University of Gdańsk

Subject card

Subject name and code	Hydroacoustic Survey Systems - classes, PG_00201115						
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 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	1.0			
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	0.0	15.0	0.0	0.0	0.0	15
	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	15		1.0		9.0	25
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] 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 the principles of operation and use of measuring devices used in hydrographic research, including the principles of their calibration and accuracy assessment	[SW4] test/exam - oral or written
[HML3-W12] knows and understands, at an advanced level, the key processes occurring in the life cycle of devices, facilities, and technical systems	knows the basic processes involved in the life cycle of technical devices, facilities, and systems	[SW4] test/exam - oral or written
[HML3-U11] is able to use navigation devices, means of technical observation and communication as well as measuring instruments, as well as apply in practice various techniques of measurement and observation in the field of professional activity related to the field of study	is able to use measuring instruments and apply in practice various measurement and observation techniques in the field of hydrographic activities	[SU4] test/exam - oral or written
[HML3-U14] is able to use the applicable terminology in presenting and discussing problems related to the field of study	is able to use current terminology in presenting and discussing problems in the field of hydroacoustic survey equipment	[SU4] test/exam - oral or written
[HML3-U09] is able to critically analyse the functioning of existing technical solutions and evaluate these solutions	is able to critically analyze the functioning of existing technical solutions and evaluate these solutions	[SU4] test/exam - oral or written
[HML3-U02] is able to 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	is able to select and apply optimal measurement techniques in the field of research on the aquatic environment, as well as plan and carry out hydrographic measurements, develop the obtained results and interpret them properly	[SU4] test/exam - oral or written
[HML3-W07] 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 the principles of their calibration and assessment of accuracy	knows the principles of operation and use of sonar technology	[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 the 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-U13] is able to determine the technical condition of navigation and hydrotechnical infrastructure, as well as maintain navigation and hydrographic equipment and systems, both on board and on shore	is able to determine the technical condition and take care of devices and measurement systems used in research on the marine environment and inland waters	[SU4] 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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