

**Subject card**

<b>Subject name and code</b>	Invasive and non-invasive seabed investigation methods, PG_00131498						
<b>Field of study</b>	Marine Hydrography						
<b>Date of commencement of studies</b>	October 2024	<b>Academic year of realisation of subject</b>			2025/2026		
<b>Education level</b>	Bachelor's studies	<b>Subject group</b>			Optional subject group Subject group related to practical vocational preparation		
<b>Mode of study</b>	full-time studies	<b>Mode of delivery</b>			at the university		
<b>Year of study</b>	2	<b>Language of instruction</b>			Polish		
<b>Semester of study</b>	4	<b>ECTS credits</b>			2.0		
<b>Learning profile</b>	practical	<b>Assessment form</b>			credit		
<b>Conducting unit</b>	Department of Geophysics -> Faculty of Oceanography and Geography -> Rector						
<b>Name and surname of lecturer (lecturers)</b>	<b>Subject supervisor</b>		prof. dr hab. Jarosław Tęgowski				
	<b>Teachers</b>						
<b>Lesson types</b>	<b>Lesson type</b>	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	<b>Number of study hours</b>	0.0	0.0	20.0	0.0	0.0	20
	E-learning hours included: 0.0						
<b>Learning activity and number of study hours</b>	<b>Learning activity</b>	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	<b>Number of study hours</b>	20		5.0		25.0	50
<b>Subject objectives</b>	<ol style="list-style-type: none"> <li>To learn and understand the mechanism of interaction of acoustic waves with the seabed, and methods of investigating the seabed using equipment hydroacoustic, laser, gravimetric and magnetometric equipment.</li> <li>To acquire the ability to analyse echograms and determine geological facies from them.</li> </ol>						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[HML3-U07] effectively use information and communication techniques, including utility programs to solve professional problems		[SU4] test/exam - oral or written
	[HML3-W01] selected facts, phenomena and processes, as well as methods and theories concerning them, explaining the complex relationships between them, constituting basic general knowledge in the field of scientific disciplines forming the theoretical foundations specific to the field of study	Relationship of processes physical processes with geological occurring in marine environment	[SW4] test/exam - oral or written
	[HML3-W02] 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	Geological processes occurring in the marine environment marine environment; definition of methods their study; application geophysical methods in recognition of structures lithosphere.	[SW4] test/exam - oral or written
	[HML3-W03] directions of development and the latest discoveries in the field of scientific disciplines forming the theoretical basis appropriate to the field of study	Geological processes occurring in the marine environment marine environment; definition of methods their study; application geophysical methods in recognition of structures lithosphere.	[SW4] test/exam - oral or written
	[HML3-W08] principles of operation and use of measuring instruments used in professional activities related to the field of study, including principles for their calibration and accuracy assessment	Principles of operation and use of measuring instruments used for invasive and non-invasive methods surveys of the seabed, including principles for their calibration and accuracy assessment.	[SW4] test/exam - oral or written
	[HML3-U01] plan and conduct experiments, including computer simulations, interpret the results obtained and draw conclusions	Use mathematical and statistical methods and specialised software for analyse data and describe geological phenomena	[SU4] test/exam - oral or written
	[HML3-U02] select and apply basic research techniques and tools in the field of aquatic environment research, as well as plan and carry out measurements, develop the obtained results and interpret them correctly	Plan and design non-invasive surveys of the seabed apply surface methods geophysical methods and use geophysical data in studies geological studies.	[SU4] test/exam - oral or written
	[HML3-U03] recognise natural (including geological) and anthropogenic objects and link them to the processes leading to their formation	Plan and design non-invasive surveys of the seabed apply surface methods geophysical methods and use geophysical data in studies geological studies.	[SU4] test/exam - oral or written
	[HML3-W04] the issue of measurements related to the exploration of sea basins and inland waters and tools allowing to describe, interpret and present the results of measurements	Geological processes occurring in the marine environment marine environment; definition of methods their study; application geophysical methods in recognition of structures lithosphere.	[SW4] test/exam - oral or written

Subject contents	Preliminary analysis of surface sediment and core samples. Reflection and scattering of acoustic signals from the seabed. Practical interpretation of seabed echograms recorded with low-frequency hydroacoustic equipment; determination of seismostratigraphic units. Analysis of bathymetric maps recorded with multibeam echosounder, analysis of sonar images of the seabed, learning the principles of sediment mapping from sonar recordings. Planning and design of non-invasive bottom surveys.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	reports and colloquium	51.0%	100.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. STEPNOWSKI, A.: Systemy Akustycznego Monitoringu Środowiska Morskiego. GTN, Gdańsk 2001.1.</li> <li>2. ŚLIWIŃSKI A.: Ultradźwięki i ich zastosowania. WNT, Warszawa 2001.2.</li> <li>3. TĘGOWSKI J.: Akustyczna klasyfikacja osadów dennych. Wyd. Rozprawy i Monografie, IO PAN, 2006.</li> </ol>	
	Supplementary literature	<ol style="list-style-type: none"> <li>1. BLONDEL P.: The Handbook of Sidescan Sonar. Springer, 2009.1.</li> <li>2. LURTON X.: An introduction to Underwater Acoustics. Principles and applications. Wyd. Springer, 2002.2.</li> <li>3. MACLENNAN D. N., SIMMONDS E. J.: Fisheries Acoustics Theory and Practice. Blackwell Publishing Limited, 2005.3.</li> <li>4. MEDWIN H., CLAY C. S.: Fundamentals of Acoustical Oceanography. Academic Press, Boston 1998.4.</li> <li>5. MEDWIN H.: Sounds in the Sea. From Ocean Acoustics to Acoustical Oceanography. Cambridge University Press, New York 2005.5.</li> <li>6. URICK R. J.: Principles of underwater sound. McGraw-Hill, 1975.</li> </ol>	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<p>Geotechnical characteristics of bottom sediments - cohesiveness, granulometry, stratified structure. Equipment for sediment sampling Surface sediment sampling devices (drawers, box corers), sampling methods and initial analysis. Subsurface sediment sampling equipment (core gravity samplers, vibroprobes), sampling methods and pre-analysis. Drilling equipment, methods of core sampling and preliminary analysis. Biological sampling - bottom dredging. Geoacoustic properties of bottom sediments. Theoretical basis of acoustic wave propagation in water depth and seabed. Influence of refraction on bottom acoustic measurements. Sources and receivers of acoustic signals, construction of hydroacoustic transmitting and receiving antennas. Hydroacoustic devices for bottom survey, their construction, application, positioning system and dynamic corrections with them - single beam echosounder, multibeam echosounder, parametric echosounder, subbottom profiler, side scan sonar, interferometric side scan sonar, Range Gain Control (TVG). Underwater positioning - USBL and similar systems. GPS positioning - system design and operation, RTK corrections. Introduction to numerical analysis of acoustic linear and chirp. Acoustic sediment classification - commercial systems RoxAnn, QTC, VBT. Techniques for non-invasive seabed surveys (gravimetry, magnetometry, 3D laser scanner, underwater photography, scintillation counter). Underwater vehicles used for non-invasive exploration of the seabed (AUV, ROV). Organisation of non-invasive seabed surveys. Survey vessels suited to seabed acoustic seabed surveys, organisation of a survey cruise, survey methodology, new seabed survey techniques.</p>		
Work placement	Not applicable		

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