GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Selected problems of nuclear power engineering, PG_00057331		
Field of study	Power Engineering, Power Engineering, Power Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
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. Marcin Jaskólski dr inż. Tomasz Minkiewicz	

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_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.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[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.	[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
[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.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
[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.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation

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 auxialary 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
Test	60.0%	60.0%
Presentation	60.0%	40.0%

Recommended reading

Basic literature	1. Kiełkiewicz M.: Jądrowe reaktory energetyczne, WNT, Warszawa 1978. 2. Celiński Z., Strupczewski A.: Podstawy energetyki jądrowej, WNT, Warszawa 1984. 3. Ackermann G. (red.): Eksploatacja elektrowni jądrowych, WNT, Warszawa 1987. 4. Reński A.: Elektrownie jądrowe. Materiały szkoleniowe dla studiów podyplomowych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 1991. 5. Kubowski J.: Nowoczesne elektrownie jądrowe, WNT, Warszawa 2010.
Supplementary literature	1. Jezierski G.: Energia jądrowa wczoraj i dzisiaj, WNT, Warszawa 2005. 2. Cauci D. G. (Ed.): Handbook of Nuclear Engineering. Springer Science and Bussines Media LLC 2010. 3. Jeleń K., Rau Z. (red.): Energetyka jądrowa w Polsce, Wyd. Wolters Kluwer Sp. z o.o., Warszawa 2012.
eResources addresses	Adresy na platformie eNauczanie: WYBRANE ZAGADNIENIA ENERGETYKI JĄDROWEJ [2023/24] - Moodle ID: 21762 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=21762

Example issues/ example questions/ tasks being completed

1. Draw a basic diagram of the power plant with a pressurized water reactor. Sign devices in the system and their functions.2. Draw a basic scheme of the power plant with a boiling water reactor. Sign devices in the system and their functions.3. Draw and describe the design of the core of the pressurized water reactor and its individual elements.4. Present an exemplary scheme of the uranium fission reaction by thermal neutrons. 5. What typical nuclear reactions occur in the reactor? Draw diagrams illustrating the initial, transitional and final phases.6. Explain the differences between the microscopic and the macroscopic cross-section.7. What is and in what range of neutron energy there is nuclear resonance (give approximate energy values from the logarithmic scale)?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.9. How is the power control of a nuclear unit with a pressurized water reactor realized?10. What is the influence of the number of moderator nuclei divided by the number of nuclei of fuel (Nm / Nu) on the criticality of a nuclear reactor?11. What effect does the degree of nuclear fuel enrichment have on the reactor's criticality?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.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?14. Provide a method for calculating annual costs at a nuclear power plant.15. Specify the method for calculating the unit energy cost.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.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.18. Provide a method for calculating the unit cost of heat from a nuclear cogeneration plant.19. On what basis are the values calculated on the orderly diagram of heat demand in the heating system calculated?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.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?

Work placement	Not applicable