GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	High Energy Physics with Elements of Nuclear Energy, PG_00068090		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
Education level	first-cycle studies	Subject group	Optional 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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
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		

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	4.0	61.0	125

Subject objectives

To acquaint students with the properties and structure of matter at the subatomic level and with the methods of accelerating of high energy beams in electric and magnetic fields. Discussion of energy release processes in nuclear reactions, applications of these processes in power engineering, medicine and safety.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_K02] is ready to critically assess possessed knowledge and acknowledge the importance of knowledge in solving cognitive and practical problems	the student critically evaluates the knowledge he/she has acquired in the field of high energy use and discusses the challenges and obligations resulting from its use	[SK5] Assessment of ability to solve problems that arise in practice
[K6_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	The student is able to solve typical problems of nuclear physics	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	the student knows and understands issues related to the structure of the atomic nucleus, the generation and interaction of ionizing radiation with the medium	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Lecture 1. Atomic structure and description of particles 2. Properties and energetics of the atomic nucleus 3. Radioactivity and nuclear reactions 4. Types of radioactive decays 5. Transmutations 6. Generation and control of charged particle beams 7. Particle accelerators 7. Generation and applications of radioisotopes in medicine, science and industry 7. Interaction of radiation with matter 8. Radiation detectors 9. Nuclear energy Arithmetic exercises 1. Elements of relativistic mechanics and quantum mechanics (energy and momentum of particles, de Broglie waves, uncertainty principle, X-ray tube). 2. Interaction of radiation with matter (linear and mass coefficient, half-thickness, range of particles in a material, phenomena characteristic of gamma radiation - Compton's effect, photoelectric, pair formation). 3. Structure and properties of the atomic nucleus, binding energy per nucleon, energy of fusion or fission of nuclei. 4. Natural radioactivity (law of decay, activity, mean lifetime and half-life). 5. Nuclear reactions, conservation laws in reactions, cross section, reaction efficiency, activation of a sample in a neutron beam, fission of nuclei.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Mechanics, Electromagnetism, atomic physics</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>half-part exam theory and problems(2/2)</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>half-part exam theory and problems(1/2)</td><td>50.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>University Physics v. 3 Openstax</td></tr>
<tr><td>Supplementary literature</td><td>S. Tavernier, Experimental Techniques in Nuclear and Particle Physics, springer Open Access book (2010)</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Binding energy of the nucleus

2. Interaction of gamma radiation with matter

3. Cyclotron - contruction and principle of operation</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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