



FACULTY OF MEDICINE
STUDY PROGRAM 0912.1 MEDICINE
DEPARTMENT OF RADIOLOGY AND IMAGING

APPROVED

at the meeting of the Commission for Quality
Assurance and Evaluation of the Curriculum
Faculty Medicine II

Minutes No. 1 of 28.08.23

Chairman, PhD, Professor
Suman Serghei

APPROVED

at the Council meeting of the Faculty Medicine
II

Minutes No. 1 of 26.08.23

Dean of Faculty Medicine II,
MD, PhD, Associate Professor
Bețiu Mircea

APPROVED

at the meeting of the Chair of Radiology and Imaging
Minutes No. 20 of 27.06.2023

Head of Chair Ph.D., Associate Professor
Maliga Oxana

SILLABUS

DISCIPLINE RADIOLOGY AND RADIOPROTECTION

Integrated studies, cycle I

Type of course: **Compulsory discipline**

Curriculum developed by the team of authors:

Maliga Oxana, PhD of med., associate professor

Nepotu Marina., University assistant



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I. INTRODUCTION

- General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program.

The discipline "Radiology and radioprotection" is welcome for students of the Faculty of Medicine. It is at the same time a fundamental and a clinical discipline in the process of preparing the future specialist. The discipline material is based on students' knowledge obtained by studying physics, anatomy, physiology, and is closely related to the courses of morphopathology, pathophysiology, internal semiology and general surgery. The discipline presents aspects of the physical bases of radioimaging methods and radiological anatomy, followed by the study of the semiology and the main radiological syndromes in the respiratory, cardiovascular, digestive, osteo-articular, hepatobiliary, renal and nervous systems pathology. The main risks related to exposure to ionizing radiation and principles and protective measures are presented. Only a very good knowledge of the possibilities of radioimaging methods, indications, contraindications, radioimaging iconographic semiology enables the student to integrate in the preparation of the future physician.

- Mission of the curriculum (aim) in professional training:

Preparing students for theoretical plan and guiding the practical aspects of radiology, frequently encountered in the work of future physicians, including physical bases of radio-imaging methods, radiation protection principles and measures, normal and pathological radio-imaging anatomy for the diagnosis at the level of syndrome.

- Language (s) of the course: Romanian Russian, English, French;
- Beneficiaries: 3rd year students, Faculty of Medicine.

II. MANAGEMENT OF THE DISCIPLINE

Code of the discipline		S.05.O.045	
Name of the discipline		Radiology and radioprotection	
Person(s) in charge of the discipline		dr. în medicină, conf. univ. Oxana Maliga asist.univ. Marina Nepotu asist.univ. Ludmila Tertîșnîi	
Year	III	Semester	V
Total number of hours: including:			90
Curs	30	Practical work	15
Seminars	15	Self-training	30
Form of assessment	E	Number of credits	3



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III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study, the student will be able to:

- **at the level of knowledge and understanding:**
 - ✓ to know the notions of radiological physics,
 - ✓ to know the construction and working principle of the X-ray tube,
 - ✓ to understand the basic physical principles of imaging methods of investigation,
 - ✓ to know the properties of ionizing radiation, principles and measures of radioprotection,
 - ✓ to know the principles of forming of radiological image by methods using ionizing and non-ionizing radiation,
 - ✓ to know the radiological anatomy of the chest, lungs, heart, digestive system, osteo-articular apparatus, hepatobiliary, renal, nervous system,
 - ✓ to know the radiological semiology of the diseases commonly encountered in current medical practice.
- **at the application level:**
 - ✓ to appreciate the quality of the radiological image,
 - ✓ to be able to appreciate the examination method,
 - ✓ to recognize the anatomical features of the examined region,
 - ✓ to perform radiological diagnosis at pulmonary, cardio-vascular, digestive, hepatic-biliary system, osteo-articular system, nervous system pathology,
 - ✓ to be able to set up contra-indications for radioimaging investigations using ionizing radiation,
 - ✓ to be able to make recommendations on radiation protection measures for patients and healthcare professionals.
- **at the integration level:**
 - ✓ to appreciate the importance of Radiology and Radioprotection in the context of Medicine.
 - ✓ to approach creatively the diagnostic problems at the syndrome level.
 - ✓ to have skills to implement and integrate the accumulated knowledge into fundamental and clinical disciplines.

