GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optical Sensors and Advanced Measurement Methods I, PG_00056983		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
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	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Adam Mazikowski	
	Teachers	dr inż. Adam Mazikowski	

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

Provision of knowledge in the field of construction, classyfication and principle of operation of selected optical sensors, networks of these sensors and distributed optical fiber sensors as well as optical advanced measurement methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study	The student knows selected laws and physical phenomena used in optical sensors, as well as the physical basis of advanced optical measurement methods.	[SW1] Assessment of factual knowledge
[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	The student knows the general structure of optical sensors, classifies optical sensors, describes the principle of operation of intensity, phase and polarimetric sensors. The student presents the types and principles of operation of fiber-optic distributed sensors and fiber optic sensor networks. The student is able to present the construction and principle of operation of advanced measurement methods.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>1. Introduction. Construction of sensors. Transfer functions, basic proper-ties. 2. Classification of sensors. 3. Intensity sensors phenomena employed in sensors. 4. Sensors employing absorption, reflectance, termochromic effect. 5. Sensors employing modifications of propagation conditions 6. Sensors employing photoluminescence. 7. Sensors employing optical tunneling and surface plasmon resonance. 8. Sensors using detection of thermal radiation 9. Example designs of intensity sensors 10. Phase sensors 11. Phase modulation methods in singlemode fibres. 12. Phase demodulation techniques. 13. Temporal and spatial coherence of light beams. Autocorrelation and cross-correlation functions. Interference of partially coherent beams. 14. Transfer function of Mach-Zehnder and Michelson interferometers. 15. Homodyne and heterodyne detection of output signal from an optical sensors. 16. White light interferometers output signal detection and processing. 17. Selected applications of interferometers: temperature and stress meas-urement, optical fibre gyroscopes. 18. Polarimetric optical sensors. 19. Sensors with electrically controlled birefringence. 20. Sensors using optical activity. 21. Selected examples of polarimetric optical fibre sensors. 22. Sensors using selected nonlinear phenomena in optical fibres. 23. Sensors using spontaneous and stimulated Raman scattering in optical fibres. 24. Sensors using spontaneous and stimulated Brillouin scattering in optical fibres. 25. The use of spontaneous and stimulated Raman and Brillouin scattering in distributed optical fibre sensors. 26. Fibre Bragg Gratings, properties and classification. 27. Fibre Bragg Gratings as transducers of physical quantities. 28. Quasi-distributed sensors using Fibre Bragg Gratings. 29. Sensor networks. Multiplexing methods. 30. Time-domain multiplexing. 31. Frequency-domain multiplexing. 32. Wavelength-domain multiplexing. 33. Advanced measurement methods 34. X-ray interferometry</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>No requirements</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Midterm colloquium</td><td>50.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>T. Pustelny: Physical and technical aspects of optoelectronic sensors, Wyd. Polit. Śląskiej, Gliwice 2005 Z. Kaczmarek: Światłowodowe czujniki i przetworniki pomiarowe, Agenda Wydawnicza PAK, Warszawa 2006</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Discuss the advantages and disadvantages of intensity optical sensors.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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