University of Gdańsk

Subject card

Subject name and code	Physical Oceanography - lecture, PG_00201105		
Field of study	Marine Hydrography		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	Bachelor's studies	Subject group	Obligatory subject group 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	practical	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	45.0	0.0	0.0	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	1.0	29.0	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
[HML3-W02] knows and understands, at an advanced level, selected phenomena and processes occurring in the hydrosphere, atmosphere, lithosphere and biosphere, their interconnections and relations, as well as practical applications of this knowledge in professional activities related to the field of study	understands, at an advanced level, the phenomena and processes occurring in the hydrosphere and atmosphere, as well as their interconnections and relationships, and the practical applications of this knowledge in hydrography	[SW4] test/exam - oral or written
[HML3-U14] is able to use the applicable terminology in presenting and discussing problems related to the field of study	is able to use the current terminology in presenting and discussing problems in physical oceanography	[SU4] 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, picocline. 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. 13. Freezing of fresh and sea water. Formation, types and physical properties of sea ice. Thermodynamics and dynamics of sea ice.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	51.0%	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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