray endovascular interventions and indications for their use.

Topic 9 Bases of radiological semiotics of pathology of the respiratory and cardiovascular systems.

Radiological diagnostic methods of respiratory system and their characteristics: radiological methods of studying morphological changes of respiratory organs; methods of studying lung function, functional tests and their significance for studying lung function. The principle of obtaining images, indications and sequence of application of radiological methods. Choice of X-ray contrast agents. Age features of application of methods of radiological research of lungs. Radiological diagnostic plan. Radiological methods of the heart diagnostic, blood vessels and mediastinal organs and their characteristics. Contrast agents used in radiological examination of the heart and blood vessels. The concept of X-ray endovascular interventions and indications for their use.

Topic 10 Radiological diagnostic methods and radiological anatomy of abdominal organs.

Plan of radiological examination of the gastrointestinal tract. Radiation methods for the diagnostic of salivary glands. Normal radiological anatomy and physiology of salivary glands. Radiological methods of examination of the digestive tract. X-ray methods of examination of the esophagus, stomach, small and large intestines: radioscopy and radiography, artificial contrast of organs using X-ray positive and X-ray negative contrast agents. Oral contrast, irrigoscopy, probe contrast, parietography, angiography. Ultrasound, CT, MRI of the digestive tract. Patient preparing for diagnostic. Indications and contraindications to radiological examination. Normal radiological anatomy and physiology of the digestive tract: sector function, tone, peristaltic and evacuation.

Topic 11 Radiological signs of emergencies.

Radiological diagnostic of emergencies. Radiological, radionuclide, ultrasound, magnetic resonance and tomographic signs of emergencies - myocardial infarction, pulmonary edema, hydropericardium, hydrothorax, pneumothorax, pulmonary embolism, foreign bodies in the bronchial cavity, tracheal cavity damage. Choice of a method of radiological research for diagnostics of a certain emergency condition.

Topic 12 Radiological study of the urinary system. radiological radiation anatomy and physiology of the genitourinary system.

Radiological methods of examination of the kidneys and urinary tract: ultrasound (B-method, Doppler, duplex sonography), radiological (review radiography, excretory urography, micturition cystography, ascending (retrograde) pyelography, angiography, CT scan, dynamic scintigraphy, SPECT), MRI. Types of renography curves. X-ray contrast and radioactive pharmaceuticals. Radiological anatomy and physiology of the kidneys and urinary tract. Preparing of patients for the study. Indications and contraindications to radiological examination. Radiological methods of genital examination. Radiological diagnosis of pregnancy and postpartum diseases.

Topic 13 Radiological study of the musculoskeletal system. Age features of the musculoskeletal system.

X-ray methods of examination of bones and joints: radiography, tomography, fistulography, pneumoarthrography, angiography, densitometry. Normal radiation anatomy and basics of physiology of bones and joints. Basic principles of radionuclide study of the musculoskeletal system, radiopharmaceuticals, used for osteoscintigraphy. X-ray and radionuclide semiotics of bone and joint damage. Possibilities of ultrasound, CT, MRI in the study of the musculoskeletal system, indications for their use. The main indications and contraindications to radiological examination of bones and joints.

Module 2. Radiological diagnostic of diseases of separate organs and systems.

Topic 14 Radiological diagnosis of congenital malformations and non-inflammatory diseases of the respiratory system (occupational diseases, cancer).

Radiological signs of respiratory malformations. Radiological signs of traumatic injuries of the respiratory organs and foreign bodies (edema, bruising, atelectasis, emphysema, pneumothorax, etc.). Radiological diagnostic of benign and malignant (primary and secondary) lung tumors. Algorithm of radiological research at the particular pathology. Radiological signs of occupational lung diseases (pneumoconiosis, their variants and radiological features).

Topic 15 Radiological diagnosis of non-specific and specific inflammatory diseases of the respiratory system.

Radiological signs of inflammatory diseases of the respiratory system (changes in lung pattern, changes in the pulmonary fields, changes in the roots of the lungs). Radiological diagnosis of acute and chronic inflammatory processes of the respiratory system: bronchitis; pneumonia and their complications (abscess, gangrene, destruction, pleurisy); pneumo-, hydro-, - hydro pneumothorax. Radiological signs of tuberculous impression of the lungs. X-ray features (semiotics of impressions) of some forms of pulmonary tuberculosis. Types of complications of pulmonary tuberculosis. Radiological signs of reduced activity of the tuberculous process. Variants of residual changes after pulmonary tuberculosis.

Topic 16 Radiological signs of diseases of the cardiovascular system. Radiological diagnostic of congenital and acquired heart defects. X-ray picture depending on hemodynamic changes.

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), the reasons for their formation. Changes in the size of the heart chamber, methods of determination. Heart contraction disorders, assessment methods. Algorithm of radiological examination and the main radiological symptoms in some heart diseases: ischemic disease and its complications, myocarditis, pericarditis, aneurysm of varicose veins (aorta, vena cava, vessels of the extremities). Hemodynamic parameters and their influence on the change of heart configuration in different heart defects.

Topic 17 Radiological signs of some diseases of the kidneys and urinary tract.

Algorithm of radiological examination in pathology of the kidneys and urinary tract: malformations, inflammatory diseases, urolithiasis, renal colic, tumors and bones, kidney injuries, hypertension.

