GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Selected problems of nuclear power engineering, PG_00064759		
Field of study	Power Engineering, Power Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	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	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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marcin Jaskólski	
	Teachers		

Lesson types

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 key issues of their operation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U14] integrates information obtained from literature and other properly selected sources, including those in a foreign language, creatively interpreting and critically evaluating them, and drawing conclusions	Correctly interprets information contained in national and international literature.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_K11] is aware of importance of professional acting, the need for critical verification of acquired knowledge and consulting experts opinion in case of facing difficulties with individual problem solving	Critically evaluates the source materials used in the presentation.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_W04] demonstrates knowledge encompassing selected issues in the field of advanced detailed knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Power Engineering	Creates a presentation on a selected topic in the field of nuclear energy.	[SW2] Assessment of knowledge contained in presentation

Subject contents

Course content – lecture

State of the art in nuclear power in the world. Generations of nuclear reactors. Classification of nuclear reactors. Classification of nuclear reactors. 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
Presentation	60.0%	40.0%
Test	60.0%	60.0%

Recommended reading

Basic literature	1. Celiński Z., Strupczewski A.: Podstawy energetyki jądrowej, WNT, Warszawa 1984. 2. Ackermann G. (red.): Eksploatacja elektrowni jądrowych, WNT, Warszawa 1987. 3. Reński A.: Elektrownie jądrowe. Materiały szkoleniowe dla studiów podyplomowych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 1991. 4. Kubowski J.: Nowoczesne elektrownie jądrowe, WNT, Warszawa 2010. 5. Zieliński A. (red): Elektrownie jądrowe w nowoczesnej gospodarce, Wydawnictwo PWN, Warszawa 2024. 6. Cauci D. G. (Ed.): Handbook of Nuclear Engineering. Springer Science and Bussines Media LLC 2010. 7. Lamarsh J.R., Baratta A.J: Introduction to Nuclear Engineering, Prentice Hall, New Jersey 2001
Supplementary literature	1. Jezierski G.: Energia jądrowa wczoraj i dzisiaj, WNT, Warszawa 2005. 2. Jeleń K., Rau Z. (red.): Energetyka jądrowa w Polsce, Wyd. Wolters Kluwer Sp. z o.o., Warszawa 2012. 3. NTERNATIONAL ATOMIC ENERGY AGENCY, Small Modular Reactors: Advances in SMR Developments 2024, Non-serial Publications , IAEA, Vienna (2024), https://doi.org/10.61092/iaea.3o4h-svum
eResources addresses	

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?

Practical activites within the subject	Not applicable