

APPROVED BY

Director of Nuclear Science & Engineering School

 / Oleg Yu. Dolmatov

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**Course Name: Radiochemistry.
Clinical Application of Radioisotopic and Roentgen Diagnostics**

Field of study: Nuclear Science and Technology

Programme name: Nuclear Science and Technology

Specialization: Nuclear medicine

Level of Study: Master Degree Programme

Year of admission: 2020

Semester, year: semester 3, year 2

ECTS: 6

Total Hours: 216

Contact Hours: 64

- **Lectures:** 16
- **Labs:** 32
- **Practical experience:** 16

Assessment: Exam

Department: Nuclear Fuel Cycle

Director of Programme

 / Vera V. Verkhoturova

Instructor

 / Vera D. Zavadovskaya

Course Name:

Radiochemistry. Clinical application of radioisotopic and roentgen diagnostics

Course Overview

Course Objectives	<p>The aim of the training course is to teach students to master theoretical basics of modern imaging methods in radiology based on the knowledge of the possibilities of modern high-tech diagnostic radiology modalities, methodological approaches to the analysis of visual images in radiology, modern diagnostic algorithms for diseases of various organs and systems, skills to apply modern methods of research, evaluation and presentation of the results of work performed and abilities to determine patient's main pathological conditions, symptoms, disease syndromes, nosological forms, to assess morphological, physiological conditions and pathological processes in the human body to solve professional problems.</p>
Learning Outcomes	<p>Upon completion of the course, a graduate will obtain the knowledge of:</p> <ul style="list-style-type: none"> – physical principles of image acquisition with modern diagnostic modalities, – principle of operation of diagnostic equipment, – methodology for diagnostic radiological research, – radiological diagnostic research methodology, – indications for the use of modern radiological technologies for diseases in cardiology, oncology, the osteoarticular system, neurology, etc., – basic diagnostic radiological patterns in diseases of various organs and systems. <p>Upon completion of the course, a graduate will be able to:</p> <ul style="list-style-type: none"> – apply optimal diagnostic algorithms for an accurate diagnosis of diseases in cardiology, oncology, the osteoarticular system, neurology, etc., – perform diagnostic studies of various organs and systems using all modern radiological diagnostic modalities, – use knowledge of the main diagnostic radiological patterns in the diagnosis of diseases of various organs and systems, – apply basic methods of digital image processing of modern radiation diagnostic modalities for the implementation of the diagnostic process, – formulate and solve medical and engineering problems in the innovative direction in modern radiation diagnostics for solving scientific and industrial problems. <p>Upon completion of the course, a graduate will have experience in:</p> <ul style="list-style-type: none"> – application of methods of digital image processing of modern radiological diagnostic modalities for the implementation of the diagnostic process, - carrying out scientific research using modern high-tech radiation diagnostic equipment.
Course Outline	<p>The course consists of 8 sections which include:</p> <ul style="list-style-type: none"> – 8 lectures (16 class hours); – 8 practical experiences (16 class hours); – 7 laboratory works (32 class hours).
Prerequisites (if available)	<ol style="list-style-type: none"> 1. Anatomy and Physiology. Basics of Roentgenology 2. Fundamentals of Imaging in Medicine 3. Basics of Pathology and Oncology 4. Treatment Planning

