GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Offshore Support Structures, PG_00065537		
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	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	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 hab. inż. Paweł Dymarski	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	9.0	9.0	9.0	0.0	0.0	27

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	27	7.0	41.0	75

Subject objectives

The aim of the course is to familiarize students with the existing types of marine support structures for wind turbines and to introduce students to the methods used to analyze (hydro) statics and the dynamics of structures subjected to the influence of the marine environment. Students learn about the methodology of model tests of floating and bottom-fixed structures.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] demonstrates structured and theory supported knowledge encompassing key issues in the field of Naval Architecture and Ocean Engineering, enabling developement and synthesis of shipborne and offshore systems, devices, and processes	The student possesses a structured understanding of the theoretical foundations of offshore support structure design and analysis. The student is able to analyze the results of model-based studies of the dynamics of a support structure subjected to wave action.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U02] formulates and tests hypotheses concerning problems related to shipborne and offshore systems/processes, as well as simple research problems	The student solves tasks related to the issue of designing offshore support structures, including simple research problems.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	Course content – lecture 1. Basic information about the types of support structures - floating structures - bottom-fixed structures 2. Hydrostatics of marine objects - buoyancy and hydrostatics of floating objects - stability mechanisms depending on the type of structure 3. Anchoring systems for floating support structures - chain anchoring (catenary mooring system) - anchoring with the use of elastic tendons (taut system) - tension leg system (TLP) - typical characteristics of anchorages (depending on type) 4. Environmental impact on offshore structures 4.1 Determination of hydrodynamic forces on offshore structures - wave forces - Morison's equation, - the Froude-Krylov method, - source-sink methods (diffraction method) - potential flow - RANSE-CFD 4.2 Determination of aerodynamic forces. 5. Introduction to the dynamics of floating structures 5.1 Basic properties of a dynamic system with one degree of freedom (1 DoF) - Discussion of the properties of the linear system - mass on a spring with a damping element, -- basic concepts: mass and added mass, damping (damping coefficient), restoring force (system stiffness coefficient) -- characteristic of the system response to the excitation as a function of frequency. The concept of natural frequency, "response" regimes of the structure. Effect of damping 5.2 Discussion of the motions of a floating object in 6 degrees of freedom. 5.3 Equations of motion of objects with one degree of freedom: - heave, - pitch/roll, - surge (TLP) - discussion of the forces acting on an object during its movement. 5.4 Coefficients of hydrodynamic forces 5.5. Solving equations of motion of an object - Analytical methods used to obtain "basic solutions" - Numerical methods (algorithms) used to solve equations of motion - Solution of equations of motion on a numerical route for example objects -- spar -- TLP 5.6 Movement in 6 degrees of freedom. - formulation of the equation of motion, - discussion of equation coefficients, - couplings between degrees of freedom Course content – exercises According to the content of the lecture Course content – laboratory 6. Model tests of offshore structures 6.1 model testing of floating wind turbines - discussion of the applied similarity laws. The issue of the scale effect - studies of free decay test - determination of the natural period and basic hydrodynamic coefficients - regular wave tests (determining the amplitude characteristics) - irregular wave tests -- spar structure model tests 6.2 (optional) model tests of TLP type structure / bottom-fixed structure 6.3 Preparation of a short-term forecast of the support structure movements based on regular wave tests (for given weather conditions / waves)
Prerequisites and co-requisites	- Knowledge of terms in the field of general mechanics: -- strength, moment of force -- distribution of force into components - Knowledge of the basics of material strength, in particular: -- characteristics of the beam section -- basics of beam bending theory (basic solutions) -- understanding the terms: truss, frame, grate. - Fundamentals of fluid mechanics: -- fluid statics, the concept of hydrostatic pressure -- thrust force and buoyancy force -- Bernoulli equation - Dynamics of the marine environment (1 semester) -- currents -- tides -- regular and irregular wave -- wind model

<table>
<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>sprawozdania</td><td>70.0%</td><td>33.0%</td></tr>
<tr><td>zadania</td><td>70.0%</td><td>33.0%</td></tr>
<tr><td>kolokwium</td><td>60.0%</td><td>34.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. S.K. Chakrabarti Hydrodynamics of Offshore Structures
2. J.F. Wilson "Dynamics of Offshore Structures"
3. G.Clauss, E.Lehmann, C.Östergaard Offshore Structures vol. 1
4. Jan Dudziak Teoria okrętu</td></tr>
<tr><td>Supplementary literature</td><td>5. A.R.J.M. Lloyd SEAKEEPING: Ship Behaviour in Rough Weather
6. O.M. Faltinsen Sea Loads on Ships and Offshore Structures
7. G.J Feikema, J.E.W. Wichers The Effect of Wind Spectra on the Low-Frequency Motions of a Tanker in Survival Condition. OTC 1991
8. T. Sarpkaya: "Wave Forces on Offshore Structures"
9. S.K. Chakrabarti "Handbook of Offshore Engineering"
10. L. Castro-Santos, V. Diaz-Casas "Floating Offshore Wind Farms"
11. S. Chandrasekaran "Dynamic Analysis and Design of Offshore Structures"</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2"></td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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