Topic 18 Radiological examination of the breast and thyroid gland. Radiological signs of breast and thyroid diseases.

Radiological methods of thyroid imaging: ultrasound, radionuclide, X-ray, CT, MRI. Normal radiological anatomy and physiology. Indications and contraindications to each radiological method of thyroid examination. Compilation of the algorithm of radiological research. Radiological semiotics of pathology of the endocrine system: hypo-, hyperthyroidism, tumor lesions of the thyroid gland inflammatory processes, abnormal location of the thyroid gland. Radiological methods of examination of the breast: ultrasound, X-ray, CT, MRI. Radiological anatomy of the breast. Possibilities and main indications and contraindications to radiological examination of the breast. Radiological semiotics of breast diseases.

Topic 19 Radiological signs of diseases of the gastrointestinal tract.

Methods of radiological examination of the gastrointestinal tract. Preparing patients for examination. Indications and contraindications to radiological examination. Radiological symptoms of diseases of the digestive tract. Algorithm of radiological diagnostic of perforation of a hollow organ in an abdominal cavity, tumors of an esophagus, a stomach, intestines. Leading radiation syndromes of achalasia (dilatation) of the esophagus, narrowing of the esophagus. Leading radiological syndromes of diseases of the digestive tract, "acute abdomen"; inflammation (esophagitis, gastritis, enteritis, colitis); gastric and duodenal ulcers and its complications; malignant (cancer); benign (polyps) tumors; developmental defects; functional diseases (atony, hypotension, reflux); intestinal obstruction.

Topic 20 Radiological signs of liver and biliary tract diseases.

Preparing of patients for examination. Indications and contraindications to radiological examination. Radiological methods of functional examination of the liver and gallbladder. Radiological signs of tumor (primary or secondary) and cystic lesions of the liver, hepatitis, cirrhosis. Calculous cholecystitis - radiological methods of research and radiological signs. Determination of external and internal secretory function of the pancreas by radioimmunoassay.

<p>Topic 21 Radiological diagnosis of inflammatory diseases and oncological diseases of the musculoskeletal system.</p> <p>Radiological signs of inflammatory lesions of the musculoskeletal system: arthritis, osteomyelitis, tuberculosis of the bones and joints. Radiological signs of bone tumors: benign (chondromas, osteomas, osteochondromas), malignant (osteogenic sarcoma, Ewing's sarcoma, osteoblastoclastoma, metastases). Radiological diagnostic of certain diseases of the spine and joints. Radiological signs of lesions of the musculoskeletal system in rheumatoid arthritis, collagenosis, aseptic osteoarthritis. Algorithm of radiological diagnostic.</p>
<p>Topic 22 Radiological diagnostic of traumatic diseases and congenital malformations of the musculoskeletal system.</p> <p>Radiological signs of diseases of the musculoskeletal system: changes in shape, size, position of the bones; changes in contours (periostitis, periostosis), changes in structure (osteoporosis, osteosclerosis, destruction, osseonecrosis, osteonecrosis, osteolysis, atrophy), changes in the joint space (narrowing, disappearance, compaction of joint surfaces, marginal, bony outgrowths). Radiological diagnostics of some diseases of the musculoskeletal system. Radiological signs of traumatic injuries of bones and joints - fractures, dislocations, types of displacement of fragments, features of fractures of children and the elderly. Radiological picture of normal fracture healing. Complications of fracture healing.</p>
<p>Topic 23 Radiological methods of central nervous system (CNS) diagnostic. Radiological signs of diseases and injuries of the CNS.</p> <p>Radiological methods of CNS research. X-ray methods of examination of the skull and brain (cranial radiography, ventriculography, cisternography). Hagiographic methods of CNS research. CT and MRI of the brain and spinal cord. Radionuclide studies of the CNS (static, scintigraphy, SPECT, PET studies). The main radiation signs of CNS pathology: traumatic injuries of the skull, brain, spine and spinal cord; vascular diseases of the brain (cerebrovascular disorders, stroke, intracerebral hematomas); vertebrogenic pain syndrome; infectious and inflammatory diseases of the brain; hypertensive syndrome. Radiological signs of brain tumors. Pituitary tumors. Interventional neuroradiology.</p>
<p>Topic 24 Differential diagnosis of diseases. Control of practical skills.</p> <p>Use of radiological methods for differential diagnosis of diseases. Interpretation of radiograms. Use of algorithms of radiological diagnostic of diseases.</p>
<p>Topic 25 Control module</p> <p>Control of theoretical knowledge of the module.</p>

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Collect data on patient complaints, medical history, life history (including occupational history), in a health care facility, its unit, using the results of the interview with the patient to be able to prescribe the necessary method of radiological examination in accordance with ethical aspects.
LO2	Evaluate information on diagnosis in the setting of a healthcare institutions, its unit, using a standard procedure, using knowledge of the person, his organs and systems.

