

Subject card

Subject name and code	Hydroacoustic survey systems - lecture, PG_00131484						
Field of study	Marine Hydrography						
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 Subject group related to practical vocational preparation		
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							
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Artur Grządziel				
	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		20.0	52
Subject objectives	Providing knowledge of basic hydroacoustic devices and systems used in hydrographic surveying.Improving system configuration, assembly and operation skills.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[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		knows: - Principles of operation and use of survey devices and equipment used in hydrographic research, including the principles of their calibration and accuracy assessment		[SW4] test/exam - oral or written		
	[HML3-W12] basic processes taking place in the life cycle of devices, facilities and technical systems		knows: - Basic processes occurring in the life cycle of devices, objects and technical systems		[SW4] test/exam - oral or written		
	[HML3-W07] principles of operation and use of measuring instruments used in professional activities related to the field of study, including the principles of their calibration and assessment of accuracy		knows: - Principles of operation and use of sonar technology		[SW4] 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		knows: - Issues of measurements related to hydrographic studies of marine and inland waters and survey systems enabling the description, interpretation and presentation of research results.		[SW4] test/exam - oral or written		

Subject contents	Introductory classes. Development of hydroacoustic systems. Acoustic waves and their propagation in the aquatic environment. Speed of sound in water, properties of water, vertical distribution of sound speed in the water column. Refraction and path of acoustic rays in the water column. Construction and operation of the transducer, characteristics of the acoustic beam. Single beam echo sounders. Dual beam echo sounders, split beam echo sounders. Construction of SBES. Principle of operation of vertical echo sounders. Configuration, installation and operation of SBES. Selection of the appropriate range, scale, signal frequency, pulse sending frequency in terms of spatial resolution. SBP systems (sub-bottom profilers). Validation and calibration. Side-scan sonar systems. Principle of operation, structure, signal geometry and launching of SSS systems. Interpretation of data from a single-beam echosounder. Sonar images and causes of data distortions and disruptions. Swath technology systems. Properties of the acoustic beam. Transducer elements and matrices (antenna arrays). Beam forming and beam steering techniques. Phased and interferometric and multi-beam systems. Principles of operation, structure and geometry of MBES and interferometric systems (with phase measurement). Amplitude and phase detection method. Bottom coverage with measurements. Changes in the size of the acoustic trace and the spacing between beams. Installation of transducers on the hull and in the outboard mount. Monitoring the surface speed of sound and the velocity distribution in the water column. Operation (service). Gain, power and pulse length. Data quality control procedures. Configuration, installation and operation of the swath system. Control of acoustic parameters for optimal system operation. Application of quality control procedures in the process of data recording and online processing.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		51.0%	100.0%
Recommended reading	Basic literature	GRZĄDZIEL A.: Single-beam echosounder in hydrographic measurements. Przegląd Morski No. 4, DMW, Gdynia 2006. GRZĄDZIEL A.: The influence of the angular sector of multibeam echosounder radiation on the accuracy of the survey. Doctoral thesis, AMW, Gdynia 2019. GUCMA M., MONTEWKA J., ZIEZIULA A.: Technical navigation devices. Foundation for the Development of the Maritime University of Szczecin, Szczecin 2005. SALAMON R.: Hydrolocation systems. Gdańsk Scientific Society, Gdańsk 2006. STEPNOWSKI A.: Acoustic monitoring systems of the marine environment. Gdańsk, Scientific Society, Gdańsk 2001.	
	Supplementary literature	GRZĄDZIEL A., WAŹ M.: Estimation of effective swath width for dual-head multibeam echosounder, Annual of Navigation, 23, 2016. HAMMERSTAD E.: Multibeam Echo Sounder Accuracy. Internal Kongsberg Simrad Publication-EM Technical Note, February, 2001. IHO: C-13, Manual on Hydrography. 1st edition, February, 2011. LURTON X.: An introduction to Underwater Acoustics. Principles and applications. Ed. Springer, 2002. MEDWIN H., CLAY C. S.: Fundamentals of Acoustical Oceanography. Academic Press, Boston 1998.	
	eResources addresses		

Example issues/ example questions/ tasks being completed	Discuss the structure and principle of operation of a single-beam probe. Discuss the construction, principle of operation and purpose of a multibeam echosounder. Define the resolution of the sonar system. Types of devices for measuring the speed of sound in water. Technical parameters of side-scan sonar and their impact on data quality.
Work placement	Not applicable

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