GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Hydro and wind energy , PG_00055938		
Field of study	Power Engineering, Power Engineering, Power Engineering		
Date of commencement of studies	October 2021	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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Maszyn Przepływowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marzena Banaszek	
	Teachers	dr inż. Marzena Banaszek dr hab. inż. Marian Piwowarski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	45.0	15.0	15.0	0.0	0.0	75

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	75	6.0	69.0	150

Subject objectives

The aim of the course is to familiarize students with the technological and economic aspects of the use of water and wind energy, the principles of operation of water and wind turbines and their applications in various working conditions.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 knows the hazards from electrical devices and the principles of protection against them, has a basic knowledge of heat exchangers, has a basic knowledge of power devices such as pumps, compressors, turbines, internal combustion engines, boilers, pipelines and their accessories and methods of their selection depending on the needs.	[SW1] Assessment of factual knowledge
[K6_W10] knows the basic installations in the field of renewable energy sources and their impact on the environment	The student knows the basic installations in the field of renewable energy sources and their impact on the environment.	[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 knows the standards and is able to dimension the basic structural elements in hydrotechnical construction facilities; is able to assess and make a list of loads acting on buildings; knows standards in the field of modern ground research and geotechnical technologies; can define the principles of foundation and safe foundation of typical buildings.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	**HYDROPOWER IN POLAND AND WORLDWIDE:** current status and development prospects, water resources in Poland and their use, hydropower potential, impact of hydropower on the environment **HYDROPOWER RESOURCES ASSESSMENT AND CHARACTERIZATION:** hydrological characteristics of the river, hydrograph, flow-duration curve, hydropower resources assessment and characterization, measurements and observations of water status and flow **HYDRAULIC STRUCTURES:** dams, weirs and spillways, reservoirs, energy dissipating structures, sediment traps, gates and walves, open channel, penstock, tailrace, fish passage **HYDROPOWER PLANTS:** site configurations, energy properties, method of hydropower plant operation during the day, head increasing methods, installed capacity, Radunia River cascade, Wierzyca River cascade **HYDRAULIC TURBINES THEORETICAL BASIS**: principle of operation, operating parameters, specific speed, Euler's equation **CONVENTIONAL HYDRAULIC TURBINES:** classification and selection criteria, action turbines: Pelton, Turgo, Banki-Michelle; reaction turbines: Kaplan, Francis, Deriaz **NON-CONVENTIONAL HYDRAULIC TURBINES:** gravitational turbines: Archimedes screw, Vortex turbine, hydrostatic turbines, hydrokinetic turbines (headless) **WIND POWER IN POLAND AND WORLDWIDE:** current state and forecasts of wind energy development, economic aspects of wind energy use, advantages and disadvantages of wind energy **TYPES OF WINDS AND THEIR STRUCTURE:** wind generation mechanism, wind characteristics, measurement of wind direction and speed **WIND PARAMETERS:** wind speed profile, wind variability, wind power **PRINCIPLES OF WIND ENERGY PROCESSING:** Betz theory, power factor c_p, wind turbine efficiency curve **THE HISTORY OF WIND POWER DEVELOPMENT** **HAWT TYPE WIND TURBINES:** propeller, diffuser, multi-blade, multi-rotor, with counter-rotating rotors turbines, turbines using the Magnus effect, Archimedes effect **VAWT TYPE WIND TURBINES:** Savonius, Darrieus turbines **SMALL WIND TURBINES:** design, application, technical and economic aspects **THE FUTURE OF WIND ENERGY:** wind microturbines, ecological buildings, innovations in wind energy **CONTROL AND REGULATION OF WIND POWER PLANTS**: the purpose of controlling and regulating, methods of controlling and power regulation **SELECTED OPERATIONAL PROBLEMS OF WIND PLANTS:** causes and effects of wind power plants damages; the impact of air pollution, atmospheric factors, biological life, fires on the operation of wind power plants; diagnostics of wind turbines damages **TUTORIALS:** Calculations related to the design and operation of modern wind and hydraulic turbines. **LABORATORIES:** Methods of measuring and determining the discharge in open channels using floats, measuring weirs, current meter. Determination of characteristics of Francis turbine, Kaplan turbine, Pelton turbine. Drag crisis for flow over a sphere, Pressure distribution around a circular cyllinder, Measurement of aerodynamic forces acting on an airfoil.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
LABORATORIES: lab reports	50.0%	30.0%
ĆWICZENIA: written tests	50.0%	30.0%
LECTURE: written exam	50.0%	40.0%

Recommended reading

Basic literature

1. Hoffman M.: Małe elektrownie wodne poradnik, Nabba Sp. z.o.o. Warszawa 1991
2. Jackowski K.: Elektrownie wodne turbozespoły i wyposażenie, WNT Warszawa 1971
3. Krzyżanowski W.: Turbiny wodne. Konstrukcja i zasady regulacji, WNT Warszawa 1971
4. Łaski A.: Elektrownie wodne rozwiązania i dobór parametrów, WNT Warszawa 1977
5. Boczar T.: Wykorzystanie energii wiatru, Wydawnictwo PAK, Warszawa 2010
6. Flaga A.: Inżynieria wiatrowa. Podstawy i zastosowania, Wydawnictwo Arkady 2008
7. Jagodziński W.: Silniki wiatrowe, PWT Warszawa 1959
8. Renewable Power Generation Costs in 2017, IRENA www.irena.org
9. Polityka energetyczna Polski do roku 2040. Projekt. Ministerstwo Energii Warszawa 2019

	Supplementary literature	1. Michałowski S., Plutecki J.: Energetyka Wodna, WNT Warszawa 1975 2. Hau E.: Wind turbines, Springer 2006 3. Lewandowski W.: Proekologiczne odnawialne źródła energii, WNT Warszawa 2012 4. Lubośny Z.: Farmy wiatrowe w systemie elektroenergetycznym, WNT Warszawa 2009 5. Marecki J.: Podstawy przemian energetycznych, WNT Warszawa 2008 6. Maroński R.: Siłownie wiatrowe, Oficyna Wydawnicza Politechniki Warszawskiej Warszawa 2016 7. GLOBAL WIND REPORT 8. Przyszłość morskiej energetyki wiatrowej w Polsce. Raport PSEW. Maj 2019
	eResources addresses	Adresy na platformie eNauczanie: Energetyka wodna i wiatrowa, W/C/L, E, sem.6. letni 23/24 (PG_00055938) - Moodle ID: 37737 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37737
Example issues/ example questions/ tasks being completed	1. Environmental, climate and social issues and impact on hydropower development 2. Hydrograph, water level discharge rating curve, flow duration curve as a method of assessing river water resources for hydropower purposes 3. Selected hydraulic structures for use in small hydropower 4. Classification of hydro power plants and their advantages 5. Components of hydropower plant and their functions 6. Classification of hydraulic turbines, discussion of the selected construction of a hydraulic turbine 7. Operating parameters and performance characteristics of hydraulic turbine 8. Euler's equation 9. Advantages and disadvantages of wind power development 10. Wind characteristics 11. Betz's law 12. Classification of wind turbines, discussion of the selected construction of a hydraulic turbine 13. Construction of a wind turbine with a horizontal axis of rotation 14. Home wind turbines, selected constructions 15. Wind turbine power curve, wind power plant regulation methods	
Work placement	Not applicable	

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