LO3	Be able to identify and record the leading radiation symptom or syndrome by making an informed decision, using preliminary history and physical examination of the patient, the results of radiological examination, knowledge about the person, his organs and systems. Be able to apply the basic methods of radiation research, using the necessary means of protection against radiation, in compliance with the relevant laws of Ukraine and radiation protection standards. Be able to establish the most probable diagnosis of the disease. Carry out differential diagnosis using the results of radiological examination. Establish a preliminary and clinical diagnosis.
LO4	Determine the necessary method of radiation treatment, radiation regimen, in the treatment of the disease, in a health care facility based on a previous clinical diagnosis, using knowledge about the person, his organs and systems, adhering to relevant ethical and legal norms, by making informed decisions according to existing algorithms and standard schemes.
LO5	Be able to prescribe and perform medical manipulations based on radiological studies. Determine emergency care tactics and provide emergency care based on an emergency diagnosis.
LO6	To organize an appropriate level of individual safety in the conduct of radiation research and radiation therapy (own and of those cared for) in case of typical dangerous situations in the individual field of activity.

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.

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PO2	To collect information about the patient's general condition; to assess the patient's psychomotor and physical development and the state of organs and systems of the body; to assess information on the diagnosis (according to the List 4) based on laboratory and instrumental findings.
PO3	To order and analyze additional (mandatory and optional) examinations (laboratory, radiological, functional and/or instrumental) (according to the List 4) in order to perform a differential diagnosis of diseases (according to the List 2).
PO4	To establish a final clinical diagnosis at a medical institution under control of a supervising doctor by means of informed decision and logical analysis of the obtained subjective and objective data of clinical and additional examinations, and differential diagnosis, following the relevant ethical and legal norms (according to the List 2).
PO21	To organize an appropriate level of individual safety (own and of those cared for) in case of typical dangerous situations in the individual field of activity.

7. Teaching and learning activities

7.1 Types of training

Topic 1. The main properties of ionizing radiation and its biological action. Radioactivity and dose. Dosimetry.

pr.tr.1 "The main properties of ionizing radiation and its biological action. Radioactivity and dose. Dosimetry." (full-time course)

History of radiology. Features of radiology departments for diagnosis and treatment of somatic and oncological diseases. Methods and means of protection from ionizing radiation. Basic sanitary rules for working with sources of ionizing and radiation safety standards. Permissible radiation doses during working with sources of ionizing radiation. Clinical dosimetry. The study of this topic involves theoretical work in the classroom (testing). Application of individual methods and means of protection when working with X-rays, permissible radiation doses and their registration (use of a dosimeter). Acquaintance with the arrangement of the radiology department of the medical institution (according to the agreement on cooperation between the medical institution and the university). View and discuss educational videos. Interactive educational games. In case of quarantine restrictions, all activities are carried out by means of video communication.

Topic 2. Principles and methods of radiation therapy.

pr.tr.2 "Principles and methods of radiation therapy." (full-time course)

Basic principles of radiation therapy. Classification of methods of radiation therapy. Radical, palliative, symptomatic treatment. Characteristics of combined, complex methods of treatment and combined-radiation method. Determination of focal dose, rhythm, irradiation fields. General and local radiation reactions with different methods of radiation therapy. Closed and open sources of ionizing radiation. External and internal irradiation. Radiotherapy. Distance method of external irradiation. Basic methods of contact radiation therapy. Rationale for radiation therapy of non-tumor diseases. The study of this topic involves theoretical work in the classroom (testing). Group and individual discussion of the material. Acquaintance with the arrangement of the department of radiation therapy of the medical institution (according to the agreement on cooperation between the medical institution and the university). View and discuss educational videos. Interactive educational games. Under quarantine conditions, all activities are carried out by means of video communication.

Topic 3. Physical and technical bases of X-ray diagnostic.

lect.1 "History of radiological diagnostics. Features of the device of X-ray departments. X-ray diagnostic methods. Physical and technical bases of X-ray studies." (full-time course)

Features of the device of X-ray departments. X-ray diagnostic methods. Physical and technical bases of X-ray studies. Teaching is conducted in the form of multimedia interactive lectures (in the presence of quarantine - in the on-line mode).

pr.tr.3 "Methods of X-ray examination" (full-time course)

Methods of X-ray examination: radiography, radioscopy, planar tomography, fluorography. Advantages and disadvantages of each method. Indications and contraindications to a particular radiological method of research. Principles of image acquisition in X-ray examination methods (radiation source and detector); purpose of methods - study of morphology or (and) function; contraindications; projection and sections of the study. Fundamentals of creation and understand of medical images using X-rays. Principles of obtaining images during computed tomography: the purpose of the method; contraindications. Natural and artificial contrast for X-ray methods. Contrasting agents. Indications for their use. Construction of clinical and radiological diagnosis. The study of this topic involves theoretical work in the classroom (testing). Acquaintance with types of diagnostic radiological equipment of medical institution. Stay and use of equipment in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Review and discussion of educational videos. Paired discussions. Under quarantine conditions, all activities are carried out by means of video communication.

Topic 4. Physical and technical bases of radionuclide diagnostic.

pr.tr.4 "Physical and technical bases of radionuclide diagnostic." (full-time course)

Principles of image production by radionuclide diagnostic methods; appointment of methods; contraindications; projection and sections of the study. Methods of functional radionuclide diagnostic: clinical radiometry, clinical radiography, dynamic scintigraphy. Imaging techniques in radionuclide diagnostic: scanning, statistical scintigraphy, single-photon emission computed tomography (SPECT) and positron emission tomography (PET). Methods of radionuclide in vitro diagnostic. Advantages and disadvantages of each method. Indications and contraindications to a particular radionuclide method of diagnostic. The study of this topic involves theoretical work in the classroom (testing). Acquaintance with a technique of carrying out radionuclide methods of diagnostics, viewing of video and its group discussion. Skills training interpretation of radionuclide studies with interactive games or online testing.

