GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Theory and design of nuclear reactors, PG_00065882		
Field of study	Nuclear Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
Education level	second-cycle 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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Thermal Power Systems -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Dariusz Mikielewicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	15.0	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	10.0	30.0	100

Subject objectives

The aim of the subject is to familiarise the student with the elements of nuclear physics in application to nuclear reactors and use of these information in presentation of different concepts of nuclear reactors.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	Carries out calculations of selected elements of the nuclear reactor using advanced engineering tools	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_U03] identifies and formulates task specifications in the scope of energy processes and systems including non-standard problems and taking into consideration their non-technical aspects.	Recognises differences between different designs of nuclear reactors.	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information
[K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Nuclear Power Technologies, the physics of processes, structure, principle of operation, operation, safety aspects, fuels and materials for reactors, systems, machines and devices of a nuclear power plant	Knows the principles of operation of a nuclear power plant, methods of its power control and the threats resulting from the breakdown.	[SW1] Assessment of factual knowledge
[K7_U04] creatively designs or modifies, either entirely or at least in part, nulear power systems, considering both technical and non-technical aspects, estimating costs and utilizing design techniques appropriate for tasks within the scope of Nuclear Power Technologies	Knows how to determine the dimensions of the reactor core with a given power, knows how to analyse the ways of heat removal from the reactor.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	Course content – lecture 1. Introduction 2h - Conventional vs nuclear power plant - natural nuclear reactor in Oklo (Gabon) - first nuclear power plants 2. Fundamentals of nuclear power 4h - Principles of operation of reactors - Reactions of fission of nucleus - Neutrons and their role in reactor - Elements of reactor physics 3. Types of nuclear reactors 6h - Pressurised water reactors (PWR) - Boiling water reactors (BWR) - Heavy water reactors (CANDU) - Gas-cooled reactors - Fast Breeder reactors (FBR) - Discussion of technological differences and applications 4. Design of nuclear reactors 4h - Reactor core - Nuclear fuel - Control rods - Moderator - Biological shields 5. Control mechanisms and safety systems 4h - Systems of chain reaction control - Systems of emergency cooling

<table>
<tr><td></td><td>- Emergency safety systems

6. Termodynamics and heat transfer in reactors - 8h

- Heat transfer processes

- Cooling systems

- Turbines and generators

7. Perspective technologies 2h

- Reactors of IV generation

- Small modular reactors (SMR)

- HTGR reactors

- Nuclear fussion</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>tutorials</td><td>60.0%</td><td>20.0%</td></tr>
<tr><td>project</td><td>60.0%</td><td>30.0%</td></tr>
<tr><td>lecture</td><td>60.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
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<tr><td>Basic literature</td><td>1. Pawlik M., Strzelczyk F., Power plants, WNT 2023.

2. Kubowski J. Nuclear power plants WNT 2013

3. IAEA - Basic professional training course - nuclear physics and reactor theory

4. Lecture notes</td></tr>
<tr><td>Supplementary literature</td><td>Every textbook on nuclear power technologies</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></td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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