

Subject card

Subject name and code	Physical Oceanography - lecture, PG_00159306						
Field of study	Oceanography						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	Bachelor's studies		Subject group		Obligatory subject group in the field of study Optional 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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		3.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Laboratory of Physical Oceanography -> Department of Physical Oceanography and Climate Research -> Faculty of Oceanography and Geography -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Marek Kowalewski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						
	Additional information: In exceptional cases, one lecture may be held remotely (online).						
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	30		15.0		30.0	75
Subject objectives	The goal of the course is to learn and understand: • spatial and temporal variability of temperature, salinity and density of seawater and the processes that shape this variability • fundamentals of marine dynamics (forces acting on water masses in the sea, types of seawater motion, geostrophic currents, Ekman theory, thermohaline circulation, tides, gravity waves in the sea, their basic characteristics, processes accompanying wave propagation, wind waves, seiches, tsunamis, internal waves) • basics of marine acoustics and optics						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	OCEANL3-W03		He/she knows and understands to an advanced degree the relationships of physical oceanography, understands the complexity of physical processes in the sea		[SW4] test/exam - oral or written		
	OCEANL3-U01		He/she is able to use current scientific terminology in presenting and discussing problems in physical oceanography		[SU4] test/exam - oral or written		
	OCEANL3-W01		He/she knows and understands the terminology used in physical oceanography to an advanced level		[SW4] test/exam - oral or written		

Subject contents	1. History and basic issues of physical oceanography. The ocean-atmosphere system. Balance of energy at the sea surface. 2. Temperature, salinity and density of seawater. Water masses and basic factors shaping their characteristics. Thermocline, halocline, pycnocline. TS diagrams and their interpretation. 3. Forces acting on water masses in the oceans. Navier-Stokes equation. The principle of conservation of mass and the continuity equation. 4. Vertical stability of water masses. Väisälä-Brunta parameter. Convective motion, turbulence, differential diffusion. 5. Sound in the sea. Speed of sound, refraction, sound channel. Absorption of sound in water. 6. Elements of marine optics. Transmission of light into the sea. Absorption and scattering of light. Satellite remote sensing, color of the sea. 7. Motion on the surface of the globe. Coriolis force. Vorticity. Frictional forces in the surface and bottom layers of the ocean. Wind currents, Ekman model. Upwelling and downwelling. 8. Large-scale ocean circulation. Vorticity. Sverdrup transport. Intensification of flows near western ocean margins. 9. Geostrophic currents. Defant's method. Mesoscale eddies. Estuarine circulations. Sea level. Storm surges. 10. Gravitational waves. Wave transformation. Surface and internal waves. 11. Interference of waves. Diffraction. Wind waves. Wave spectrum. Generation and development of wind waves. 12. Long waves: Kelvin waves, Rossby waves, seiches, tides - static and dynamic theory, tsunamis.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria exam	Passing threshold 51.0%	Percentage of the final grade 100.0%
Recommended reading	Basic literature	1. L.D. Talley, G.L. Pickard, W.J. Emery, J.H. Swift, Descriptive Physical Oceanography, Elsevier (wyd. 6), 2011, https://booksite.elsevier.com/DPO/ 2. J. Dera, Fizyka morza, PWN, 2003 3. S. Massel, Procesy Hydrodynamiczne w Ekosystemach Morskich, Wyd. UG, 2010 4. R.H. Stewart, Introduction to Physical Oceanography, Texas T&M University, 2008, https://open.umn.edu/opentextbooks/textbooks/20 5. Tomczak, Godfrey Regional Oceanography: an Introduction, 1994, https://www.geo.uni-bremen.de/~apau/dynamicclimate/course_materials_2015/Resources/tomczak_godfrey_1994.pdf	
	Supplementary literature	M. Tomczak, Exercises in Physical Oceanography: - basic: http://www.mt-oceanography.info/IntExerc/basicentry.html - advanced: http://www.mt-oceanography.info/IntExerc/advindex.html	
	eResources addresses		
Example issues/ example questions/ tasks being completed	- What is the pattern of surface currents in the oceans and what factors shape ocean circulation? - Under what conditions can "salt fingers" form?		
Work placement	Not applicable		

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