GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Measurement and Monitoring, PG_00066971		
Field of study	Smart Renewable Energy Engineering		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
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	2	Language of instruction	English
Semester of study	3	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Marine Power Plants -> Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Zbigniew Korczewski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	15.0	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

Teach the theoretical foundations of energy transformation and transmission processes in offshore wind power plants, with particular emphasis on the technology of measuring observed operation parameters for control and diagnostic purposes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K101] acknowledges the importance of knowledge related to the field of study in solving cognitive and practical problems, critically assessing the information obtained	Student is able to develop an energy balance for the energy transformation and transmission system in an offshore wind power plant.	[SK2] Assessment of progress of work
[K7_W04] knows the specifics of designing, constructing, and operating onshore/offshore wind farms, as well as the technical and logistical challenges involved in their implementation, including measurement and diagnostic technologies	Student has basic knowledge of measurement systems used in offshore wind power plants and their application for control and operational diagnostics purposes.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U101] is able to formulate complex research problems and adopts appropriate methods, obtaining innovative solutions, cooperating with other people, both as a leader and a team member	He is prepared to cooperate in a team carrying out energy research on a laboratory wind turboset.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_U04] possesses remote diagnostic skills and the ability to address technical issues in energy systems using remote diagnostic tools	Student is able to plan and carry out a diagnostic test of a wind turboset on a small-scale physical model.	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td colspan="2">Lecture: Uncertainties and errors in technological measurements. Wind speed measurement technologies. Construction forms of offshore wind turbosets. Processes of energy transformation and transmission in wind turbosets, basic and accompanying processes, energy balance, Sankey diagram. Basic and standard parameters of offshore wind turbosets, external characteristics, SCADA system. Methods of recovering and storing excess wind energy balancing energy cogeneration processes for the hybrid systems used. PMSG type wind turbine generators, characteristics, control and regulation. Control of electric power of offshore wind turbosets - machine side and grid side converters (lecturers FE&CE). Destructive impact of the marine environment on the wind power plant. Operational faults of main components of offshore wind power plants. Diagnostic systems of offshore wind turbosets - vibroacoustic, optical (drones) and thermal imaging and analysis. Technologies for monitoring the offshore wind farm support structure, real-time diagnostics and applied non-destructive testing methods.

Auditorium exercises: Estimation of type A and type B measurement uncertainty. Calculations of basic parameters of wind turbosets based on data recorded in monitoring systems. Calculations of the energy balance of a hybrid system with a wind turbine, electrolyzer and fuel cell. Calculations of the generator's driving power determination of the external characteristic (lecturers FE&CE). Calculations of the power dissipated in a wind turboset for forcing various forms of vibrations.

Laboratory exercises: Measurements of the airflow speed, as well as evaluation of the airflow force and power. Measurements of the torque and rotational speed of the wind turboset characteristics of the turbine's power. Measurements of vibroacoustic parameters in the mechanical system of a wind turboset. Identification of drive shaft fatigue using the thermal imaging method. Measurements of electrical parameters of the wind turbine generator. Regulation of the electromagnetic torque of a PMSG permanent magnet generator.

Project: Development of an energy balance for an offshore wind turboset - elaboration of a Sankey diagram for the nominal load.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">Knowledge of thermodynamics, fluid mechanics and mechanical engineering.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2">
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Report on the project</td><td>100.0%</td><td>10.0%</td></tr>
<tr><td>Reports on the laboratory exercises</td><td>100.0%</td><td>20.0%</td></tr>
<tr><td>Colloquium - auditorium exercises</td><td>51.0%</td><td>20.0%</td></tr>
<tr><td>Colloquium - lecture</td><td>51.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Ajid Bastankhah, Fernando Porté-Age: A New Miniature Wind Turbine for Wind Tunnel Experiments. Part I: Design and Performance. Energies 10(7), March 2018.

Culp A.W. : Principles of energy conversion. 2nd edition. McGraw-Hill Inc. New York 1991.

Guide to the Expression of Uncertainty in Measurement, International Organization for Standardization, Geneva, Switzerland, 1995.

Letcher T. M. Wind Energy Engineering. A Handbook for Onshore and Offshore Wind Turbines. Academic Press. Elsevier Inc. 2017.

Passon P.,Branner K., Larsen S.E., Hvenekær R.J.: Offshore Wind Turbine Foundation Design. Technical University of Denmark, Department of Wind Energy 2015.

Wu B., Youngqiang L., Navid Z., Samir K.: Power Conversion and Control of Wind Energy,   John Wiley & Sons, INC., Publication, 2011.</td></tr>
<tr><td>Supplementary literature</td><td>Korczewski, Z., & Rudnicki, J. (2024). Active Diagnostic Experimentation on Wind Turbine Blades with Vibration Measurements and Analysis. Polish Maritime Research, 126-134. https://doi.org/10.2478/pomr-2024-0042</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table>

Example issues/ example questions/ tasks being completed	Example issues/ example questions/ tasks being completed *1. Explain the notion of standard uncertainty type A and B.* *2. What do the force and wind power depend on - calculation formula.* *3. Characterize remote sensing methods of measuring wind speed (SODAR and LIDAR).* *5. Determine the energy balance of a wind turbine - Sankey diagram.* *6. Perform the external characteristics of a wind turbine.*
Work placement	Not applicable