Topic 5. Physical and technical bases of magnetic resonance imaging (MRI).

pr.tr.5 "Physical and technical bases of magnetic resonance imaging (MRI)" (full-time course)

Magnetic resonance imaging (MRI). Bases of MRI diagnostic. Use of contrast agents. Advantages and disadvantages of this method. Indications and contraindications to MRI. Principles of image acquisition by magnetic resonance imaging; natural and artificial contrast for MRI; purpose of the method; sections of the study. The study of this topic involves theoretical work in the classroom (testing). Introduction to the method of MRI and group discussion of the advantages and disadvantages of the method. Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university).

Topic 6. Ultrasound diagnostic methods.

pr.tr.6 "Ultrasound diagnostic methods." (full-time course)

Physical and technical bases of ultrasound diagnostic (USD). Advantages and disadvantages of each ultrasound technique. Indications and contraindications to their conduct. Dopplerography. Ultrasound semiotics of diseases of internal organs. Principles of obtaining images by USD methods; natural and artificial contrast; appointment of methods; contraindications to USD. The study of this topic involves practical work in the office of ultrasound diagnostics. Introduction to the technique of ultrasound diagnosis, watching videos and his group discussion. Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Diagnosis mastering topics through testing.

Topic 7. Fundamentals of radiological, radionuclide CT and ultrasound and MRI semiotics of pathology of various organs and systems.

pr.tr.7 "Fundamentals of radiological, radionuclide CT and ultrasound and MRI semiotics of pathology of various organs and systems." (full-time course)

Fundamentals of radiological, radionuclide CT and ultrasound and MRI semiotics. X-ray semiotics in natural and artificial contrast. Computed tomography semiotics: density. The nature of image in the ultrasound examination - echogenicity. The nature of radionuclide semiotics, the degree of accumulation of radiopharmaceuticals. The nature of magnetic resonance imaging - the signal intensity in a magnetic field. The study of this subject provides theoretical work in the training room (testing). Drawing visual summaries and their group discussion. Skills training radiant interpretation of research using radiographs of patients, consolidate practical skills through interactive games.

Topic 8. Radiological diagnostic methods and radiological anatomy of the thoracic cavity.

lect.2 "Radiation diagnostic methods and radiation anatomy of the thoracic cavity." (full-time course)

Radiological methods of chest examination. Basic of radiological semiotics of respiratory and heart pathology. Teaching is conducted in the form of multimedia interactive lectures (in the presence of quarantine - in the on-line mode).

pr.tr.8 "Radiological diagnostic methods and radiological anatomy of the thoracic cavity." (full-time course)

Radiological diagnostic methods of respiratory system and their characteristics: radiological methods of studying morphological changes of respiratory organs; methods of studying lung function, functional tests and their significance for studying lung function. The principle of obtaining images, indications and sequence of application of radiological methods. Choice of X-ray contrast agents. Age features of application of methods of radiological research of lungs. Radiological diagnostic plan. Radiological methods of the heart diagnostic, blood vessels and mediastinal organs and their characteristics. Contrast agents used in radiological examination of the heart and blood vessels. The concept of X-ray endovascular interventions and indications for their use. The study of this topic involves theoretical work in the classroom (testing), work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of chest radiographs (work in pairs under the supervision of a teacher). Under the conditions of quarantine, group analysis of radiographs by means of video communication and practice of practical skills by means of interactive games.

Topic 9. Bases of radiological semiotics of pathology of the respiratory and cardiovascular systems.

pr.tr.9 "Bases of radiological semiotics of pathology of the respiratory and cardiovascular systems." (full-time course)

Radiological anatomy and physiology of the respiratory organs: chest, tracheobronchial tree, lung roots and lung pattern, their morphological substrate. Age features of radiological anatomy and physiology of lungs. Fundamentals of radiation semiotics of pathology of the respiratory system. Radiological anatomy of the mediastinum, heart and main vessels: radiological, ultrasound and CT - anatomy in standard projections. Evaluation of the results of radiological examination of cardiac function: M-mode, Doppler echocardiography, dynamic radiocardiography, radionuclide angiocardiology, perfusion scintigraphy. The study of this topic involves theoretical work in the classroom (testing). Practical work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs - cross-discussion. Under quarantine conditions, group analysis of radiographs by video link and online testing.

