



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 2025		Academic year of realisation of subject		2024/2025		
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 Lecture is given in Polish		
Semester of study	1		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Zakład Systemów i Urządzeń Energetyki Ciepłej -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Dariusz Mikielewicz				
	Teachers		prof. dr hab. inż. Dariusz Mikielewicz				
Lesson types and methods of instruction	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, nuclear 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

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

	<ul style="list-style-type: none">- Emergency safety systems <p>6. Thermodynamics and heat transfer in reactors - 8h</p> <ul style="list-style-type: none">- Heat transfer processes- Cooling systems- Turbines and generators <p>7. Perspective technologies 2h</p> <ul style="list-style-type: none">- Reactors of IV generation- Small modular reactors (SMR)- HTGR reactors- Nuclear fusion		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tutorials	60.0%	20.0%
	project	60.0%	30.0%
	lecture	60.0%	50.0%
Recommended reading	Basic literature	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	
	Supplementary literature	Every textbook on nuclear power technologies	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		

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