IV. PROVISIONAL TERMS AND CONDITIONS

- knowing the basics of medical physics,
- knowledge of human anatomy and physiology.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

Nr. d/o	THEME	Number of hours		
		Courses	Practical work	Self- training
1.	Evolution of radiodiagnostics. Notion of radiophysics.	2	2	2
2.	Radioprotection.	2	2	2
3.	Radiological methods of investigation.	2	2	2



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Nr. d/o	THEME	Number of hours		
		Courses	Practical work	Self- training
4.	Magnetic resonance imaging. Ultrasonography. Nuclear medicine.	2	2	2
5.	Radiological investigation of the respiratory system. Normal radiological anatomy of thorax.	2	2	2
6.	Radiological signs of pathology of respiratory system. Opacities.	2	2	2
7.	Radiological signs of pathology of respiratory system. Hyperlucency.	2	2	2
8.	Cardio-vascular imaging.	2	2	2
9.	Radiological signs of cardio-vascular pathology.	2	2	2
10.	Radiological investigation and normal radiological anatomy of digestive tube.	2	2	2
11.	Radiological signs of pathology of digestive tube.	2	2	2
12.	Radiological investigation of the liver, biliary system and pancreas.	2	2	2
13.	Radiological diagnosis in traumatic lesions of bones and joints.	2	2	2
14.	Imaging diagnosis of osteo-articular pathology of non-traumatic origin.	2	2	2
15.	Diagnostic imaging of the urinary system.	2	2	2
Total		30	30	30

VI. PRACTICAL SKILLS PURCHASED AT THE END OF THE COURSE

Mandatory essential practical skills are:

- Simple standard chest radiograph. Total/subtotal opacity.
- Simple standard chest radiograph. Limited opacity.
- Simple standard chest radiograph. Rounded opacity.
- Simple standard chest radiograph. Nodular opacity.
- Simple standard chest radiograph. Hyperlucency.
- Simple standard chest radiograph. Mitral configuration.
- Simple standard chest radiograph. Aortic configuration.
- Simple standard chest radiograph. Tricuspid configuration.
- Simple abdominal radiograph. Bowel occlusion.
- Simple abdominal radiograph. Pneumoperitoneum.
- Barium study of digestive tube. Imaging by plus filling.
- Barium study of digestive tube. Imaging by minus filling.
- Abdominal ultrasonography. Cholelithiasis.
- Bone radiograph. Fracture.
- Bone radiograph. Osteomyelitis.
- Bone radiograph. Bony tumor.
- Renal ultrasonography. Urolithiasis.
- Intravenous urography. Hydronephrosis /Congenital anomaly/ Urolithiasis.



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- Renal scintigraphy. Renogram.
- To recognize method of investigation, anatomical region, view and normal anatomical structures: standard radiograph, CT, tomosynthesis, MRI, ultrasonography, scintigraphy.

