University of Gdańsk

Subject card

Subject name and code	Radiobiology, Dosimetry, Radiological Protection, Patient Radiation Protection Course, PG_00205387						
Field of study	Medical Physics						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2028/2029		
Education level	Bachelor's studies		Subject group		Obligatory subject group in the field of study Subject group related to scientific research in the field of study		
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	3		Language of instruction		Polish		
Semester of study	5		ECTS credits		3.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Tomasz Bandurski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		0.0		30.0	90
Subject objectives	To master the radiobiological knowledge required to pass the patient radiation protection course and, after obtaining the professional bachelor's degree, to be authorized as a radiation protection inspector.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[FIZMEDL3_W08] Knows and understands to an advanced degree the mechanisms of general and systemic pathology, the pathogenesis of diseases and dysfunctions, the fundamentals of clinical examination, and the role of radiological and radioisotopic imaging in clinical diagnostics to the extent necessary for the independent resolution of complex professional tasks.	The student explains how ionizing radiation induces genetic changes, mutations, and chromosomal aberrations, and understands their significance in the pathogenesis of oncological diseases. The student describes the effects of irradiation on specific organs and systems, such as bone marrow, the gastrointestinal tract, the brain, or reproductive organs, leading to specific diseases, such as radiation-induced cataracts or infertility. The student points out and discusses the importance of radiological and radioisotope examinations (e.g., scintigraphy) as diagnostic tools for detecting and monitoring various diseases. The student recognises and characterises developmental defects in the fetus resulting from radiation exposure during pregnancy and can discuss the principles of radiation protection for pregnant women.	[SW4] test/exam - oral or written
	[FIZMEDL3_W07] Knows and understands at an advanced level the concepts of diagnostic and therapeutic methods and their quality control in medical applications.	The student discusses the principles and protocols of quality control for dosimetric and diagnostic equipment using ionizing radiation. The student explains how quality control impacts patient and staff safety, as well as the accuracy of diagnosis and the effectiveness of therapy. The student evaluates and compares various methods of radiation therapy in terms of their effectiveness and the risk of side effects. The student knows the control procedures used to ensure the proper functioning of dosimetric and radiological equipment.	[SW4] test/exam - oral or written
	[FIZMEDL3_W11] Knows at an advanced level the concepts of radiobiology, dosimetry, and radiological protection.	The student defines and characterises the physical phenomena underlying the interaction of ionizing radiation with matter, including the photoelectric effect, Compton scattering, and pair production. The student describes the mechanisms of direct and indirect radiation effects on cells and tissues, considering the role of free radicals. The student defines and explains physical quantities in radiobiology, such as Linear Energy Transfer (LET) and Relative Biological Effectiveness (RBE). The student identifies and describes the acute and late effects of whole-body irradiation, including hematopoietic, gastrointestinal, and neurovascular syndromes. The student explains the basic principles of radiation protection, including the ALARA (As Low As Reasonably Achievable) principle, and defines and applies the concepts of dose, dose equivalent, and radiation exposure. The student distinguishes and characterises different types of ionizing radiation and their sources, both natural and artificial.	[SW4] test/exam - oral or written

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_U03] He is able to select and apply appropriate medical equipment to perform selected diagnostic measurements or to carry out basic and specialised tests, and to prepare a report containing a description, analysis, error discussion, and conclusions regarding the results of the studies within the competence of a medical physicist.	The student can select and use appropriate dosimetric equipment (e.g., a dose rate meter, a personal dosimeter) depending on the type and energy of ionizing radiation to perform measurements in various environmental conditions. The student can perform basic dosimetric measurements, such as measuring ambient dose rate, personal dose, or determining the degree of radiation absorption by various shielding materials. The student can prepare a full report on laboratory exercises, which includes: a description of the methodology, analysis of the results, identification and discussion of measurement errors, and the formulation of substantive conclusions. The student can critically evaluate measurement results in terms of their compliance with applicable standards and dose limits for professionally exposed personnel and the general public.	[SU3] text preparation/written work
[FIZMEDL3_U06] Can present in an accessible way the latest achievements in the field of medical physics, the principles of operation of diagnostic and therapeutic equipment and the principles of radiation protection.	The student can interpret and present complex issues in radiobiology in an understandable way, such as the mechanisms of cell damage, chromosomal aberrations, and the effects of radiation on tissues. The student can explain the operating principles of basic medical equipment that uses ionizing radiation in an accessible manner, for example, X-ray machines, computed tomography scanners, or teleradiotherapy devices. The student can clearly and concisely describe and justify the basic principles of radiation protection, including dose minimisation, optimisation, and dose limits, for both staff and patients. The student can present the latest scientific findings in the field of radiobiology, dosimetry, and radiation protection, such as those related to new radiation detectors or radiotherapy methods.	[SU4] test/exam - oral or written

