GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automation Systems and Ship Positioning Systems, PG_00070363		
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	5.0
Learning profile	general academic profile	Assessment form	exam
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 hab. inż. Marek Dzida dr hab. Anna Witkowska prof. dr hab. inż. Wiesław Tarełko prof. dr hab. inż. Roman Śmierzchalski	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	45.0	0.0	90
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 7297 Automation Systems and Ship Positioning Systems [WIMiO][2026/27] https://enauczanie.pg.edu.pl/2025/course/view.php?id=7297						

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	90	5.0	30.0	125

Subject objectives	The course aims to prepare students to model, analyse, design and evaluate ship automation systems as well as ship motion and positioning control systems based on knowledge of automation, control theory and ship dynamics, while developing the ability to select and apply modern control methods in marine engineering applications.

Learning outcomes	see table below

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	knows and understands advanced methods, techniques and algorithms used in ship automation systems as well as ship motion and positioning 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	ormulates and tests hypotheses concerning the operation of ship motion and positioning control systems using mathematical models, computer simulations and results analysis.	[SU4] Assessment of ability to use methods and tools
[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	uses analytical, simulation and experimental methods as well as mathematical models to analyse and evaluate ship automation systems and ship motion and positioning control systems.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of Naval Architecture and Offshore Structures	evaluates the suitability and potential application of new techniques and technologies in ship automation systems and ship motion and positioning control systems.	[SU2] Assessment of ability to analyse information

Subject contents

Course content – lecture

1. Architecture of integrated ship automation systems and ship motion and positioning control systems.
2. Modelling of ship dynamics and environmental disturbances for control system design.
3. Design and analysis of ship course, trajectory and manoeuvring control systems.
4. Dynamic Positioning (DP) systems: architecture, classification, components and classification requirements.
5. Design of propulsion, thruster and tunnel thruster control systems, including thrust allocation in DP systems.
6. Design of reliable, fault-tolerant and safe ship automation systems, including redundancy, diagnostics and failure management.
7. Analysis, design and evaluation of advanced control methods applied in ship automation and positioning systems.
8. Modelling, simulation and validation of control systems using MATLAB/Simulink.
9. Industrial case studies in ship automation and positioning systems, and future trends in autonomous marine systems.

Course content – exercises

1. Analysis of mathematical ship motion models and their application in control system design.
2. Analysis of the influence of environmental disturbances on ship control and positioning accuracy.
3. Design and analysis of ship course, trajectory and positioning control strategies.
4. Analysis of Dynamic Positioning (DP) system architecture and component selection.
5. Evaluation of thrust allocation methods and propulsion system configurations for different ship types.
6. Analysis of reliability, redundancy and failure scenarios in ship automation and positioning systems.
7. Interpretation of analysis and simulation results, and evaluation of control system performance.

Course content – project

1. Development of a mathematical model of a selected ship and environmental disturbance models.
2. Design of a ship course, trajectory or Dynamic Positioning (DP) control system according to a specified design brief.
3. Selection of the automation system architecture, sensors, actuators and propulsion system configuration.
4. Implementation of mathematical models and control algorithms using MATLAB/Simulink.
5. Analysis of control performance, disturbance rejection and system behaviour under selected operational and failure scenarios.
6. Evaluation of the obtained results and preparation of the technical project documentation.

Prerequisites and co-requisites

Basic knowledge of automation, control theory, mathematical modelling and ship dynamics at the B.Sc. level. Basic familiarity with the MATLAB/Simulink environment is recommended.

<table>
<tr><td>Assessment methods and criteria</td><td>

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam - lecture	56.0%	40.0%
Project	50.0%	40.0%
Tests/Assignments	50.0%	20.0%

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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>

1. Fossen, T. I., Handbook of Marine Craft Hydrodynamics and Motion Control, 2nd Edition, John Wiley & Sons, 2021. (podstawowa pozycja dla całego przedmiotu)
2. Nise, N. S., Control Systems Engineering, 8th Edition, John Wiley & Sons, 2019.
3. Lewis, E. V. (Ed.), Principles of Naval Architecture Series: Ship Dynamics, Society of Naval Architects and Marine Engineers (SNAME), latest edition.

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<tr><td>Supplementary literature</td><td>

1. Fossen, T. I., *Marine Control Systems: Guidance, Navigation and Control of Ships, Rigs and Underwater Vehicles*, Marine Cybernetics, 2002.
2. Perez, T., *Ship Motion Control: Course Keeping and Roll Stabilisation Using Rudder and Fins*, Springer, 2005.
3. Skjetne, R., Fossen, T. I., Kokotović, P. V., *Adaptive Maneuvering, Path Following and Point Stabilization of Ships: A Passive Nonlinear Model Approach*, *International Journal of Adaptive Control and Signal Processing*, 2004.
4. SNAME, *Principles of Naval Architecture Series – Ship Dynamics*, Society of Naval Architects and Marine Engineers, latest edition.
5. IMO, *Guidelines for Vessels with Dynamic Positioning Systems (MSC/Circ.645)* and relevant IMO circulars and guidelines related to Dynamic Positioning systems.
6. DNV, *Dynamic Positioning Systems* (Recommended Practices and Classification Rules), latest edition.
7. IMCA, *Guidelines for the Design and Operation of Dynamically Positioned Vessels*, latest edition.

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<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">

- Mathematical modelling of ship motion and environmental disturbances.
- Analysis and design of ship course, trajectory and positioning control systems.
- Analysis of the architecture and components of Dynamic Positioning (DP) systems.
- Selection of propulsion system configurations and thrust allocation methods.
- Analysis of the influence of environmental disturbances and actuator limitations on control system performance.
- Modelling and simulation of ship automation and control systems using MATLAB/Simulink.
- Design and evaluation of control algorithms for selected marine engineering applications.
- Analysis of reliability, redundancy and failure scenarios in ship automation and positioning systems.
- Interpretation of simulation results and evaluation of control system performance.
- Analysis of industrial case studies related to modern ship automation and positioning systems.

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<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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