Course Structure	<p>The course material is divided into 9 parts. Each part consists of lectures and practical experiences.</p> <p>Section 1. An introduction to the basics of radiological diagnosis. Conventional (routine) x-ray and tomographic diagnostics of diseases of the cardiovascular system.</p> <p><i>As a result of mastering the section, students will learn about:</i></p> <p><i>Radiation diagnostics of coronary heart disease. Radiation diagnostic algorithm of coronary heart disease, myocardial infarction. Angiographic diagnostics and endovascular treatment of coronary heart disease, acute myocardial infarction, and congenital heart defects. Angiographic symptoms of major cardiovascular diseases. Modern possibilities of x-ray surgical treatment of congenital heart defects.</i></p> <p><i>Indications for CT diagnostics of heart diseases. Indications and contraindications to CT coronary angiography. Preparation of the patient for CT-coronarography. CT picture of soft calcified and mixed plaques. Assessment of the degree of stenosis. CT diagnostics of atherosclerosis. Indications for MRI diagnostics of heart diseases. MRI diagnostics of ischemia/myocardial infarction. MRI diagnostics of myocarditis. MRI diagnosis of tumors of the heart. Complex radiation diagnosis of pulmonary embolism.</i></p> <p>Section 2. Private issues of nuclear medicine. Radionuclide diagnostics in cardiology.</p> <p><i>As a result of mastering the section, students will learn about:</i></p> <p><i>Radionuclide methods of research of the cardiovascular system. The role of radionuclide methods of research of the cardiovascular system in the diagnosis of coronary heart disease (CHD). Radionuclide equilibrium ventriculography. Perfusion scintigraphy of the myocardium, indications, method, RFPL. Myocardial scintigraphy with fatty acids to detect ischemia without stress tests. PET / CT and SPECT / CT are hybrid methods that increase the information content of each modality in the diagnosis of coronary heart disease.</i></p> <p>Section 3. Conventional (routine) x-ray and tomographic diagnostics of diseases of the respiratory system and mediastinum.</p> <p><i>As a result of mastering the section, students will learn about:</i></p> <p><i>Modern methods of radiation diagnosis of lung cancer and radiation algorithms aimed at its detection. CT-semiotics of central, peripheral and bronchiolo-alveolar lung cancer. CT in the staging and operability of lung cancer. Syndrome dissemination in radiology, the causes of the syndrome of dissemination. Algorithm for radiological examination of a patient with dissemination syndrome. Radiographic and CT-semiotics of the syndrome of dissemination. Differential diagnosis of the dissemination syndrome. Focal education of the lungs. Recommendations for monitoring foci in the lungs based on CT data. Perfusion and ventilation lung scintigraphy. Mediastinum in radiographic, CT and MRI images. Classification of diseases of the anterior, middle and posterior mediastinum. The rationale for the use of CT angiography for the visualization of mediastinal lymph nodes.</i></p> <p>Section 4. Conventional (routine) x-ray and tomographic diagnostics of diseases of the gastrointestinal tract and hepatoduodenal zone.</p> <p><i>As a result of mastering the section, students will learn about:</i></p> <p><i>The main syndromes of pathology of the gastrointestinal tract: local and diffuse narrowing, local and diffuse expansion, dislocation of the organ, ulcerative "niche" syndrome, filling defect, change in the relief of the mucosa. Acute diseases of the abdominal cavity and retroperitoneal space. Algorithm of</i></p>
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	<p>radiological examination in acute pathology of the abdominal cavity. Radiography, ultrasound, CT and MRI in the diagnosis of intestinal obstruction, perforation of the hollow organ and abdominal abscesses, cholecystitis, pancreatitis, cholelithiasis. Radiation diagnostics for mechanical jaundice". Retrograde pancreato-cholangiography, Mr-cholangio-pancreatography, CT in the diagnosis of mechanical jaundice. Diffuse and focal liver lesions. Radiation diagnostic algorithm for diffuse and focal liver lesions.</p> <p>Section 5. Modern radiation diagnostics of the urinary system and male and pelvic organs.</p> <p>As a result of mastering the section, students will learn about:</p> <p>Radiation diagnostic algorithm for diseases of the urinary system. The role of ultrasound, CT and MRI in the diagnosis of tumors of the urinary system. The role of MRI in the diagnosis of abnormalities of the urinary system. The role of dynamic nephroscintigraphy in assessing kidney function. Advantages of ultrasound and MRI compared to CT in assessing the state of the male and female pelvic organs. Radiation diagnostic algorithm for diseases of the prostate. BI-RADS system in the diagnosis of prostate cancer using multiparameter magnetic resonance imaging. Radiation diagnostic algorithm for malignant neoplastic diseases of the pelvic organs in women.</p> <p>Section 6. Neuroimaging. Tomographic methods (CT and MRI) in neuroimaging. Methods of nuclear medicine in neuroimaging.</p> <p>As a result of mastering the section, students will learn about:</p> <p>Comparative characteristics of CT and MRI in brain structure visualization. The concept of "mass effect". Neuroimaging in the diagnosis of brain blood flow disorders. Neuroimaging in traumatic brain injury. Diagnosis of brain tumors. The concept of open and closed hydrocephalus. The framework methodology of the study of cerebral perfusion. Structural and functional diagnostic methods in neuroimaging. Research of the spine, spinal canal, spinal cord.</p> <p>Section 7. Conventional (routine) x-ray tomographic diagnostics of diseases of the musculoskeletal system.</p> <p>As a result of mastering the section, students will learn about:</p> <p>Comparative capabilities of CT and MRI in visualization of calcified and ossified structures of the axial and peripheral skeleton. Possibilities of MRI and ultrasound in visualization of intra-articular structures. Visualization of bone marrow edema. Visualization of anatomical features of joints, including hyaline and fibrous-fibrous cartilage. Differential diagnostics of oncological and inflammatory diseases of the skeleton.</p> <p>Section 8. Particular issues of nuclear medicine. Radionuclide diagnostics in oncology. Modern radiation diagnostics in mammology.</p> <p>As a result of mastering the section, students will learn about:</p> <p>Diagnostic algorithms using the methods of radionuclide diagnostics for the exclusion/confirmation of metastatic bone lesions. PET / CT in the diagnosis and staging of malignant tumors. The technique of scintigraphic display of the "sentinel node" in cancer of the breast, melanoma, larynx, organs of small pelvis. Scintigraphy using tumorspecific RFP. Radiation diagnostic methods in mammology – x-ray mammography, ultrasound, magnetic resonance imaging. Radiation diagnostics of benign (cysts, lipomas, fibroadenomas) and malignant (cancer) breast formations. Breast cancer staging.</p>
Facilities and Equipment	Classroom for lectures and practical experiences: 634050, Tomsk, Lenina Ave., 2, building 10, room 125A.

