GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Wind Turbine Control, PG_00070372		
Field of study	Naval Architecture and Offshore Structures		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Specialty 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	1	Language of instruction	English
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Automation and Marine Energy -> Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mohammad Ghaemi	
	Teachers	dr inż. Piotr Kołodziejek dr inż. Mohammad Ghaemi	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

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	45	2.0	3.0	50

Subject objectives

To provide fundamental knowledge and practical skills in modelling, analysing, simulating and designing wind turbine control systems, taking into account aerodynamic, mechanical, electrical and operational aspects, and to develop the ability to apply and evaluate control strategies in offshore energy systems, with particular emphasis on offshore wind farms.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U82] is able to proficiently obtain and process information related to field of study and academic environment in foreign language at B2+ level of the Common European Framework of Reference for Languages (CEFR)	Is able to acquire, analyse and apply information from English-language scientific literature, technical documentation and standards related to the modelling, analysis and control of wind turbines.	[SU2] Assessment of ability to analyse information
[K7_U81] is able to communicate with ease in foreign language at B2+ level of the Common European Framework of Reference for Languages (CEFR) in everyday life, in academic and professional environments	Is able to communicate in English using professional terminology related to wind turbine control, presenting and justifying engineering solutions as well as the results of analyses and simulations.	[SU5] Assessment of ability to present the results of task
[K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Naval Architecture and Ocean Engineering, the construction and principles of operation of marine systems, processes and their components, as well as methods and means of their design and operation	knows and understands the structure, operating principles, and modelling and operation methods of wind turbine control systems as components of offshore energy systems.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
1. Introduction, course objectives, nomenclature, basic concepts and architecture of wind turbine control systems.
2. Modelling of wind turbines as control system plants, including aerodynamic, mechanical and electrical subsystems, and modelling of wind as a disturbance input.
3. Operational aspects of wind turbines, including energy conversion, mechanical loading, power quality and operating modes.
4. Wind turbine control methods and strategies, including yaw control, pitch control, torque and power control, stall control, and selected generator control strategies.
5. Analysis, design and synthesis of wind turbine control systems using classical and selected advanced control methods.
6. Implementation and industrial aspects of wind turbine control systems, including actuators, control hardware and programmable logic controllers (PLCs).

Course content – laboratory
1. MATLAB, Simulink and Simscape environment – fundamentals of modelling and simulation of dynamic systems.
2. Modelling and simulation of selected dynamic systems using MATLAB and Simulink.
3. Modelling, simulation and control design of a wind turbine system with Tip Speed Ratio (TSR) regulation.
4. Analysis of an industrial wind turbine control system model in Simscape/Simulink, including supervisory control, power regulation and pitch control.
5. Wind turbine system identification using SCADA data and the MATLAB System Identification Toolbox.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basic knowledge of automation, control theory, modelling and simulation of dynamic systems at the B.Sc. level. Basic familiarity with MATLAB/Simulink is recommended.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lab. report</td><td>50.0%</td><td>48.0%</td></tr>
<tr><td>Attendance</td><td>0.0%</td><td>4.0%</td></tr>
<tr><td>Test/colloquium</td><td>50.0%</td><td>48.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. Lubośny Z., Farmy wiatrowe w systemie elektroenergetycznym, Wydawnictwo Naukowe PWN, Warszawa, 2016.
2. Bianchi F. D., De Battista H., Mantz R. J., Wind turbine control systems - principles, modelling and gain scheduling design, ISBN-10: 1-84628-492-9, Springer-Verlag London Limited, 2007.</td></tr>
<tr><td>Supplementary literature</td><td>1. Precup R. E., Kamal T., SHassan S. Z., Advanced Control and Optimization Paradigms for Wind Energy Systems, ISBN 978-981-13-5994-1, Springer Nature Singapore Pte Ltd., 2019.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>• Modelling a wind turbine as a control system plant.
• Analysis of the influence of aerodynamic parameters and wind conditions on turbine operation.
• Design and analysis of selected wind turbine control strategies.
• Controller selection and tuning for selected control systems.
• Modelling and simulation of control systems using MATLAB/Simulink.
• Analysis of an industrial wind turbine control system model.
• Wind turbine system identification based on SCADA data.
• Interpretation of simulation results and evaluation of control system performance.

A list of topics and sample questions is available on the course e-learning platform.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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