VII. REFERENCE OBJECTIVES AND CONTENTS UNITS

Objectives	Content units
Theme (Chapter) 1. Imaging methods of investigation. Radioprotection.	
<ul style="list-style-type: none">• to define radiology, medical imaging, radioscopy, radiography, dosimetry, radioprotection• to define radionuclide, the radiopharmaceutical preparation• to know the properties of X-rays, gamma rays, ultrasound• to know the laws of forming of radiographic imaging and quality criteria• to demonstrate the ability to properly assess the imaging investigation method• to correctly apply the specific terminology of different imaging investigations• to know and to be able to apply radiation protection measures• to integrate the gained knowledge in clinical disciplines	1. Medical imaging. Definition. Component parts of medical imaging.
	2. Radiology. Definition. The construction and working principle of the X-ray tube. Nature of Rontgen radiation. X-ray properties. Properties of radiographic image.
	3. Dosimetry. Units for ionizing radiation. International system of units. Absorbed dose. Biological dose.
	4. Radiological protection of the patient. Radiological protection of personnel involved with ionizing radiation.
	5. Fluoroscopy. Definition. Forming of radiographic image. Advantages and disadvantages of fluoroscopy.
	6. Radiography. Definition. Forming of radiographic image. Advantages and disadvantages of radiography.
	7. The laws of forming of radiographic image. Radiographic image quality criteria. Special radiological methods.
	8. Radiological contrast agents. Classification.
	9. Tomographic radiological methods: conventional tomography, tomosynthesis, computed tomography. Principles. Advantages, disadvantages, indications, contraindications.
	10. Magnetic resonance imaging. Physical basics. Advantages, disadvantages, indications, contraindications.
	11. The nature and properties of ultrasound. Methodology, ultrasonographic semiology. Advantages, disadvantages, indications, contraindications.
	12. Basics of nuclear physics. Radionuclide, the radiopharmaceutical preparation, requirements, ways of production. Radionuclide Investigations: methodology, modalities, interpretation of results. Advantages, disadvantages, indications, contraindications.
Theme (Chapter) 2. Radioimaging of the respiratory system.	
<ul style="list-style-type: none">• to know basic radiological methods used in the diagnosis of respiratory pathology• to know the radiological anatomy of the respiratory organs• to define the radiological pulmonary hilum, the pulmonary vascular pattern• to demonstrate the ability to recognize anatomical structures on a radiograph• to define pulmonary opacity and hyperlucency• to apply elements of intersyndromic radiological differential diagnostics• to integrate the gained knowledge in clinical disciplines	1. Standard chest radiography. The thoracic wall. The thoracic content. Projection of lung lobes. Pulmonary segments.
	2. Pulmonary vascular pattern. Definition. Characteristic of normal pulmonary vascular pattern. Modifications of pulmonary vascular pattern in pulmonary affections. Pulmonary hilum. Definition. Pathology of the pulmonary hilum and mediastinal lymph nodes.
	3. Using of conventional tomography for evaluation of the pathology of the respiratory apparatus. Indications. Computed tomography of the chest. Indications and contraindications.
	4. Pulmonary scintigraphy. Types. Indications and contraindications.
	5. Basic pathological radiological syndromes of respiratory apparatus. Pulmonary opacity. Definition. Classification. Radiological signs. Pathological syndromes that are radiographically manifested by opacity in the lung field.
	6. Pulmonary hyperlucency. Definition. Classification. Pathological syndromes that are radiographically manifested by pulmonary hyperlucency.
	7. Radiographic signs of troubles of bronchial permeability. Bronchial permeability disorders.



