GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Principles of Renewable Energy Systems , PG_00066970		
Field of study	Principles of Renewable Energy Systems		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	English
Semester of study	2	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Fluid-Flow Machinery -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marzena Banaszek	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	35.0	0.0	40.0	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	9.0	66.0	150

Subject objectives

The aim of the course is to familiarize students with the technological and economic aspects of using energy from renewable sources, such as solar, wind, hydro, geothermal, and biomass-derived energy. The basics of thermodynamic energy conversion processes in systems with renewable sources are presented, as well as the limitations resulting from the nature of these sources. Currently used and prospective systems for energy conversion using renewable energy sources are discussed.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] knows and understands theories related to wind energy generation and can explain the operating principles of wind turbines and the process of converting wind energy into electricity	The student knows and understands the basics of thermodynamic energy conversion processes in systems with renewable sources, as well as the limitations resulting from the nature of these sources.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
[K7_U02] is capable of creating and analyzing digital models of renewable energy systems, including wind power systems, and utilizes digital tools for project analysis, evaluation, supervision, and optimization	The student is able to use IT tools to solve energy-related problems, can utilize simulation tools and specialized software, and verify the results obtained.	[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu [SU4] Ocena umiejętności korzystania z metod i narzędzi
[K7_W05] understands the principles of sustainable development and safety in the context of energy systems, including the role of electrification, and can assess the environmental impact of renewable energy systems, particularly wind power installations	The student understands the issues related to the reliability of energy equipment operation and is aware of the risks associated with the environmental impacts of the energy technologies used.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
[K7_K04] understands the principles of sustainable development and can apply them to energy projects, taking into account environmental, economic, and social considerations	The student understands the principles of sustainable development and is able to apply them in energy projects.	[SK5] Ocena umiejętności rozwiązywania problemów występujących w praktyce

Subject contents	Course content – lecture **HYDROPOWER:** hydropower assessment of river resources, water structures, hydroelectric power plants, conventional and unconventional water turbines. Energy from seas and oceans, hydroelectric power plants (wave, tidal, and marine current power plants). **WIND ENERGY:** types of winds and their structure, wind parameters, principles of wind energy conversion, selected designs of HAWT and VAWT wind turbines. Offshore wind farms. **SOLAR ENERGY:** solar radiation energy and ways of converting it, liquid and air collectors, and heating systems with solar collectors, photovoltaic installations, their types and equipment. **GEOENERGY:** characteristics of geoenergy, shallow geothermal energy and its use in heating, energy systems supported by geothermal energy. **BIOMASS:** technologies and processes, potential and resources, energy efficiency and economic aspects of biomass utilization. Course content – laboratory Methods of measuring and determining discharge in open channels. Determining the model characteristics of a Francis turbine, Kaplan turbine, Pelton turbine. Drag crisis. Distribution of pressures around a circular profile. Measurement of aerodynamic forces on a lifting surface. Studies of a vertical-axis wind turbine. Energy studies of a solar collector. Studies of installations with photovoltaic cells. Co-firing of biomass in power boilers: determining boiler efficiency using direct and indirect methods. Use of a water table for 2D simulation of boiler operation.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratories (Lab reports)	56.0%	40.0%
Lecture (exam, written test)	56.0%	60.0%

Recommended reading	Basic literature	1. Michealides E.E.: Alternative Energy Sources. Springer-Verlag Berlin Heidelberg 2012. 2. Ghosh T.K., Prelas M.A.: Energy Resources and Systems. Springer Dordrecht Heidelberg London New York 2011. 3. Kaltschmitt M., Streicher W., Wiese A.: Renewable Energy: Technology Economics and Environment. Springer-Verlag Berlin Heidelberg 2007. 4. Culp A.W. : Principles of energy conversion. 2nd edition. McGrawHill Inc. New York 1991. 5. Wu B., Youngqiang L., Navid Z., Samir K.: Power Conversion and Control of Wind Energy, John Wiley & Sons, INC., Publication, 2011.
	Supplementary literature	1. Chmielniak T.: Technologie energetyczne. Wydawnictwo Naukowe PWN SA, Warszawa 2021. 2. Lewandowski W. M.: Proekologiczne odnawialne źródła energii odnawialnej. WNT Warszawa 2006. 3. Marecki J.: Podstawy przemian energetycznych, WNT Warszawa 2008. 4. Gronowicz J.: Niekonwencjonalne źródła energii. Biblioteka Problemów Eksploatacji, Radom-Poznań 2008. 5. Tytko R.: Urządzenia i systemy energetyki odnawialnej. Wydawnictwo Eco Investment, Kraków 2021.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Environmental, climate, and social issues and their impact on the development of renewable energy sources. 2. Characteristics of hydroelectric power plants, components of a hydroelectric power plant and their functions. 3. Operating parameters of a water turbine, characteristics of water turbine operation. 4. Classification of wind turbines, discussion of a selected wind turbine design. 5. Betz's law. 6. Characteristics of a solar collector. 7. Construction and principle of operation of a PV panel. 8. Types of geothermal reservoirs and the schematic of a binary geothermal power plant. 9. Boilers used in power generation: charactersitics.	
Practical activites within the subject	Not applicable	