University of Gdańsk

Subject card

Subject name and code	Hydroacoustic survey systems - lecture, PG_00131484		
Field of study	Marine Hydrography		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
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 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-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
[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-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-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

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., WĄŻ 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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