Topic 10. Radiological diagnostic methods and radiological anatomy of abdominal organs.

lect.3 "X-ray methods of examination of the gastrointestinal tract (GIT), urinary and hepatobiliary systems." (full-time course)

X-ray methods of examination of the gastrointestinal tract (GIT), urinary and hepatobiliary systems. X-ray semiotics of gastrointestinal diseases, renal pathology and hepatobiliary tract. X-ray examination in urgent conditions (trauma, bleeding, pain, bowel obstruction). Teaching is conducted in the form of multimedia interactive lectures (in the presence of quarantine - in the on-line mode).

pr.tr.10 "Radiological diagnostic methods and radiological anatomy of abdominal organs.." (full-time course)

Plan of radiological examination of the gastrointestinal tract. Radiation methods for the diagnostic of salivary glands. Normal radiological anatomy and physiology of salivary glands. Radiological methods of examination of the digestive tract. X-ray methods of examination of the esophagus, stomach, small and large intestines: radioscopy and radiography, artificial contrast of organs using X-ray positive and X-ray negative contrast agents. Oral contrast, irrigoscopy, probe contrast, parietography, angiography. Ultrasound, CT, MRI of the digestive tract. Patient preparing for diagnostic. Indications and contraindications to radiological examination. Normal radiological anatomy and physiology of the digestive tract: sector function, tone, peristaltic and evacuation. The study of this topic involves theoretical work in the classroom (testing). Practical work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs - cross-discussion. Under quarantine conditions, group analysis of radiographs by video link and online testing.

Topic 11. Radiological signs of emergencies.

pr.tr.11 "Radiological signs of emergencies." (full-time course)

Radiological diagnostics of emergencies. Radiological, radionuclide, ultrasound, magnetic resonance and tomographic signs of emergencies - myocardial infarction, pulmonary edema, hydropericardium, hydrothorax, pneumothorax, pulmonary embolism, foreign bodies in the bronchial cavity, tracheal cavity damage. Choice of a method of radiological research for diagnostics of a certain emergency condition. The study of this topic involves theoretical work in the classroom (testing), work in the radiology and ultrasound departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs (cross-discussion). Under the conditions of quarantine by means of video communication. Practice of practical skills (interactive games, case method).

Topic 12. Radiological study of the urinary system. radiological radiation anatomy and physiology of the genitourinary system.

pr.tr.12 "Radiological study of the urinary system. radiological radiation anatomy and physiology of the genitourinary system." (full-time course)

Radiological methods of examination of the kidneys and urinary tract: ultrasound (B-method, Doppler, duplex sonography), radiological (review radiography, excretory urography, micturition cystography, ascending (retrograde) pyelography, angiography, CT scan, dynamic scintigraphy, SPECT), MRI. Types of renography curves. X-ray contrast and radioactive pharmaceuticals. Radiological anatomy and physiology of the kidneys and urinary tract. Preparing of patients for the study. Indications and contraindications to radiological examination. Radiological methods of genital examination. Radiological diagnosis of pregnancy and postpartum diseases. The study of this topic involves theoretical work in the classroom (testing), work in the radiology and ultrasound departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs (cross-discussion). Under the conditions of quarantine by means of video communication. Practice of practical skills (interactive games, case method).

Topic 13. Radiological study of the musculoskeletal system. Age features of the musculoskeletal system.

lect.4 "Radiological diagnostic of the musculoskeletal system. Radiation semiotics of diseases of bones and joints." (full-time course)

Radiological diagnostic of the musculoskeletal system. Radiation semiotics of diseases of bones and joints. Teaching is conducted in the form of multimedia interactive lectures (in the presence of quarantine - in the on-line mode).

pr.tr.13 "Radiological diagnostic of the musculoskeletal system. Age features of the musculoskeletal system." (full-time course)

X-ray methods of examination of bones and joints: radiography, tomography, fistulography, pneumoarthrography, angiography, densitometry. Normal radiation anatomy and basics of physiology of bones and joints. Basic principles of radionuclide study of the musculoskeletal system, radiopharmaceuticals, used for osteoscintigraphy. X-ray and radionuclide semiotics of bone and joint damage. Possibilities of ultrasound, CT, MRI in the study of the musculoskeletal system, indications for their use. The main indications and contraindications to radiological examination of bones and joints. The study of this topic involves theoretical work in the classroom (discussion of radiographs cross-discussion) and work in the diagnostic radiology department (features of laying patients to obtain high-quality radiographs of bones). Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Under quarantine by video link.

Topic 14. Radiological diagnosis of congenital malformations and non-inflammatory diseases of the respiratory system (occupational diseases, cancer).

lect.5 "Radiological diagnosis of congenital malformations and non-inflammatory diseases of the respiratory system." (full-time course)

Radiological diagnosis of congenital malformations and non-inflammatory diseases of the respiratory system. Teaching is conducted in the form of multimedia interactive lectures (in the presence of quarantine - in the on-line mode).

pr.tr.14 "Radiological diagnosis of congenital malformations and non-inflammatory diseases of the respiratory system (occupational diseases, cancer)." (full-time course)

Radiological signs of respiratory malformations. Radiological signs of traumatic injuries of the respiratory organs and foreign bodies (edema, bruising, atelectasis, emphysema, pneumothorax, etc.). Radiological diagnostic of benign and malignant (primary and secondary) lung tumors. Algorithm of radiological research at the particular pathology. Radiological signs of occupational lung diseases (pneumoconiosis, their variants and radiological features). The study of this topic involves theoretical work in the classroom (testing, discussion of situational tasks), practice of skills of analysis of radiographs. Practice of skills of conducting X-ray functional tests with the help of role-playing games. Application of instrumental methods of diagnostics (work with radiographs and results of CT, ultrasound, radionuclide research methods) with discussion of results. Discussion of diagnostic tactics. Introduction to the technique of CT, ultrasound in hospital departments (under the cooperation agreement between medical institutions and universities).

