



Subject card

Subject name and code	Offshore support structures, PG_00065619						
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		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Wydział Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Paweł Dymarski				
	Teachers		dr hab. inż. Paweł Dymarski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	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		8.0		22.0	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_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.		[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools		
	[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		

Subject contents	<p>1. Basic information about the types of support structures</p> <ul style="list-style-type: none"> - floating structures - bottom-fixed structures <p>2. Hydrostatics of marine objects</p> <ul style="list-style-type: none"> - buoyancy and hydrostatics of floating objects - stability mechanisms depending on the type of structure - hydrostatic forces acting on bottom-fixed structures <p>3. Anchoring systems for floating support structures</p> <ul style="list-style-type: none"> - chain anchoring (catenary mooring system) - anchoring with the use of elastic tendons (taut system) - tension leg system (TLP platforms) - typical characteristics of anchorages (depending on type) <p>4. Environmental impact on offshore structures</p> <p>4.1 Determination of hydrodynamic forces on offshore structures</p> <ul style="list-style-type: none"> - wave forces - Morison's equation, - the Froude-Krylov method, - source-sink methods (diffraction method) - potential flow - RANSE-CFD viscous flow methods. - forces caused by sea currents, the significance of these forces <p>4.2 Determination of aerodynamic forces.</p> <p>5. Introduction to the dynamics of floating structures</p> <p>5.1 Basic properties of a dynamic system with one degree of freedom (1 DoF)</p> <ul style="list-style-type: none"> - 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, resonant frequency, "response" regimes of the structure. Effect of damping on the response characteristics. <p>5.2 Discussion of the motions of a floating object in 6 degrees of freedom. The names and nature of the subspecific movements.</p> <p>5.3 Equations of motion of objects with one degree of freedom:</p> <ul style="list-style-type: none"> - heave, - pitch/roll, - surge (on the example of TLP) - discussion of the forces acting on an object during its movement. <p>5.4 Coefficients of hydrodynamic forces</p> <p>5.5. Solving equations of motion of an object</p> <ul style="list-style-type: none"> - 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 <p>5.6 Movement in 6 degrees of freedom.</p> <ul style="list-style-type: none"> - formulation of the equation of motion, - discussion of equation coefficients, - couplings between degrees of freedom <p>6. Model tests of offshore structures</p> <p>6.1 model testing of floating wind turbines</p> <ul style="list-style-type: none"> - 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 <p>6.2 (optional) model tests of TLP type structure / bottom-fixed structure</p> <p>6.3 Preparation of a short-term forecast of the support structure movements based on regular wave tests (for given weather conditions / waves)</p>
Prerequisites and co-requisites	<ul style="list-style-type: none"> - Knowledge of terms in the field of general mechanics: <ul style="list-style-type: none"> -- strength, moment of force -- distribution of force into components - Knowledge of the basics of material strength, in particular: <ul style="list-style-type: none"> -- characteristics of the beam section -- basics of beam bending theory (basic solutions) -- understanding the terms: truss, frame, grate. - Fundamentals of fluid mechanics: <ul style="list-style-type: none"> -- fluid statics, the concept of hydrostatic pressure -- thrust force and buoyancy force -- Bernoulli equation - Dynamics of the marine environment (1 semester) <ul style="list-style-type: none"> -- currents -- tides -- regular and irregular wave -- wind model

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	kolokwium	60.0%	34.0%
	zadania	70.0%	33.0%
	sprawozdania	70.0%	33.0%
Recommended reading	Basic literature	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	
	Supplementary literature	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"	
	eResources addresses		
	Example issues/ example questions/ tasks being completed		
Work placement	Not applicable		

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