NUCLEAR MEDICINE METHODS AND IMAGING TECHNIQUES IN BIOMEDICINE	
GENERAL INFORMATION	
Course teacher	Prof. Ivica Mihaljević, MD, PhD
Associates	Assoc. Prof. Mario Štefanić, Md, PhD Asst. Prof. Tomislav Kizivat, MD, PhD Ivana Marić, MD, PhD Vlado Wagenhofer, MD, PhD Dunja Mudri, MD
Study programme	University Graduate Study of Medical Laboratory Diagnostics
Course status	Elective
Year of study, semester	1st year, 2nd semester
ECTS credits	**5**
Form of teaching (number of classes)	Lectures: 35; seminars: 20; Clin. exercises: 15
Expected number of students attending the course	20
COURSE DESCRIPTION	
Course objectives	
To introduce students to selected methods of nuclear medicine, physical principles and types of ionising radiation found in nature and the way such radiation interacts with substance; to explain how charged particle accelerators and nuclear analytical methods can be used for characterisation of biological samples.	
Course entry requirements and competencies needed for the course	
Completed courses at the Undergraduate Study Programme of Medical Laboratory Diagnostics or equivalent bachelor's degree (baccalaureate)	
Learning outcomes at study programme level	
1.1, 1.2, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2	
Expected learning outcomes at course level	
After attending lectures, seminars, exercises, independent study and passing the exam, students will be able to: 1. critically evaluate principles of scintigraphic tests of functioning and diseases of specific organs and organ systems by means of a gamma camera, single-photon emission computed tomography (SPECT), positron emission tomography (PET) and PET/CT. 2. prepare radiopharmaceutical.s 3. determine the concentration of hormones, antibodies and tumour markers in serum by means of radioimmunoassays and other *in vitro* methods. 4. explain when it is suitable to use positron emission tomography. 5. explain potential application of immunoscintigraphic methods in modern diagnostics and treatment of oncological and non-oncological diseases.	
Course content	
Lectures: Radioactive markers in biology and medicine: relationship between morphology and function. Radiopharmaceuticals: production and preparations of radionuclides (radiopharmaceuticals). Mechanisms of biodistribution. Immunoanalysis in the determination of concentrations of thyroid hormones, antibodies and tumor markers. Diagnosis and treatment of thyroid diseases: measurement of radioiodine accumulation, scintigraphy, ultrasound, cytology and treatment with radioiodine. Measurement of radioiodine accumulation in the thyroid, thyroid scintigraphy, ultrasound, cytology and treatment of thyroid diseases with radioiodine. Nuclear medicine in cardiology and pulmonology: myocardial perfusion scintigraphy, radionuclide ventriculography and shunt detection. Perfusion and ventilation lung scintigraphy. Nuclear medicine in gastroenterology and hematology: scintigraphy of the esophagus, Meckel's	

diverticulum, liver, spleen, bile ducts, stomach and bleeding. Nuclear medicine diagnostics of infections. Nuclear medicine in neurology: brain scintigraphy, radionuclide cisternography, SPECT and PET/CT of the brain. Nuclear medicine in nephrology and urology. Radiation protection: basics of dosimetry, biological effects of ionizing radiation, effects of excessive radiation on the body and medical procedures in case of excessive radiation. Nuclear medicine in examination of the bone system and oncology: scintigraphy of bones and joints and bone marrow. Nuclear medicine diagnostics of inflammation and infection, scintigraphy with labeled antibodies. Comparison of nuclear medicine and other imaging methods (round table).

Exercises: Diagnostic devices for scintigraphy, gamma camera, SPECT and computer scintigram processing. Radiopharmaceuticals: production of radionuclides and preparations. RIA and nonRIA concentrations of thyroid hormones, antibodies and tumor markers. Measurement of radioiodine accumulation in the thyroid, thyroid scintigraphy, ultrasound, cytology and treatment of thyroid diseases with radioiodine. Myocardial perfusion scintigraphy, radionuclide ventriculography and shunt detection. Perfusion and ventilation lung scintigraphy. Scintigraphy of the liver, spleen, esophagus, gastrointestinal bleeding and Meckel's diverticulum. Brain scintigraphy, radionuclide cisternography, SPECT and PET/CT of the brain. Kidney scintigraphy, clearances, radionuclide cystography and testicular scintigraphy. Diagnostic and therapeutic procedures in case of excessive radiation. Scintigraphy of bones, joints and bone marrow. Scintigraphy of inflammation and infection, with labeled antibodies and receptor scintigraphy.

Forms of teaching

Lectures; seminars, clinical practicums, independent assignments.

Students' responsibilities

Attendance is obligatory throughout all course forms, and the student has to attend all the exams. Student absence of up to 30% is considered acceptable in each teaching form. Practical work and seminars that were not completed have to be taken in the form of colloquiums. The student has to attend all forms of exams required.

Monitoring students' work *(Connecting learning outcomes, teaching methods and evaluation)*

Teaching activity	ECTS	Learning outcome	Student activity	Evaluation methods	Grade points	
					Min.	Max.
Attending classes Lectures	1.5	1-5	Attendance,	Attendance records	5	10
Seminars			Seminar paper	Writing and presenting seminar paper	15	20
Practicums		2,3	Practical work	Submitted report	15	20
Final exam	3.5	1-5	Studying for final exam	Written exam	15	50
Total	**5**				**50**	**100**

Evaluation of written part of final exam

Percentage of correct answers (%)	Grade points
60.00-64.99	15
65.00-69.99	20
70.00-74.99	25
75.00-79.99	30
80.00-84.99	35
85.00-89.99	40
90.00-94.99	45
95.00-100	50

Formulating the final grade:
Grade points achieved in classes are combined with points achieved in the final exam. Grading in the ECTS system is absolute grading and represents one's final achievement. Grades are numerically expressed as follows: A – excellent (5): 80-100 grade points; B – very good (4): 70-79.99 grade points; C – good (3): 60-69.99 grade points; D – sufficient (2): 50-59.99 grade points

Assigned reading (available in the library and in other media)

Title	Number of copies in the library	Availability in other media
D.Dodig, Z. Kusić. Klinička nuklearna medicina, Medicinska naklada, Zagreb, 2012.	10	
Relevant scientific articles available free of charge online		On line

Further reading

Ell PJ, Gambhir SS, editors. Nuclear medicine in clinical diagnosis and treatment. 3rd ed. Edinburgh London New York Oxford Philadelphia San Francisco Sydney: Churchill Livingstone; 2004.

Quality assurance methods that ensure the acquisition of exit competencies

Anonymous, quantitative, standardised students' opinion survey on the course and teacher's work, carried out by the Quality Assurance Office of the Faculty of Medicine in Osijek.