Topic 15. Radiological diagnosis of non-specific and specific inflammatory diseases of the respiratory system.

pr.tr.15 "Radiological diagnosis of non-specific and specific inflammatory diseases of the respiratory system." (full-time course)

Radiological signs of inflammatory diseases of the respiratory system (changes in lung pattern, changes in the pulmonary fields, changes in the roots of the lungs). Radiological diagnosis of acute and chronic inflammatory processes of the respiratory system: bronchitis; pneumonia and their complications (abscess, gangrene, destruction, pleurisy); pneumo-, hydro-, hydro pneumothorax. Radiological signs of tuberculous impression of the lungs. X-ray features (semiotics of impressions) of some forms of pulmonary tuberculosis. Types of complications of pulmonary tuberculosis. Radiological signs of reduced activity of the tuberculous process. Variants of residual changes after pulmonary tuberculosis. The study of this topic involves theoretical work in the classroom (testing, discussion of situational tasks), practice skills of analysis of radiographs, with a discussion of the results (cross-discussion). Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Under quarantine via video link. Practice of practical skills (interactive games, testing, case method).

Topic 16. Radiological signs of diseases of the cardiovascular system. Radiological diagnostic of congenital and acquired heart defects. X-ray picture depending on hemodynamic changes.

pr.tr.16 "Radiological signs of diseases of the cardiovascular system. Radiological diagnostic of congenital and acquired heart defects. X-ray picture depending on hemodynamic changes." (full-time course)

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), the reasons for their formation. Changes in the size of the heart chamber, methods of determination. Heart contraction disorders, assessment methods. Algorithm of radiological examination and the main radiological symptoms in some heart diseases: ischemic disease and its complications, myocarditis, pericarditis, aneurysm of varicose veins (aorta, vena cava, vessels of the extremities). Hemodynamic parameters and their influence on the change of heart configuration in different heart defects. The study of this topic involves theoretical work in the classroom (testing, discussion of situational tasks), practice skills of analysis of radiographs, with a discussion of the results (cross-discussion). Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Under quarantine via video link. Practice of practical skills (interactive games, testing, case method).

Topic 17. Radiological signs of some diseases of the kidneys and urinary tract.

pr.tr.17 "Radiological signs of some diseases of the kidneys and urinary tract." (full-time course)

Algorithm of radiological examination in pathology of the kidneys and urinary tract: malformations, inflammatory diseases, urolithiasis, renal colic, tumors and bones, kidney injuries, hypertension. The study of this topic involves theoretical work in the classroom (testing, discussion of situational tasks), practice skills of analysis of radiographs, with a discussion of the results (cross-discussion). Work in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Under quarantine via video link. Practice of practical skills (interactive games, on-line testing, case method).

Topic 18. Radiological examination of the breast and thyroid gland. Radiological signs of breast and thyroid diseases.

pr.tr.18 "Radiological examination of the breast and thyroid gland. Radiological signs of breast and thyroid diseases." (full-time course)

Radiological methods of thyroid imaging: ultrasound, radionuclide, X-ray, CT, MRI. Normal radiological anatomy and physiology. Indications and contraindications to each radiological method of thyroid examination. Compilation of the algorithm of radiological research. Radiological semiotics of pathology of the endocrine system: hypo-, hyperthyroidism, tumor lesions of the thyroid gland inflammatory processes, abnormal location of the thyroid gland. Radiological methods of examination of the breast: ultrasound, X-ray, CT, MRI. Radiological anatomy of the breast. Possibilities and main indications and contraindications to radiological examination of the breast. Radiological semiotics of breast diseases. The study of this topic involves theoretical work in the classroom (testing), work in the department of ultrasound diagnostics of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of mammograms. Work in the office of ultrasound diagnostics. Under quarantine by video link.

Topic 19. Radiological signs of diseases of the gastrointestinal tract.

pr.tr.19 "Radiological signs of diseases of the gastrointestinal tract." (full-time course)

Methods of radiological examination of the gastrointestinal tract. Preparing patients for examination. Indications and contraindications to radiological examination. Radiological symptoms of diseases of the digestive tract. Algorithm of radiological diagnostic of perforation of a hollow organ in an abdominal cavity, tumors of an esophagus, a stomach, intestines. Leading radiation syndromes of achalasia (dilatation) of the esophagus, narrowing of the esophagus. Leading radiological syndromes of diseases of the digestive tract, "acute abdomen"; inflammation (esophagitis, gastritis, enteritis, colitis); gastric and duodenal ulcers and its complications; malignant (cancer); benign (polyps) tumors; developmental defects; functional diseases (atony, hypotension, reflux); intestinal obstruction. Work in the profile departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs (work in pairs under the supervision of a teacher). In the absence of radioscopies, educational videos are used in the department. Under quarantine by video link. Visual annotation techniques, interactive games and case method are used.

Topic 20. Radiological signs of liver and biliary tract diseases.

pr.tr.20 "Radiological signs of liver and biliary tract diseases." (full-time course)

Preparing of patients for examination. Indications and contraindications to radiological examination. Radiological methods of functional examination of the liver and gallbladder. Radiological signs of tumor (primary or secondary) and cystic lesions of the liver, hepatitis, cirrhosis. Calculous cholecystitis - radiological methods of diagnostic and radiological signs. Determination of external and internal secretory function of the pancreas by radioimmunoassay. The study of this topic involves theoretical work in the classroom (testing), work in the office of ultrasound diagnostics, role-playing games (practice skills of obtaining ultrasound images). Discussion of educational videos and presentations. Under quarantine by video link.

