University of Gdańsk

Subject card

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|---|---|---|---|
| Subject name and code | Physical Oceanography - lecture, PG_00205263 | | |
| Field of study | Oceanography | | |
| 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<br>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

**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 | 2.0 | 43.0 | 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-U01] is able to use the current scientific terminology in the field of oceanography in various forms of expression | Is able to use current scientific terminology in presenting and discussing problems in physical oceanography | [SU4] test/exam - oral or written |
| [OCEANL3-W01] has an advanced knowledge and understanding of the terminology used in oceanography and related exact and natural sciences (in Polish and a selected foreign language) | Is knows and understands the terminology used in physical oeanography to an advanced level | [SW4] test/exam - oral or written |
| [OCEANL3-W03] has an advanced understanding of the relationships between living and non-living components of aquatic environments, and is aware of the complex nature, intricacy, and natural variability of these environments | Is 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 |

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