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_K01] He is ready for a critical evaluation of his own knowledge and the information he receives, and understands the need for further education and for improving professional and personal competencies.	The student demonstrates a critical attitude toward information sources on radiological hazards, distinguishing reliable data from common myths and misinformation. The student is ready to self-reflect on their own gaps in knowledge and skills in radiobiology, dosimetry, and radiation protection and to take action to address them. The student understands and accepts the need for continuous education due to the dynamic development of medical technologies and changing legal regulations in radiation protection. The student demonstrates an awareness of professional responsibility for their decisions and actions in the field of dosimetry and radiation protection, which motivates them to strive for the highest quality of services provided. The student is ready to actively participate in discussions on topics related to radiation protection, presenting their arguments in a well-founded manner and respecting the opinions of others.	[SK3] text preparation/written work
[FIZMEDL3_K02] He is ready to constantly update his knowledge in physics and medical physics to solve cognitive and practical problems independently and to use the opinions and assistance of experts.	The student demonstrates an open attitude toward the latest scientific findings in radiobiology and dosimetry, independently seeking and analysing publications on new mechanisms of radiation effects on the body. The student is ready to solve practical problems related to radiation protection, for example, in emergency situations, using their knowledge and skills to assess threats and take appropriate action. The student demonstrates a readiness to collaborate with other specialists (e.g., physicians, technologists, radiation protection inspectors) to solve complex clinical and practical problems, recognising the value of an interdisciplinary approach. The student is ready to accept and follow the recommendations of experts in the field of dosimetry and radiation protection to ensure the highest level of safety for patients and staff.	[SK3] text preparation/written work
[FIZMEDL3_W09] Knows at an advanced level the construction and operating principles of measurement instruments, electronic systems, and diagnostic and therapeutic equipment used in physics research and in medical diagnosis and therapy.	The student describes the construction and operating principles of personal dosimeters and dose rate meters used for monitoring staff exposure. The student knows the types of ionizing radiation detectors (e.g., ionization, scintillation, semiconductor) and explains their application in dosimetry and radiation protection. The student knows the operating principles of basic diagnostic equipment using ionizing radiation, including X-ray machines, computed tomography scanners, and gamma cameras. The student knows and understands the role and application of quality control for dosimetric and diagnostic equipment.	[SW4] test/exam - oral or written

<table>
<tr><td>Subject contents</td><td>Radiobiology: Radiation's effect on cells: Targets. Direct and indirect action/ Consequences of irradiation in tissues and organs. Organism's response to irradiation. Properties of electromagnetic radiation: Physical phenomena. Photoelectric effect. Compton scattering. Pair production phenomenon. Physical quantities: Linear Energy Transfer (LET). Relative Biological Effectiveness (RBE). Gene structure: Information coding. Mutations. Chromosomal aberrations. Consequences in tissues and organs: Consequences for the entire organism: hematopoietic syndrome, gastrointestinal syndrome, cerebrovascular syndrome, conditioning factors; life-span shortening, cancers. Radiation-induced cataracts. Infertility. Embryo radiosensitivity: Developmental defects.

Radiation Protection: Types of ionizing radiation. Sources of ionizing radiation. Phenomena of ionization and excitation. Biological effects of ionizing radiation. Differences in the biological effectiveness of various types of ionizing radiation. Radiation doses: Dose equivalent. Radiation exposure. Dosimetric instruments. Basic principles of radiation protection: for occupationally exposed personnel and patients.Preventive examinations and official certification regarding radiation damage.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>credit</td><td>51.0%</td><td>30.0%</td></tr>
<tr><td>exam</td><td>51.0%</td><td>70.0%</td></tr>
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</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>not applicable</td></tr>
<tr><td>Supplementary literature</td><td>not applicable</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>not applicable</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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