Topic 21. Radiological diagnosis of inflammatory diseases and oncological diseases of the musculoskeletal system.

pr.tr.21 "Radiation diagnosis of inflammatory diseases and oncological diseases of the musculoskeletal system." (full-time course)

Radiation signs of inflammatory lesions of the musculoskeletal system: arthritis, osteomyelitis, tuberculosis of the bones and joints. Radiation signs of bone tumors: benign (chondromas, osteomas, osteochondromas), malignant (osteogenic sarcoma, Ewing's sarcoma, osteoblastoclastoma, metastases). Radiation diagnosis of certain diseases of the spine and joints. Radiation signs of lesions of the musculoskeletal system in rheumatoid arthritis, collagenosis, aseptic arthrosis. Algorithm of radiological research. The study of this topic involves theoretical work in the classroom (testing, situational tasks) and in the radiology department of the medical institution (according to the agreement on cooperation between the medical institution and the university). Analysis and discussion of radiographs (work in pairs under the supervision of a teacher). Under quarantine by video link.

Topic 22. Radiological diagnostic of traumatic diseases and congenital malformations of the musculoskeletal system.

pr.tr.22 "Radiological diagnostic of traumatic diseases and congenital malformations of the musculoskeletal system." (full-time course)

Radiological signs of diseases of the musculoskeletal system: changes in shape, size, position of the bones; changes in contours (periostitis, periostosis), changes in structure (osteoporosis, osteosclerosis, destruction, osseonecrosis, osteonecrosis, osteolysis, atrophy), changes in the joint space (narrowing, disappearance, compaction of joint surfaces, marginal, bony outgrowths). Radiological diagnostics of some diseases of the musculoskeletal system. Radiological signs of traumatic injuries of bones and joints - fractures, dislocations, types of displacement of fragments, features of fractures of children and the elderly. Radiological picture of normal fracture healing. Complications of fracture healing. The study of this topic involves theoretical work in the classroom (testing, analysis and discussion of radiographs). Visual annotation techniques, interactive games and case method are used.

Topic 23. Radiological methods of central nervous system (CNS) diagnostic. Radiological signs of diseases and injuries of the CNS.

pr.tr.23 "Radiological methods of central nervous system (CNS) diagnostic. Radiological signs of diseases and injuries of the CNS." (full-time course)

Radiological methods of CNS research. X-ray methods of examination of the skull and brain (cranial radiography, ventriculography, cisternography). Hagiographic methods of CNS research. CT and MRI of the brain and spinal cord. Radionuclide studies of the CNS (static, scintigraphy, SPECT, PET studies). The main radiation signs of CNS pathology: traumatic injuries of the skull, brain, spine and spinal cord; vascular diseases of the brain (cerebrovascular disorders, stroke, intracerebral hematomas); vertebrogenic pain syndrome; infectious and inflammatory diseases of the brain; hypertensive syndrome. Radiological signs of brain tumors. Pituitary tumors. Interventional neuroradiology. The study of this topic involves theoretical work in the classroom (viewing and discussion of educational videos and presentations). Analysis and discussion of radiographs, CT, MRI examinations in the departments of the medical institution (according to the agreement on cooperation between the medical institution and the university). Under quarantine by video link.

Topic 24. Differential diagnosis of diseases. Control of practical skills.

pr.tr.24 "Differential diagnosis of diseases. Control of practical skills." (full-time course)
 Use of radiological research methods for differential diagnosis of diseases. Interpretation of radiographs. Use of algorithms of radiological diagnostics of diseases. Work in the radiology department and the department of ultrasound diagnostics (demonstration of acquired practical skills). Work with databases of radiographs and ultrasound, CT, MRI images. Testing by radiographs and other results of radiological examinations. Interpretation and written description of radiographs. In case of quarantine restrictions using the Mix.sumdu.edu.ua platform, Google meet

Topic 25. Control module

pr.tr.25 "Control module" (full-time course)
 Control module. In case of quarantine restrictions using the Mix.sumdu.edu.ua platform, Google meet

7.2 Learning activities

LA1	Practical work with the patient in the specialized departments of the hospital
LA2	Participation in discussion (group and pair)
LA3	Preparation for practical classes
LA4	Analysis of specific situations (Case-study)
LA5	Solving practical problems using online technologies
LA6	Preparation of multimedia presentations
LA7	Interpretation of radiological (MRI, radionuclide, echocardiography, ultrasound, CT, radiography) methods of examination
LA8	E-learning in systems (Zoom, MIX.sumdu.edu.ua)
LA9	Individual research project (student research paper, article, thesis, etc.)
LA10	Work with textbooks and relevant information sources
LA11	Self-study

8. Teaching methods

Course involves learning through:

TM1	Interactive lectures
TM2	Case-based learning (CBL). Training based on the analysis of a clinical case, situations
TM3	Team-based learning (TBL)
TM4	Think-pair-share
TM5	Role-playing game
TM6	Cross-discussion
TM7	Brain storm

TM8	Research-based learning (RBL). Learning through research
TM8	Навчальна дискусія / дебати
TM9	Educational discussion / debate
TM10	Round Table

