



Subject card

Subject name and code	Echolocation and Navigation Methods, PG_00064522						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	February 2025	Academic year of realisation of subject			2025/2026		
Education level	second-cycle studies	Subject group			Optional subject group Specialty 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	1	Language of instruction			English		
Semester of study	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Marine Electronic Systems -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jacek Marszał					
	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	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	4.0		16.0	50	
Subject objectives	The aim of the course is to acquaint students with the principle of operation, construction and parameters of radars, sonars and aeroacoustic systems used in automatic control and give them knowledge of methods and techniques of generation, emission, detection and imaging.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Student describes the principles of work, functional diagrams and signal processing algorithms of echolocation systems used in automatic control and robotics. He defines the technical and operational parameters of echolocation systems and analyzes relationships occurring between them.			[SW1] Assessment of factual knowledge		
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	He selects solutions of echolocation systems appropriate to tasks met in automatic control and robotics. He analyzes technical solutions of system for their realisability and costs.			[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<ol style="list-style-type: none"> 1. Course organization, requirements, consultations 2. General principles of echolocation systems functioning 3. Principles of microwave echolocation systems 4. Principles of microwave echolocation systems 5. Principles of laser echolocation systems 6. Application of echolocation systems in automatics and robotics 7. Functional model of echolocation systems 8. Range, angular and range resolutions, time of space sector scanning 9. Space scanning techniques 10. Single- and multi-beam systems 11. Sounding signals, spectra and autocorrelation functions 12. Ambiguity function 13. Antennas of microwave echolocation systems 14. Transducers and antennas of acoustic echolocation systems 15. Transmitters and detectors of laser echolocation systems 16. Directivity patterns 17. Directivity index 18. Source level 19. General features of echolocation systems channels 20. Space distribution of wave propagation velocity 21. Refraction and wave propagation trajectories 22. Wave reflection, echolocation targets 23. Reverberations 24. Noise in echolocation channels 25. Electric noise in receivers 26. Echo signals, Doppler effect 27. Signal detection and parameter estimation, detection and false alarm probabilities 28. Reception of a known signal with Gaussian noise background, matched receiver 29. Detection threshold, receiver operation characteristics 30. Range equation 31. Range equation parameters 32. Determination of system technical parameters from the range equation 33. Techniques of echo signal imaging 34. Methods of moving objects tracking 35. Review of technical solutions of microwave echolocation systems in automatics and robotics 36. Review of technical solutions of acoustic echolocation systems in automatics and robotics 37. Review of technical solutions of optical echolocation systems in automatics and robotics 38. Development trends in echolocation systems 											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Subject passing criteria</th> <th style="width: 30%;">Passing threshold</th> <th style="width: 30%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Written exam</td> <td>60.0%</td> <td>100.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Written exam	60.0%	100.0%			
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Example issues/ example questions/ tasks being completed												
Work placement	Not applicable											

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