Grading Policy	<p>In accordance with TPU assessment system we use:</p> <ul style="list-style-type: none"> – Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering the theoretical material and the results of practical activities (tests, tasks, problem solving). Max score for current assessment is 80 points. – Course final assessment (exam) is performed at the end of the semester. Max score for course final assessment is 20 points. <p>In the process of mastering the course “Radiochemistry. Clinical Application of Radioisotopic and Roentgen Diagnostics”, students perform 7 laboratory works, which are organized on the basis of the Department of Radiation Diagnostics and Radiation Therapy and the Department of X-ray Diagnostics, the Department of Tomographic Research Methods and the Laboratory of Radionuclide Research Methods of the Siberian State Medical University under the guidance of specialists. The purpose of the laboratory work is to master the skills of conducting diagnostic studies and the analysis of diagnostic information.</p> <p>The results of laboratory work are issued in the form of reports with answers to test questions, submitted in writing to the teacher for verification of the discipline. Laboratory reports are defended orally. Reports on laboratory works are executed in accordance with the TPU standard.</p> <p>The number of pages in the report (with the exception of the title page and list of references) should be at least 15 and not more than 30.</p> <p>The maximum score for successful laboratory work is 4 points, depending on the topic and the amount of work performed. The number of points a student receives for each laboratory work is determined according to the knowledge assessment system.</p> <p>To perform current assessment of the quality of theoretical and practical material mastering during a practical lesson, a survey is conducted. Questions on the topic of the practical lesson are given to students in advance to prepare for the lesson. The survey is carried out orally. The total number of points for the survey is 3 points.</p> <p>Testing is carried out at the end of each lesson to assess the quality of theoretical and practical material mastering on the topic of the lesson. The test includes from 12 to 15 questions with one correct answer. The maximum score for each test 3 points.</p> <p>Students are admitted to the exam, provided that he successfully completed all semester surveys, tests, defended all laboratory works. The examination is performed orally in the form of answering theoretical questions. The examination paper includes 2 questions. Each question is supported with illustrative material in analog or digital format. The instructor during the oral examination has the right to ask additional questions about the exam program. The answer to each question is rated at 10 points. The maximum number of points that a student can obtain for the exam is 20 points.</p>
Course Policy	<p>Class attendance will be taken into consideration when evaluating students' participation in the course. Students are expected to be actively engaged in class discussions on the assigned reading materials. All classes are obligatory to visit. Attendance is strictly controlled. All classes are obligatory to presence. Students are required to wear a lab coat and indoor shoes.</p>
Teaching Aids and Resources	<p>Compulsory reading:</p> <ol style="list-style-type: none"> 1. Radiation diagnostics: teaching aid for students of medical universities. Part 1: Methods of radiation diagnostics. Radiation anatomy of organs and

