



## Subject card

Subject name and code	Dynamics of the Marine Environment, PG_00062663						
Field of study	Naval Architecture and Offshore Structures						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Obligatory subject group in the field of study 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	1	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Paweł Dymarski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	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		7.0		48.0	100
Subject objectives	The aim of the course is for students to master mathematical models describing the dynamics of the marine environment in order to determine (calculate) the forces acting on offshore and coastal objects such as: ships offshore facilities: - drilling rig - offshore wind turbines (OWT): -> bottom-fixed OWT structures -> floating wind turbine structures other offshore structures						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_U03] Formulates research challenges and selects appropriate analytical methods, leveraging advanced IT tools, then critically evaluates the obtained results		The student knows analytical methods for modeling sea waves, wind and sea currents. The student is able to analyze the results of research on the impact of waves on monopiles. The student knows analytical methods for determining the loads on a monopile structure		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment		
	[K7_U05] Efficiently collaborates with team members both as a leader and a collaborator, achieving group goals through effective teamwork		Collaborates with team members as a leader or collaborator. Preparation of laboratory reports.		[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment		
[K7_W01] Identifies with a profound understanding the phenomena related to ocean engineering, describing advanced theories and methods for analyzing processes in technical oceanographic systems		The student knows the theories and methods of calculating phenomena related to sea waves, current and wind. Is able to calculate the impact of waves on basic ocean engineering structures (monopoles)		[SW3] Assessment of knowledge contained in written work and projects			

Subject contents	<ol style="list-style-type: none"> <li>1. Basic equations governing the motion of fluids</li> <li>2. Gravitational stability of water masses (vertical movements)</li> <li>3. Progressive movement of water masses</li> <li>4. Tides</li> <li>5. Wave motion of the sea <ol style="list-style-type: none"> <li>5.1 Linear wave model (Airy model)</li> <li>5.2 Regular wave <ol style="list-style-type: none"> <li>5.2.1 Basic quantities describing a regular wave</li> <li>5.2.2 Basic properties of a regular wave.</li> </ol> </li> <li>5.3 Irregular wave <ol style="list-style-type: none"> <li>5.3.1 Sea wave record analysis. Basic concepts describing an irregular wave</li> <li>5.3.2. Spatial (omnidirectional) and plane (unidirectional) irregular wave</li> <li>5.3.3 General equation for irregular waves</li> <li>5.3.4 Wave energy spectrum. Mathematical description of the wave spectrum</li> <li>5.3.5 Determination of irregular wave parameters based on the wave spectrum</li> <li>5.3.6 Determining the irregular wave equation from the wave spectrum.</li> </ol> </li> </ol> </li> <li>5.4 Higher order wave models</li> <li>6. Wind <ol style="list-style-type: none"> <li>6.1 Laws governing the movement of air (atmosphere)</li> <li>6.2. Basic wind models (stationary approach). Velocity profile equations</li> <li>6.3. Wind as a non-stationary phenomenon <ol style="list-style-type: none"> <li>6.4.1 Analysis of the recording of the velocity of air masses as a function of time</li> <li>6.4.2 Wind energy spectral density function. Mathematical models of the wind energy spectrum</li> <li>6.4.3 Velocity equation for unidirectional unsteady air flow</li> <li>6.4.4 Complex models describing airflow</li> </ol> </li> </ol> </li> <li>7. Impact of the marine environment on objects of simple geometry. Basic models mathematical tools for calculating hydrodynamic forces. Introduction to modeling loads on offshore structures</li> </ol>											
Prerequisites and co-requisites	<p>Knowledge of mathematical analysis and numerical methods:</p> <ul style="list-style-type: none"> <li>- integration: analytical and numerical methods,</li> <li>- trigonometric functions,</li> <li>- spectral analysis, Fourier series,</li> <li>- basic knowledge of vector algebra</li> </ul> <p>Ability to use a spreadsheet, basic programming skills</p>											
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Subject passing criteria</th> <th style="width: 33%;">Passing threshold</th> <th style="width: 33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Labs</td> <td>70.0%</td> <td>33.0%</td> </tr> <tr> <td>Lecture</td> <td>60.0%</td> <td>67.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Labs	70.0%	33.0%	Lecture	60.0%	67.0%
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Labs	70.0%	33.0%										
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Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. Jan Dudziak Teoria okrętu, rozdział Dynamika środowiska</li> <li>2. Czesław Druet Dynamika morza. Gdańsk 2000</li> <li>3. A.R.J.M. Lloyd SEAKEEPING: Ship Behaviour in Rough Weather</li> <li>4. S.K. Chakrabarti Hydrodynamics of Offshore Structures</li> <li>5. 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</li> </ol>										
	Supplementary literature	<ol style="list-style-type: none"> <li>6. O.M. Faltinsen Sea Loads on Ships and Offshore Structures</li> <li>7. G.Clauss, E.Lehmann, C.Östergaard Offshore Structures vol. 1</li> <li>8. Barry J. Heyer and Lymon C. Reese "ANALYSIS OF SINGLE PILES UNDER LATERAL LOADING".</li> </ol>										
	eResources addresses	Adresy na platformie eNauczanie:										
Example issues/ example questions/ tasks being completed	<p>Przykładowe pytania (nie pokrywają pełnego zakresu przedmiotu)</p> <ol style="list-style-type: none"> <li>1. Napisz równanie fali regularnej. Narysuj wykres (szkic) fali w układzie x, z, oznacz na wykresie amplitudę fali i jej długość.</li> <li>2. Napisz równanie fali regularnej. Narysuj wykres (szkic) fali w układzie t,z (czas, z), oznacz na wykresie amplitudę fali i jej okres.</li> <li>3. Naszkicuj kształt trajektorii cząstek wody na przykładzie a) akwenu głębokiego, b) akwenu o średniej głębokości oraz c) akwenu płytkiego.</li> <li>4. Napisz równanie fali nieregularnej. Naszkicuj przykładowy wykres fali, nanieś oznaczenia okresów piku, okresów miejsc zerowych oraz oznacz amplitudy (przykładowe).</li> <li>5. Pokaż na przykładach czym się różni widmo falowania wąsko- od szerokopasmowego (szkic)</li> <li>6. Wypisz znane Ci wyidealizowane funkcje widmowe falowania. Zilustruj wpływ zmiany poszczególnych parametrów na kształt widma (wykresy).</li> <li>7. Naszkicuj typowy profil prędkości wiatru. Podaj wzór.</li> <li>8. Wymień znane Ci typy prądów morskich, naszkicuj profile prędkości, podaj wzory.</li> <li>9. Sformułuj równanie Morisona, nazwij człony równania, omów wielkości w nim występujące (w tym współczynniki). Dla jakiego typu (kształt/wielkość) konstrukcji można to równanie stosować.</li> <li>10. Omów metodę Froudea-Kryłowa wyznaczania sił na obiekty offshore. Na jakim założeniu opiera się metoda F-K ? (podpowiedź: w jaki sposób wyznaczamy pole ciśnień?)</li> <li>11.Omów model p-y oddziaływania dno(grunt)-pal</li> </ol>											
Work placement	Not applicable											