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Objectives	Content units
Theme (Chapter) 3. Radioimaging of the cardiovascular system.	
<ul style="list-style-type: none">•to know basic radiological methods used in the diagnosis of cardiovascular pathology•to know the radiological anatomy and normal values of the heart and great vessels•to know changes in the pulmonary vascular pattern in cardiovascular pathology•to demonstrate the ability to recognize anatomical structures on a radiograph•to apply elements of intersyndromic radiological differential diagnostics•to integrate the gained knowledge in clinical disciplines	1. Medical imaging methods used to explore the cardiovascular system (standard radiography, CT, MRI, echocardiography, radionuclide investigation). General notions.
	2. Radiological anatomy of the heart. Topometry. Radiological criteria for magnification in the dimensions of the heart and great vessels.
	3. Changes in pulmonary vascular pattern in cardiovascular pathology (hipovolemia, arterial hypervolemia, venous congestion, pulmonary arterial hypertension).
	4. Pathological heart configurations. Pathological processes, more commonly encountered, manifested by pathological configurations of the heart.
Theme (Chapter) 4. Radioimaging of the digestive tube.	
<ul style="list-style-type: none">•to know the basic radiological methods used in exploration of the digestive tube•to know the radiological anatomy of the digestive tract compartments•to demonstrate the ability to recognize anatomical structures on a radiograph•to know and be able to apply key moments of patient preparing for radiological digestive tract investigation•to apply elements of intersyndromic radiological differential diagnostics•to integrate the gained knowledge in clinical disciplines	1. Simple abdominal radiography. Indications.
	2. Radiological investigation of the digestive tract with the contrast substance. Patient preparation for radiological examination of the stomach and duodenum. Irrigoscopy and irrigography. Indications, patient preparation.
	3. Radiological anatomy of the esophagus, stomach, small intestine, colon.
	4. Tonus. Peristalsis. Notion. Functional samples. Indications.
	5. Images by plus filling: niche, diverticulum.
	6. Images by minus filling: gap, amputation, incision.
	7. Changes in the structure of digestive tract compartments: halo, stenosis, stiffness. Changes of relief.
	8. Functional changes in digestive tract organs: tonus and motility disorders, secretion disorders, evacuation disorders, transit changes.
	9. Changes in length, caliber, fixation and position: esophagus, stomach, duodenum, intestines.
Theme (Chapter) 5. Radioimaging of the osteo-articular apparatus.	
<ul style="list-style-type: none">•to know the basic radiological methods used in the diagnosis of the pathology of the osteo-articular apparatus•to know the radiological anatomy of bones and joints•to demonstrate the ability to recognize anatomical structures on a radiograph•to apply elements of intersyndromic radiological differential diagnostics•to integrate the gained knowledge in clinical disciplines	1. Imaging methods for osteo-articular system examination.
	2. Radiological semiology of fractures: fracture line, displacement of fragments. Types of fractures, evolution, complications.
	3. Particularities of fractures: in children, in elderly, skull fractures, vertebral column fractures.
	4. Imaging semiology of changes in bone shape and dimensions (bone atrophy, oedostosis, bone deformities, bone hypertrophy).
	5. Imaging semiology of bone structure changes (osteoporosis, osteosclerosis, osteodestruction, osteonecrosis, osteolysis).
	6. Changes in periosteum (periostosis, periostitis: linear, acciform, Codman's triangle).
	7. Changes of soft tissues (volume and structure).
	8. Imaging semiology of pathology of joints: luxations, subluxations, changes of inflammatory origin.



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Objectives	Content units
Theme (Chapter) 6. Radioimaging of the hepatobiliary and urinary system.	
<ul style="list-style-type: none">•to know the basic radiological methods used in the diagnosis of pathology of the hepatobiliary and urinary system•to know the radioimaging anatomy: liver, gallbladder, urinary system•to demonstrate the ability to recognize anatomical structures on a radiograph•to apply elements of intersyndromic radiological differential diagnostics•to integrate the gained knowledge in clinical disciplines	1. Methods of examination of liver, gallbladder and bile ducts (standard radiology, ultrasonography, scintigraphy). Radioimaging anatomy.
	2. Signs of imaging in the morphological and functional disorders of the gallbladder and bile ducts.
	3. Imaging signs in diffuse liver and focal liver diseases.
	4. Imaging diagnosis of pancreatic pathology.
	5. Imaging methods of investigation of the urinary system (simple abdominal radiograph, intravenous urography, ultrasonography, radionuclide investigations). Patient preparing, advantages, disadvantages, indications, contraindications. Radiological anatomy.
	6. Morphological changes of the kidneys (number, position, shape, contour, dimensions, structure).