	<p>systems. The main pathological syndromes / editor V. D. Zavadovskaya. - Moscow: Vidar, 2009. - 374 p. – Текст : непосредственный.</p> <p>2. Ternovoy S. K. Radiology diagnosis and therapy. General radiology diagnostics: textbook: in 2 volumes. Vol. 1 / S. K. Ternovoy, V. E. Sinitsyn, A. I. Shekhter. - Moscow: GEOTAR-Media, 2014. - 232 p. - Текст : электронный // ЭБС "Консультант студента" : [сайт]. - URL : https://www.studentlibrary.ru/ru/book/ISBN9785970429891.html (дата обращения: 20.09.2020). - Режим доступа : по подписке.</p> <p>3. Atlas of human ray anatomy / V. I. Filimonov, V. V. Shilkin, A. A. Stepankov, O. Yu. Churakov. - Moscow: GEOTAR-Media, 2010. - 452 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970413616.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>4. Radiology diagnosis of heart and vascular diseases: national guide / chap. ed. volume L.S. Kokov, ed. series of S.K. Ternovoy. - Moscow: GEOTAR-Media, 2011. - 688 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970419878.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>5. Radiology diagnosis of diseases of bones and joints: national guide / chap. ed. volume A.K. Morozov. - Moscow: GEOTAR-Media, 2016. - 832 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970435595.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>6. Radiology diagnosis and therapy of diseases of the head and neck: national guide / chap. ed. volume T.N. Trofimova. - Moscow: GEOTAR-Media, 2013 . - 888 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970425695.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>Additional reading:</p> <p>1. Atlas of X-ray anatomy and styling : a guide for doctors / ed. M.V. Rostovtsev. - 2nd ed. - Moscow: GEOTAR-Media, 2017. - 320 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970443668.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>2. Radiology diagnosis of the chest organs: national guide / chap. ed. volume V. N. Troyan, A. I. Shekhter. - Moscow: GEOTAR-Media, 2014. - 584 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970428702.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>3. Radiology diagnosis and therapy in gastroenterology: national guide / chap. ed. volume G. G. Karmazanovsky. - Moscow: GEOTAR-Media, 2014. - 920 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970430538.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p>
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	<p>4. Radiology diagnosis and therapy in urology: national guide / chap. editors volume A. I. Gromov, V. M. Builov. - Moscow: GEOTAR-Media, 2011. - 544 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970420188.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>5. Radiology diagnosis and therapy in obstetrics and gynecology: national guide / chap. editors volume L. V. Adamyan, V. N. Demidova, A. I. Gus, I. S. Obelchaka. - Moscow: GEOTAR-Media, 2012. - 656 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970421178.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>6. Radiology diagnosis of liver diseases (MRI, CT, ultrasound, SPECT, and PET): manual / chap. editor volume G. E. Trufanov. - Moscow: GEOTAR-Media, 2008. - 264 p. - Текст: электронный // Консультант врача : электронная-медицинская библиотека. - URL: https://www.rosmedlib.ru/book/ISBN9785970407424.html (дата обращения: 20.09.2020). – Режим доступа: по подписке.</p> <p>7. Zavadovskaya, V. D. Fundamentals of radiation diagnosis of diseases of the musculoskeletal system: a textbook for students studying in the specialties "General Medicine", "Pediatrics", "Medical Biophysics", "Medical Cybernetics", "Dentistry" / V. D. Zavadovskaya. - Tomsk: Publishing House of the Siberian State Medical University, 2016. - 94 p — URL: http://irbis64.medlib.tomsk.ru/cgi-bin/irbis64r_14/cgiirbis_64.exe?Z21ID=&P21DBN=ELS&I21DBN=ELS&S21FMT=fullwebr&C21COM=S&2_S21P02=0&2_S21P03=I=&2_S21STR=-343668354 (дата обращения 20.09.2020). — Режим доступа: из корпоративной сети СибГМУ. — Текст: электронный.</p>
Instructor	<p>Zavadovskaya Vera D., Professor, Doctor of Medical Sciences, Head of the Department of Radiology and Radiotherapy, Siberian State Medical University, e-mail: wdzav@mail.ru, tel: +7-906-948-41-77</p>