GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automation systems and ship positioning systems, PG_00065631						
Field of study	Naval Architecture and Offshore Structures						
Date of commencement of studies	February 2025		Academic year of realisation of subject	2025/2026			
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	Polish			
Semester of study	2		ECTS credits	5.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Biuro Praw,Wartości Akademickich i Równego Traktowania -> HR Center						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Mohammad Ghaemi				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	30.0	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		12.0	38.0	125	
Subject objectives	The objective of the course is to introduce students to the principles of operation and design of marine automation systems, with a particular focus on ship motion control and dynamic positioning (DP) systems. The course covers ship dynamics modeling, the analysis of environmental disturbances, the control of thrusters and bow thrusters, as well as the design of disturbance-resistant control systems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W04] demonstrates knowledge encompassing selected issues in the field of advanced knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Naval Architecture and Ocean Engineering	Demonstrates knowledge of selected topics in advanced control methods and algorithms, particularly those applied in ship automation, dynamic positioning systems, and ship course and trajectory control systems.	[SW1] Assessment of factual knowledge
[K7_U02] formulates and tests hypotheses concerning problems related to shipborne and offshore systems/processes, as well as simple research problems	Formulates and tests hypotheses related to ship control problems, including course regulation, trajectory tracking, and dynamic positioning, using mathematical models, computer simulations, and experimental analyses.	[SU4] Assessment of ability to use methods and tools
[K7_U04] creatively designs or modifies, either entirely or in part, a shipborne or offshore system or process according to a given specification, considering both technical and non-technical aspects, estimating costs and adopting design techniques representative for the field	Creatively designs or modifies, in whole or in part, ship automation and positioning systems according to specified technical and operational requirements, considering environmental, operational, and economic aspects, while utilizing appropriate modeling and optimization techniques.	[SU2] Assessment of ability to analyse information
[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	Explains and describes the structure and operating principles of ship automation and positioning systems based on knowledge of automation and control theory, as well as methods for their design and operation in the context of operational and environmental conditions.	[SW1] Assessment of factual knowledge
[K7_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study	Assesses the applicability and potential use of new techniques and technologies in ship automation, including dynamic positioning systems, autopilots, and modern ship control strategies.	[SU2] Assessment of ability to analyse information
[K7_U01] applies acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of shipborne and offshore systems and processes	Applies learned analytical, simulation, and experimental methods, as well as mathematical models, to analyze and evaluate ship control systems, including course regulation, trajectory control, and dynamic positioning systems.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

1. Fundamentals of Marine Automation
2. Modeling of Ship Dynamics and the Impact of Environmental Disturbances
3. Ship Motion and Trajectory Control Systems
4. Dynamic Positioning (DP) Systems Classification and Components
5. Control of Thrusters, Bow Thrusters, and Propellers
6. Robustness of Control Systems to Disturbances and Failures
7. Design and Optimization of DP Systems
8. Simulation of Control Systems in MATLAB/Simulink Environment
9. Emergency Cases and Operational Scenarios in DP and Autopilot Systems

Prerequisites and co-requisites

Fundamentals of Control Systems

Hyromechanics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	56.0%	40.0%
Colloquia/Tests	50.0%	20.0%
Lab. reports	50.0%	40.0%

Recommended reading	Basic literature	1. T. I. Fossen, *Handbook of Marine Craft Hydrodynamics and Motion Control*, 2nd Edition, John Wiley & Sons, 2021. Official publisher's website: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119575054 Additional materials: https://github.com/cybergalactic/FossenHandbook 2. N. S. Nise, *Control Systems Engineering*, 8th Edition, John Wiley & Sons Inc., 2019. Official publisher's website: https://www.wiley.com/en-us/Control+Systems+Engineering%2C+8th+Edition-p-9781119474227 3. Z. Domachowski, M. H. Ghaemi, *Okrętowe układy automatyki*, Wydawnictwo Politechniki Gdańskiej, 2019. Publisher's store: https://sklep.pg.edu.pl/pl/automatyka-i-robotyka/360-domachowski-z-ghaemi-mh-okretowe-uklady-automatyki.html 4. R. Śmierzchalski, *Automatyzacja i sterowanie statkiem*, Wydawnictwo Politechniki Gdańskiej, 2013. Publisher's website: https://www.pg.edu.pl/wydawnictwo/oferta-wydawnicza/automatyzacja-i-sterowanie-statkiem 5. G. Rutkowski, *Eksploatacja statków dynamicznie pozycjonowanych* , Trademar, 2013. Book information: https://trademar.pl/eksploatacja-statkow-dynamicznie-pozycjonowanych
	Supplementary literature	1. T. Kaczorek, *Podstawy teorii sterowania* (Fundamentals of Control Theory), Wydawnictwo Naukowe PWN, Warsaw, 2020. Publisher's website: https://ksiegarnia.pwn.pl/Podstawy-teorii-sterowania,68439881,p.html 2. K. Ogata, *Modern Control Engineering*, 5th Edition, Prentice-Hall, 2010. Book information: https://www.pearson.com/store/p/modern-control-engineering/P100000143847 3. A. Witkowska, "Metody alokacji sterowań w układach dynamicznego pozycjonowania statku" (*Methods of Control Allocation in Ship Dynamic Positioning Systems*), in: *Aktualne problemy automatyki i robotyki* (*Current Issues in Automation and Robotics*), ed. K. Malinowski, J. Józefczyk, J. Świątek, Akademicka Oficyna Wydawnicza EXIT, 2015. Book information: https://www.exit.pl/aktualne-problemy-automatyki-i-robotyki 4. R. Śmierzchalski, "Struktura systemu sterowania statkiem dynamicznie pozycjonowanym" (*Structure of the Control System for a Dynamically Positioned Ship*), *Scientific Papers of the Faculty of Electrical Engineering and Automation, Gdańsk University of Technology*, No. 51, 2016. Article available online: https://mostwiedzy.pl/pl/publication/struktura-systemu-sterowania-statkiem-dynamicznie-pozycjonowanym,1234567890
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	**Topics for Analysis and Discussion:** 1. Fundamental differences between classical ship motion control and dynamic positioning (DP) systems. 2. The impact of environmental factors on ship motion and methods of compensation in automation systems. 3. Key components of dynamic positioning systems and their functions. 4. Modeling ship dynamics considering hydrodynamic effects and environmental disturbances. 5. Advantages and limitations of different control methods used in ship positioning systems. **Sample Exam / Test Questions:** 1. Principles of operation of dynamic positioning systems of different classes and their applications. 2. The role of sensors in ship positioning systems and their impact on control accuracy. 3. The use of control algorithms in ship positioning systems. 4. Methods of modeling ship motion and their applications. 5. Compensation of environmental disturbances in DP systems. **Sample Practical Tasks:** 1. Simulation of ship motion control systems in a computational environment. 2. Designing basic dynamic positioning systems. 3. Analyzing the impact of disturbances and failures on DP system performance. 4. Applying different control methods for ship positioning. 5. Verifying the performance of control systems using real navigation data.
Work placement	Not applicable

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