Method of demonstrations (patient, equipment, means of radiation protection, educational video). Role play. Brain storm. Practical classes allow students to plan a patient examination scheme and interpret results of examination, to diagnose and assist with urgent conditions, learn the rules of work of medical staff in appropriate departments, carry out medical procedures and work out them under the supervision of the teacher (LR 1, LR 2, LR 3, LR 4, LR5). Performing situational tasks will allow to analyze the tactics of examination of patients (LR 1, LR 2, LR 4, LR 5). Practical demonstrations involve the interpretation of radiological methods of investigation and emergency assistance (LR 2, LR 3, LR 5). Students will develop self-study, synthesis, and analytical thinking skills in preparing for practice-oriented presentations. Independent work will facilitate the preparation for practical classes.

Ability to abstract thinking, analysis and synthesis. Ability to learn, master modern knowledge and apply it in practical situations. Knowledge and understanding subject area and understanding of professional activity. Ability to adapt and act in the new situations. Ability to make informed decisions; work in a team; skills interpersonal interaction. Ability to use information and communication Technologies Definiteness and perseverance in terms of tasks and responsibilities.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
	Outstanding performance without errors	5 (Excellent)	$170 \leq RD \leq 200$
	Above the average standard but with minor errors	4 (Good)	$140 \leq RD < 169$
	Fair but with significant shortcomings	3 (Satisfactory)	$120 \leq RD < 139$
	Fail – some more work required before the credit can be awarded	2 (Fail)	$0 \leq RD < 119$

9.2 Formative assessment

FA1	Peer assessment.
FA2	Teacher's instructions in the process of performing practical tasks
FA3	Testing
FA4	Interviews and oral comments of the teacher on his results
FA5	Research-based learning (RBL). Learning through research
FA6	Defense of presentations and essays
FA7	Independent performance of situational exercises by students in practical classes and their discussion.

FA8	Захист індивідуального дослідницького проєкту (виступ на конференції, конкурсі наукових робіт)
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9.3 Summative assessment

SA1	The average grade for current success in the discipline
SA2	Drawing up of complex written modular control
SA3	Defense of an individual research project (incentive activities, additional points)

Form of assessment:

7 semester		200 scores
SA1. The average grade for current success in the discipline		120
	Assessment of current student performance is carried out in the form of surveys, tests of written work and practical skills, testing in each practical lesson on a four-point scale and converted into points according to the scale of recalculation of traditional grades.	120
SA2. Drawing up of complex written modular control		80
	Testing by radiographs and other results of radiological examinations	20
	Testing of theoretical skills.	10
	Written answers to theoretical questions.	30
	Interpretation and written description of radiographs	20

Form of assessment (special cases):

7 semester		200 scores
SA1. The average grade for current success in the discipline		120
	Assessment of current student performance is carried out in the form of surveys, tests of written work and practical skills, testing in each practical lesson on a four-point scale and converted into points according to the scale of recalculation of traditional grades. In case of quarantine restrictions, practical classes are held remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet	120
SA2. Drawing up of complex written modular control		80
	Testing on radiographs and other results of radiological examinations are carried out remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	20
	Testing of theoretical skills. In case of quarantine restrictions, practical classes are conducted remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	10
	Written answers to theoretical questions. In case of quarantine restrictions, practical classes are conducted remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	30

	Interpretation and written description of radiographs are performed remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	20
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Checking test and written tasks

10. Learning resources

10.1 Material and technical support

MTS1	Graphic tools (drawings, sketches, diagrams, posters, etc.)
MTS2	Library funds
MTS3	Technical means (movies, sound and video recordings, etc.)
MTS4	Information and communication systems
MTS5	Projection equipment
MTS6	Base results of radiation survey (analog and electronic)
MTS7	Negatoscope
MTS8	Medical facilities / premises and equipment (MNO CLINICAL HOSPITAL № 4 OF SCC)

10.2 Information and methodical support

Essential Reading	
1	Kovalsky O. Radiology. Radiotherapy. Diagnostic Imaging [Текст] : textbook for students of higher med. education establishments of IVth accreditation level / O. Kovalsky, D. Mechev, V. Danylevych. — 2nd ed. — Vinnytsia: Nova Knyha, 2017. — 504 p.
2	Emergency Radiology of the Chest and Cardiovascular System [Электронный ресурс] / edited by Mariano Scaglione, Ulrich Linsenmaier, Gerd Schueller, Ferco Berger, Stefan Wirth. — 1st ed. 2017. — Cham : Springer International Publishing, 2017.
Supplemental Reading	
3	Pitfalls in Musculoskeletal Radiology [Электронный ресурс] / edited by Wilfred C. G. Peh. — 1st ed. 2017. — Cham : Springer International Publishing, 2017.
4	Chen M. Basic Radiology / Michael Y. M. Chen, Thomas L. Pope, David J. Ott. — 2nd ed. — McGraw Hill Professional, 2010. — 408 p.
5	Learning Radiology: Recognizing the Basics (With STUDENT CONSULT Online Access), 2e, by William Herring MD (Author), 2015.
Web-based and electronic resources	
6	AccessMedicine - http://accessmedicine.mhmedical.com 5. PubMed - https://www.ncbi.nlm.nih.gov/pmc