GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Nuclear Power, PG_00037319		
Field of study	Technical Physics		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2023/2024
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	4	Language of instruction	Polish
Semester of study	7	ECTS credits	1.0
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. Tomasz Minkiewicz	
	Teachers	dr inż. Tomasz Minkiewicz	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

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	15	2.0	8.0	25

Subject objectives

Deepening knowledge on selected issues in nuclear energy.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U01	Can independently acquire knowledge from various sources and effectively as well as independently acquire the knowledge in the field of nuclear energy.	[SU3] Assessment of ability to use knowledge gained from the subject
K6_W01	Understands the civilization importance of nuclear energy.	[SW1] Assessment of factual knowledge
K6_W02	Possesses ordered knowledge of basic, physical and operational problems related to the functioning of nuclear power plants.	[SW1] Assessment of factual knowledge

Subject contents	The lecture: 1. Elements of nuclear processes in atomic energy reactors: atomic and nuclear structure, atomic and mass number, isotopes, nuclear forces, radioactive decay, cross section of nuclear reactions, reactions induced by neutrons, fission of heavy nuclei, fissionable materials, prompt and delayed neutrons, moderation of neutrons, neutron diffusion (4 hrs.) 2. Elements of reactor physics: chain reaction, mean lifetime of a generation of neutrons, distribution of neutron flux in a reactor, multiplication factor and its characteristics, critical mass, reactor reactivity (2 hrs.). 3. Reactor kinetics: kinetics equation without delayed neutrons, influence of delayed neutrons on reactor kinetics, a surge of reactor reactivity, critical and supercritical state induced by prompt neutrons, reactivity vs. power change, temperature influence on reactor reactivity (3 hrs.). 4. Reactor poisoning: xenon poisoning, loss in reactivity due to xenon poisoning, xenon oscillations, samarium poisoning, loss in reactivity due samarium poisoning, reactivity in steady- and transient states (2 hrs.). 5. Reactor reactivity (power) control: control by rods, control by boric acid, usage of burning-off poisons (1 hour). 6. Generations basic types of nuclear reactors: BWR reactor, power plant with a BWR reactor, PWR reactor, power plant with a PWR reactor, RBMK reactor, heavy-water reactors, fast-breeder reactors, gas- and high-temperature reactors (3 hrs.). 7. Heat-, transfer and flow in nuclear reactors: heat sources, spatial distribution of heat sources, sources of residual heat, heat conduction within a reactor, heat conduction in a fuel element, heat conduction through a fuel element can, heat transmission within a working reactor, heat transfer to water flowing in forced convection conditions, heat transfer during bubble boiling, heat transfer to a two-phase mixture in forced convection conditions, departure from nucleate boiling, the heat- and flow-processes after the nuclear reactor primary coolant system line break (4 hrs.). 8. Reactor fuel cycle: cycle diagram, fissionable materials, fabrication of pure uranium components, uranium isotopic enrichment, nuclear fuel fabrication of fuel assemblies, fuel burnup and reactor in-core fuel management, fuel isotopic composition, used fuel management, used fuel processing, radioactive waste classification and treatment, fuel cycle economy (4 hrs.). 9. Nuclear power plant operation: nuclear power plant start-up, reactor control during normal operation, scheduled and emergency shutdown of a reactor, changes in fuel during reactor operation, operations on nuclear fuel, processes in reactor primary coolant system, sources of radiation at a nuclear power plant, threats to the personnel during power plant operation, threats to the power plant neighboring area (4 hrs.). 10. Chosen aspects of nuclear power plant safety: possible failures at a nuclear power plant with a PWR reactor, the corium and its influence on the surrounding, in-depth protection, threat of terrorist attack, nuclear power plant safety requirements, International Nuclear Events Scale, review of nuclear power plant accidents (3 hrs.).
Prerequisites and co-requisites	1. Basic knowledge of quantum mechanics. 2. Basic knowledge of chemistry. 3. Knowledge of a university course in physics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Colloquium	60.0%	100.0%

Recommended reading

Basic literature	1. J. Massalski ,,Fizyka dla inżynierów cz. 2 fizyka współczesna", Wydawnictwa Naukowo -Techniczne, Warszawa 2005. 2. V. Acosta, C.L. Cowan, B.J. Graham ,,Podstawy fizyki współczesnej"", PWN Warszawa 1987. 3. H.A. Enge, M.R. Wehr, J.A. Richards ,,Wstęp do fizyki atomowej, PWN, Warszawa 1983. 4. G. Jezierski, ,,Energia jądrowa wczoraj i dziś, Wydawnictwa Naukowo - Techniczne, Warszawa 2005. 5. E. Boeker, R. van Grondelle ,,Fizyka środowiska, Wydawnictwo Naukowe PWN, Warszawa 2002. 6. Z. Celiński, A. Strupczewski Podstawy energetyki jądrowej, Wydawnictwa Naukowo - Techniczne, Warszawa 1984. 7. J. Kubowski Elektrownie jądrowe, Wydawnictwo WNT Warszawa 2013
Supplementary literature	1.Publications of the International Atomic Energy Agency
eResources addresses	Adresy na platformie eNauczanie: Energetyka jądrowa [2023/24] - Moodle ID: 33181 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33181

Example issues/ example questions/ tasks being completed	1. The fission of the U235 nucleus. 2. Nuclear reactor time constant. 3. The PWR reactor.
Work placement	Not applicable