VIII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

✓ Professional (specific) (SC) competences

- **PC1.** Responsible execution of professional tasks with the application of the values and norms of professional ethics, as well as the provisions of the legislation in force.
- **PC2.** Adequate knowledge of the sciences about the structure of the body, physiological functions and behavior of the human body in various physiological and pathological conditions, as well as the relationships between health, physical and social environment.
- **PC3.** Resolving clinical situations by developing a plan for diagnosis, treatment and rehabilitation in various pathological situations and selecting appropriate therapeutic procedures for them, including providing emergency medical care.
- **PC4.** Promoting a healthy lifestyle, applying prevention and self-care measures.
- **PC5.** Interdisciplinary integration of the doctor's activity in a team with efficient use of all resources.

✓ Transversal competences (TC)

- **TC1.** Autonomy and responsibility in the activity.

✓ Study outcomes

Upon completion of the study, the student will be able to:

- to know the working principle of the X-ray tube, the properties of ionizing radiation, principles and methods of radioprotection,
- to understand the basic physical principles of imaging methods of investigation,
- to know the radiological anatomy of the chest, lungs, heart, digestive system, osteo-articular apparatus, hepatobiliary, renal, nervous system,
- to recognize the anatomical features of the examined region,



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- to perform radiological diagnosis at syndrome level for the pathology of pulmonary, cardiovascular, digestive, hepato-biliary system, osteo-articular system, nervous system,
- to set contraindications to radioimaging examinations using ionizing radiation,
- to make recommendations on radiation protection measures for patients and healthcare professionals.

IX. STUDENT'S SELF-TRAINING

Nr.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Problem report	Oral communication, Power Point Presentation,	Knowing and mastering the theme, The completeness of the elucidation of the question raised for the referral, Ability to highlight the essence of the theme, The representativeness of the images used to illustrate the theme, Answer questions, Compliance with the prescribed regulation	For practical lesson
2.	Homework	Written work in the workbook depending on the question or problem formulated.	The correctness of solving the problem	To be ready for practical lesson
3.	Working with information sources	Read the lecture and the material in the manual to the theme carefully. To get acquainted with the list of additional information sources on the topic. Select the source of additional information for that theme. Wording of generalizations and conclusions related to the theme of the lesson.	The ability to extract the essential, Interpretative ability, The volume of work	During the semester

X. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- *Teaching and learning methods used:*
- Course
 - introductive
 - current
 - synthesis



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- theoretical and practical
- debates
- Practical lessons
 - synthesis
 - repetitive
 - debates
- Traditional methods
 - case study
 - role playing
 - interactive
 - tests
- *Applied teaching strategies / technologies (specific to the discipline)*

Analysis of normal and pathological radiographs, computed tomography, magnetic resonance tomography, ultrasound and nuclear medicine investigation results.

- *Methods of assessment (including the method of final mark calculation)*

Current: each student's knowledge will be evaluated at each practical lesson in one or several ways: oral, test, control work, image interpretation, clinical case resolution. 20% of the mark is assigned to the individual work of the student.

Final: semester V - exam. The students, who have the average annual mark under the grade "5" or have not recovered absences from practical lessons by the end of the semester, are not admitted to the exam. The exam consists of testing by the Test Editor in the specialized room for this type of evaluation. The final grade for the exam consists of 0.5 of the average annual score and 0.5 of the one obtained by the test.

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	2	F
3,01-4,99	4	FX
5,00	5	E
5,01-5,50	5,5	
5,51-6,0	6	
6,01-6,50	6,5	D
6,51-7,00	7	
7,01-7,50	7,5	C



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7,51-8,00	8	B
8,01-8,50	8,5	
8,51-8,00	9	
9,01-9,50	9,5	A
9,51-10,0	10	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

*Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero).
The student has the right to have two re-examinations.*

XI. RECOMMENDED LITERATURE:

A. Compulsory:

1. Materials of the Course of Radiology and Radioprotection, Department of Radiology and Medical Imaging.
2. Malîga O., Rotaru N., Obadă A. Medical imaging in tables and algorithms. Guidelines. Chisinau, 2015.
3. Holger Petterson. A Global Text Book of Radiology. Sweden, 2010.

B. Additional (available in electronic form at the chair):

1. David Sutton. Textbook of radiology and imaging, 7th edition.