GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automatic guidance and controll systems in transportation, PG_00064992		
Field of study	Automatyczne systemy naprowadzania i sterowania środkami transportu		
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	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Office of Rights, Academic Values and Equal Treatment -> HR Center -> University-wide Units		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mohammad Ghaemi	
	Teachers	prof. dr hab. inż. Wiesław Tarełko dr inż. Jakub Kowalski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	30.0	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	11.0	44.0	100

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_W12] identifies and interprets the main developmental trends and significant new achievements in the field of engineering and technical sciences and disciplines relevant to the course of study	Identifies and interprets key development trends and the latest advancements in ship automation, dynamic positioning systems, and modern ship control methods.	[SW1] Ocena wiedzy faktograficznej
[K7_U03] identifies and formulates task specifications in the scope of transport systems and processes design, including non-standard problems and taking into consideration their non-technical aspects	Identifies and formulates task specifications for designing ship automation and positioning systems, including non-standard tasks, while considering environmental, operational, and economic aspects.	[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu
[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] Ocena umiejętności analizy informacji

Subject contents

Course content – lecture

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	
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.	
Practical activites within the subject	Not applicable	

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