



## Subject card

Subject name and code	Selected problems of nuclear power engineering, PG_00057331						
Field of study	Power Engineering						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2024/2025		
Education level	second-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	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Electrical Power Engineering -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marcin Jaskólski					
	Teachers	dr inż. Tomasz Minkiewicz dr inż. Marcin Jaskólski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	15.0	45
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	45	8.0		22.0		75
Subject objectives	The purpose of the course is to provide basic knowledge of existing designs of nuclear systems, their safety and fundamentals of operation.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W02] has extended and deepened knowledge of physics, chemistry, thermodynamics, fluid mechanics, material science, necessary to understand and describe basic thermal and flow phenomena occurring in and around power equipment and systems, transmission networks and internal installations	They have extended and in-depth knowledge of the physics of reactors and thermal circuits used in nuclear units.			[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	[K7_W10] knows the basic installations of advanced energy systems, transmission networks and internal installations and their impact on the environment	They know the basic systems of nuclear reactors and their impact on the environment.			[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	[K7_U01] is able to acquire information from literature, databases and other sources, has the ability of self-education in order to improve his/her professional competence (also in English), is able to prepare a simple scientific paper and its summary in English, as well as an oral presentation	They can use sources in different languages to prepare a presentation on a given topic.			[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information		
[K7_U05] is able to integrate technical and economic analysis of the use of various energy technologies, including technologies using renewable energy sources and conventional and nuclear energy	They can make simple calculations of the profitability of a nuclear power plant.			[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment			

Subject contents	State of the art in nuclear power in the world. Generations of nuclear reactors. Classification of nuclear reactors. Classification of nuclear reactors. General characteristics of pressurised water reactor and auxiliary systems. Localisation of nuclear power plants. Nuclear fuel management. Fuel cycle. Management of nuclear waste. Operation of nuclear power plants. Radiation protection. Problems related to safety of nuclear power plants.		
Prerequisites and co-requisites	Courses: mathematics I, II, heat transfer, thermodynamics, fluid mechanics.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Presentation	60.0%	40.0%
	Test	60.0%	60.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. Kiełkiewicz M.: Jądrowe reaktory energetyczne, WNT, Warszawa 1978.</li> <li>2. Celiński Z., Strupczewski A.: Podstawy energetyki jądrowej, WNT, Warszawa 1984.</li> <li>3. Ackermann G. (red.): Eksploatacja elektrowni jądrowych, WNT, Warszawa 1987.</li> <li>4. Reński A.: Elektrownie jądrowe. Materiały szkoleniowe dla studiów podyplomowych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 1991.</li> <li>5. Kubowski J.: Nowoczesne elektrownie jądrowe, WNT, Warszawa 2010.</li> </ol>	
	Supplementary literature	<ol style="list-style-type: none"> <li>1. Jezierski G.: Energia jądrowa wczoraj i dzisiaj, WNT, Warszawa 2005.</li> <li>2. Cauci D. G. (Ed.): Handbook of Nuclear Engineering. Springer Science and Business Media LLC 2010.</li> <li>3. Jeleń K., Rau Z. (red.): Energetyka jądrowa w Polsce, Wyd. Wolters Kluwer Sp. z o.o., Warszawa 2012.</li> </ol>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> <li>1. Draw a basic diagram of the power plant with a pressurized water reactor. Sign devices in the system and their functions.</li> <li>2. Draw a basic scheme of the power plant with a boiling water reactor. Sign devices in the system and their functions.</li> <li>3. Draw and describe the design of the core of the pressurized water reactor and its individual elements.</li> <li>4. Present an exemplary scheme of the uranium fission reaction by thermal neutrons.</li> <li>5. What typical nuclear reactions occur in the reactor? Draw diagrams illustrating the initial, transitional and final phases.</li> <li>6. Explain the differences between the microscopic and the macroscopic cross-section.</li> <li>7. What is and in what range of neutron energy there is nuclear resonance (give approximate energy values from the logarithmic scale)?</li> <li>8. Write the dependence on the effective multiplication factor for the finite system (including the four-factor Fermi formula). Explain the symbols. Provide a criticality condition for the nuclear reactor.</li> <li>9. How is the power control of a nuclear unit with a pressurized water reactor realized?</li> <li>10. What is the influence of the number of moderator nuclei divided by the number of nuclei of fuel (<math>N_m / N_u</math>) on the criticality of a nuclear reactor?</li> <li>11. What effect does the degree of nuclear fuel enrichment have on the reactor's criticality?</li> <li>12. Present a schematic of the secondary circuit of a nuclear unit with a pressurized water reactor with inter-stage superheating and regeneration of the feed water. Draw the graph of the cycle on enthalpy-entropy.</li> <li>13. Compare on the diagram the basic temperature-entropy (without overheating and regeneration) secondary cycles of the nuclear unit with a pressurized water reactor for dry saturated steam and for superheated steam (referring to the fresh steam). Which of the circuits will be more efficient? What is the common limitation for both circuits?</li> <li>14. Provide a method for calculating annual costs at a nuclear power plant.</li> <li>15. Specify the method for calculating the unit energy cost.</li> <li>16. Present the scheme of a nuclear unit with a pressurized water reactor, adapted to transfer heat to the needs of the municipal heating system. Describe the modifications to be made in connection with the power plant overhead and their impact on energy effects.</li> <li>17. Present the scheme of a nuclear unit with a boiling water reactor, adapted to transfer heat to the needs of the municipal heating system. Describe the modifications to be made in connection with the power plant overhead and their impact on energy effects.</li> <li>18. Provide a method for calculating the unit cost of heat from a nuclear cogeneration plant.</li> <li>19. On what basis are the values calculated on the orderly diagram of heat demand in the heating system calculated?</li> <li>20. Provide a method for calculating the loss of power and electricity as a result of the adaptation of a nuclear power plant to cogeneration.</li> <li>21. What conditions should be provided for comparing the annual costs of a nuclear power plant adapted to cogeneration with a back-pressure coal-fired combined heat and power plant?</li> </ol>		
Work placement	Not applicable		