GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Radiation Protection Elements, PG_00068777		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group 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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Complex Systems Spectroscopy -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Brygida Mielewska	
	Teachers	dr Brygida Mielewska	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	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	30	3.0	17.0	50

Subject objectives	To familiarize students with the basics of radiological protection in diagnostics, therapy and nuclear energy (SMR, nuclear power plants), to provide knowledge about applicable national and European regulations and with the scope of functions of the Radiological Protection Inspector (IOR) in various types of units.

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<tr><td>Learning outcomes</td><td>

Course outcome	Subject outcome	Method of verification
[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	The student independently prepares an emergency procedure plan for selected radiation cases.	[SU1] Assessment of task fulfilment
[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	The student understands and is able to calculate the dose from a given type of source, shielding multiplicities, and action plans in the event of a radiological threat.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	The student knows and understands the causes of radiological hazards in the context of diagnostic, therapeutic and energy production devices.	[SW1] Assessment of factual knowledge
[K7_W54] knows and understands in-depth selected aspects of biomedical engineering, in particular chemistry, biochemistry, biomaterials and materials science, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences	The student knows the basic principles of radioprotection, the requirements for protection, the physical causes of radiation damage and methods of protection against it.	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge

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<tr><td>Subject contents</td><td>

Course content – lecture
Lectures (14h) 1. Fundamentals of the physics of ionizing radiation (2h) Types of radiation, natural and artificial sources Basic quantities and units of radiological protection (dose, activity, exposure) Interaction of radiation with matter (based on Grupena1) 2. Biological effects of ionizing radiation (1h) Cellular damage mechanisms Deterministic and stochastic effects ALARA and ALARP principles 3. Detection and measurement of radiation (1h) Radiation detectors (ionization chambers, Geiger counters, dosimeters) Principles of calibration and quality control 4. Fundamentals of radiological protection (2h) Principles of protection (justification, optimization, dose limitation) Shields, distance, exposure time Practical personal protective equipment 5. Radiological protection in diagnostics and therapy (3h) Principles of protection in radiology, nuclear medicine, Radiotherapy Planning and quality control of medical procedures Responsibilities of the Radiological Protection Inspector in medical units 6. Radiological protection in nuclear energy (2h) Protection principles in relation to research reactors, SMRs and nuclear power plants Environmental monitoring, radioactive waste management Risk analysis and emergency plans 7. Legislative requirements (3h) Atomic law, regulations of the Minister of Health, Minister of Climate and Environment EU directives (2013/59/EURATOM), IAEA standards, ICRP Role and responsibilities of the OR Inspector, source registers, documentation, training

Problems (14h)

1. Calculation of radiation doses and source activity Conversion of units, tasks with absorbed, equivalent and effective dose 2. Designing radiological shields Selection of materials, determination of shield thickness for different types of radiation Examples: X-ray room, accelerator bunker, SMR 3. Analysis of exposure cases and risk assessment Simulation of emergency situations, designation of controlled and supervised zones 4. Tasks related to environmental monitoring and waste Calculations related to the spread of radioactive contamination Examples from nuclear power plants and research reactors 5. Preparation of documentation and procedures in accordance with legal requirements

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<tr><td>Prerequisites and co-requisites</td><td>Basic physics course (electricity and magnetism, modern physics)</td></tr>
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<tr><td rowspan="3">Assessment methods and criteria</td><td>Subject passing criteria</td><td>Passing threshold</td><td>Percentage of the final grade</td></tr>
<tr><td>preparation of sample radiological protection documentation for a given case</td><td>50.0%</td><td>20.0%</td></tr>
<tr><td>final test with lectures and problems</td><td>50.0%</td><td>80.0%</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">• Claus Grupen, Introduction to Radiation Protection (2010)
• IAEA Safety Standards for protecting people and the environment General Safety Requirements Part 3 No. GSR Part 3 Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">University Physics ed. Openstax</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1. Discuss the basic principles of radiation protection (justification, optimization, dose limitation) and their practical application in diagnostic imaging laboratories and nuclear reactors.

2. Discuss the principles of selecting shielding materials for beta-emitters

3. A 120 keV X-ray tube is used in an X-ray laboratory. The maximum permissible dose behind the wall is 0.5 mSv/year. Knowing the radiation attenuation coefficient for lead at this energy ($\mu = 5.0\ cm^{1}$), calculate the minimum thickness of the lead shield that will provide the required level of protection if the dose on the source side is 1 mSv/week.working hours), compare it with the annual dose limit for employees according to applicable regulations.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="3">Not applicable</td></tr>
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