GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Construction and design of water turbines, wind turbines and pumps, PG_00055906		
Field of study	Power Engineering, Power Engineering, Power Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2024/2025
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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	9.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Paweł Dymarski	
	Teachers		

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	60.0	30.0	0.0	15.0	0.0	105
	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	105	9.0	111.0	225

Subject objectives	The aim of the course is to become acquainted with the methods of designing water and wind turbines and to become familiar with the types of pumps and their characteristics. The student will gain knowledge about the types of water and wind turbines (onshore and offshore) and the principles of their operation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W10] knows the basic installations in the field of renewable energy sources and their impact on the environment	The student knows the basic renewable energy installations and their impact on the environment. Knows the basic principles/methods of minimizing (negative) impact on the environment.	[SW1] Assessment of factual knowledge
[K6_W09] knows the dangers of electrical devices and the principles of protection against them, has basic knowledge of heat exchangers, has basic knowledge of power equipment such as pumps, compressors, turbines, combustion engines, boilers, pipelines and their accessories and methods of their selection depending on the needs	The student has basic knowledge of energy devices such as pumps, turbines and their accessories, as well as methods of their selection depending on needs.	[SW1] Assessment of factual knowledge
[K6_U11] Can design and properly dimension basic foundations in hydrotechnical construction facilities; can evaluate and list the loads acting on constructions, knows the codes of modern geotechnical investigations and technologies, knows the principles of foundations and safe design of foundations of typical buildings	The student is able to dimension the working and structural elements of water and wind turbines, is able to determine the loads acting on the supporting structure and foundations, knows the frequency ranges (excitations), is able to determine the natural frequencies of the working elements (e.g. blades) and the structure. Is able to approximately determine the type/size of the supporting structure/foundation, knowing the parameters of the soil.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

1. Wind power plants
1.1 Types of wind farms
1.2 Large horizontal axis wind farms
1.3 Wind turbine aerodynamics
- forces on the aerodynamic profile
- determining the flow of the turbine blade.
- model of an ideal wind turbine (principle of conservation of momentum for 1D flow)
1.4 Determination of forces on turbine blades (Blade Element Method)
1.5 Turbine blade dynamics
1.6 Wind models
1.7 Supporting structures for wind turbines
- Supporting structures placed
- Floating wind turbines
1.8 Basics of analysis of the dynamics of supporting structures
- determining the mass matrix, stiffness matrix and damping matrix
- determination of natural frequencies
- simple models of structure-substrate interaction
1.9 Wind farms. Interaction of turbines
1.10 Impact of wind farms on the environment

2. Hydroelectric power plants
2.1 Classification of hydropower plants
2.2 Types of turbines and control systems
2.3 Impact of hydroelectric power plants (depending on type) on the environment
2.4 Types of control systems (circuits) and their protection
2.5 Examples of control systems used depending on the types of turbines and water conditions

3. Pumps
3.1 Types of Pumps
3.2 Pump characteristics
3.3 Basic principles of pump selection
3.4 Pump application examples

Prerequisites and co-requisites

1. Basic knowledge of fluid mechanics:
- flow continuity equation,
- principle of conservation of momentum,
- Bernoulli equation,
- basics of hydro/aerodynamic profile theory,

2. Basic knowledge of structural statics (strength of materials)
- cross-section characteristics,
- bending beam,
- stiffness, stiffness matrix,

3. Basic knowledge of structure dynamics
- mathematical model: "mass on a spring with a damping element"

4. Knowledge of the basics of vector and matrix calculus

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture	60.0%	40.0%
	Exercises	60.0%	30.0%
	Project	70.0%	30.0%
Recommended reading	Basic literature	Dawid Taler, Kazimierz Rup: Podstawy obliczeń turbin wiatrowych i wodnych. Wydawnictwo Naukowe PWN 2021 Geraldo Magela Pereira: Design of Hydroelectric Power Plants Step by Step. T&F 2022 Martin O. L. Hansen: Aerodynamics of Wind Turbines. 2008	
	Supplementary literature	Joao Cruz, Mairead Atcheson: Floating Offshore Wind Energy. Springer 2016 Madjid Karimirad: Offshore Energy Structures For Wind Power, Wave Energy and Hybrid Marine Platforms. Springer 2014	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		