University of Gdańsk

Subject card

Subject name and code	Invasive and Non-invasive Seabed Investigation Methods - lecture, PG_00201127		
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 Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	2.0
Learning profile	practical	Assessment form	credit
Conducting unit	Department of Geophysics -> Faculty of Oceanography and Geography -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Jarosław Tęgowski	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	0.0	0.0	0.0	0.0	20
	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	20	1.0	29.0	50

Subject objectives	1. To learn and understand the mechanism of interaction of acoustic waves with the seabed and methods of investigating the seabed using hydroacoustic, laser, gravimetric and magnetometric equipment. 2. To acquire the ability to analyse echograms and determine geological facies from them.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[HML3-W01] knows and understands, at an advanced level, 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	knows and understands, at an advanced level, the relationship between physical processes and geological processes occurring in the marine environment	[SW4] test/exam - oral or written
[HML3-W04] knows and understands, at an advanced level, 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	knows and understands, at an advanced level, the geological processes occurring in the marine environment, and defines methods for studying them; the application of geophysical methods in the identification of lithospheric structures	[SW4] test/exam - oral or written
[HML3-W08] knows and understands, at an advanced level, 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	knows and understands, at an advanced level, the principles of operation and use of measuring instruments employed in invasive and non-invasive seabed survey methods, including the principles of their calibration and accuracy assessment	[SW4] test/exam - oral or written
[HML3-W03] knows and understands, at an advanced level, directions of development and the latest discoveries in the field of scientific disciplines forming the theoretical basis appropriate to the field of study	knows and understands, at an advanced level, the geological processes occurring in the marine environment, and defines methods for studying them; the application of geophysical methods in the identification of lithospheric structures	[SW4] test/exam - oral or written
[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	knows and understands, at an advanced level, the geological processes occurring in the marine environment, and defines methods for studying them; the application of geophysical methods in the identification of lithospheric structures	[SW4] test/exam - oral or written

Subject contents

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 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 construction 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 acoustic seabed surveys, organisation of a survey cruise, survey methodology, new seabed survey techniques.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
colloquium	51.0%	100.0%

Recommended reading

Basic literature

1. STEPNOWSKI, A.: Systemy Akustycznego Monitoringu Środowiska Morskiego. GTN, Gdańsk 2001.1.
2. ŚLIWIŃSKI A.: Ultradźwięki i ich zastosowania. WNT, Warszawa 2001.2.
3. TĘGOWSKI J.: Akustyczna klasyfikacja osadów dennych. Wyd. Rozprawy i Monografie, IO PAN, 2006

	Supplementary literature	1. BLONDEL P.: The Handbook of Sidescan Sonar. Springer, 2009.1. 2. LURTON X.: An introduction to Underwater Acoustics. Principles and applications. Wyd. Springer, 2002.2. 3. MACLENNAN D. N., SIMMONDS E. J.: Fisheries Acoustics Theory and Practice. Blackwell Publishing Limited, 2005.3. 4. MEDWIN H., CLAY C. S.: Fundamentals of Acoustical Oceanography. Academic Press, Boston 1998.4. 5. MEDWIN H.: Sounds in the Sea. From Ocean Acoustics to Acoustical Oceanography. Cambridge University Press, New York 2005.5. 6. URICK R. J.: Principles of underwater sound. McGraw-Hill, 1975.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Geotechnical characteristics of bottom sediments - cohesiveness, granulometry, stratified structure. Surface sediment sampling equipment (core grab, box corers), sampling methods and initial analysis. Subsurface sediment sampling equipment (gravity core samplers, vibrotors), sampling methods and initial 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 bottom survey equipment, their construction, application, positioning system and dynamic corrections associated with them - single beam echosounder, multibeam echosounder, parametric echosounder, subbottom profiler, side scan sonar, side interference sonar, Range Gain Control (TVG). Underwater positioning - USBL and similar systems. GPS positioning - system design and operation, RTK corrections. Introduction to numerical analysis of linear and chirp acoustic signals. 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 seabed survey (AUV, ROV). Organisation of non-invasive seabed surveys. Research vessels adapted for acoustic seabed surveys, organisation of a survey cruise, survey methodology, new seabed survey techniques.	
Work placement	Not applicable	

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