Subject card

Subject name and code	Echolocation Systems, PG_00048131
Field of study	Electronics and Telecommunications

Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment

Conducting unit	Department of Marine Electronic Systems -> Faculty of Electronics, Telecommunications and Informatics

Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Roman Salamon
	Teachers	prof. dr hab. inż. Roman Salamon

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	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	45	3.0	27.0	75

Subject objectives	Understanding the basic principles, technical solutions and parameters of echolocation systems.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W35] Knows the concepts of the technique of signal transmission, operation of telecommunications networks and multimedia services and the rules for providing them	Student describes principles of operation, functional diagrams and signal processing algorithms in radars, sonars, ultrasonographs and echolocation alarm systems.	[SW1] Assessment of factual knowledge
	[K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications	He examines relationships occurring between technical and operating parameters of echolocation systems. He makes choice of echolocation system solutions and their operational parameters for tasks they meet in specific applications. He analyzes modes of technical implementation of systems in modern technology and compares their costs. He supports basic underwater acoustic devices and interprets the information obtained about observed environment.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	1. Course organization, requirements, consultations.
	2. General principles of echolocation systems functioning.
	3. Echolocation systems purposes and classification.
	4. Functional model of echolocation systems.
	5. Range, angular and range resolution, time of space sector scanning.
	6. Space sector scanning techniques.
	7. Single- and multi-beam systems.
	8. Narrowband sounding signals: time length, spectrum and autocorrelation function.
	9. Frequency modulated sounding signals: time length, spectrum and autocorrelation function.
	10. Ambignity function.
	11. Antennas of echolocation systems.
	12. Definition of directivity pattern.
	13. Techniques of directivity patterns determination.
	14. Examples of echolocation systems antennas directivity patterns.
	15. Directivity index.
	16. Source level.
	17. General characteristics of echolocation systems channels.
	18. Space distribution of propagation velocity.
	19. Refraction and wave propagation trajectories.
	20. Wave reflection, echolocation targets.
	21. Reverberations.
	22. Noises in echolocation channels.
	23. Receiver electric noise.
	24. Echo signals.
	25. Problem of echo signals detection and parameters estimation.
	26. Detection as testing of hypotheses.
	27. Reception of a known signal with Gaussian noise background, matched receiver.
	28. Reception sinusoidal signal of a unknown frequency with Gaussian noise background.
	29. Detection threshold.
	30. Receiver operation characteristics ROC.
	31. Receiver processing gain.
	32. Range equation.
	33. Range equation parameters.
	34. Determination of technical parameters of the system from the range equation.
	35. Techniques of echo signals imaging.
	36. Aviation radiolocation systems.
	37. Marine radiolocation systems.
	38. Acoustics waves in echolocation systems
	39. Hydrolocation systems in navigation, fishery and oceanology.
	40. Military hydrolocation systems.
	41. Ultrasonography.
	42. Defectoscopy.
	43. Summary.

Prerequisites and co-requisites	

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercise	60.0%	40.0%
	Midterm colloquium	60.0%	60.0%

Recommended reading	Basic literature	A. Nowicki "Diagnostyka ultradźwiękowa" Makmed, 2000 R. Salamon: Systemy hydrolokacyjne, Wyd. GTN, 2006 M. Skolnik: Radar Handbook, McGraw-Hill Professional, 2008
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	

Work placement	Not applicable