



Subject card

Subject name and code	Modern Photonic Devices and Circuits, PG_00048688						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2023/2024		
Education level	second-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	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			exam		
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	15.0	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		6.0		24.0	75
Subject objectives	The aim of the course is to familiarize students with the basic photonic devices and systems, the principle of their operation, the parameters and possibilities of their use in metrology, medicine and industry.						

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	He knows the physical phenomena used in photonic elements, knows the effects associated with the relinquishing of optical radiation on matter.	[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.	He knows the basic features of modern photonic devices and systems, knows the structure of optical memories with 2D and 3D recordings and their parameters, knows the structure and operation principle of multi-and single-shot correlators to measure the duration and correlators working in the field of time and frequency for measuring the shape of ultrashort laser pulses. Explains the principle of operation of optical time patterns and methods for measuring the frequency of tera and petahertz optical signals using mixers or "optical comb"	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge
	[K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions	He is able to analyze the actions of elements using non-linear optical phenomena.	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject
K7_K02	He is ready to critically assess the impact of photonics on solving problems related to information processing and transmission.	[SK4] Assessment of communication skills, including language correctness	
Subject contents	<ol style="list-style-type: none"> 1. Introduction, definition of photonic system, the main areas of applications of photonics. 2. Bandwidth of photonic systems, integration of photonic systems with electronic, optoelectronic or integrated optic systems. 3. Density limit of 2D optical memory, diffraction limit, methods of increasing of the recording density. 4. Density limit of 3D optical memory, contrast limit. 5. Holographic Storage Systems physical principles. 6. Optical memories, write once memories, rewriteable memories. 7. Photorefractive crystals, two-photon photorefractive materials, long-life photorefractive materials. 8. Optical operating memory. 9. Properties of nonlinear optical materials. 10. Second or higher harmonic generation phase condition, application of nonlinear birefringent materials for second or higher harmonic generation. 11. Optical correlators: multi-shot correlator, one-correlator. 12. Spectral phase interferometry for direct electric-field reconstruction (SPIDER) correlator. 13. Frequency-resolved optical gating (FROG) correlator, GRating-Eliminated No-nonsense Observation of Ultrafast Incident Laser Light Efields (GRENOUILLE) correlator. 14. Modulation of optical radiation. 15. Ultrafast optical logic gates physical limitations (switching time, switching energy). 16. Pico- and femtosecond pulse propagation in selected materials. 17. Femtosecond pulses handling, multi- and demultiplexation of femtosecond pulses. 18. Processing in highspeed optical systems. 19. Conditions of solitons generation and transmission, interactions between solitons. 20. Requirements for petabyte telecommunication optical systems. 21. Optical switches micromirror switches, electrically controlled Bragg mirrors, electro-holographic switches. 22. Photonic routers. 23. Photonic time standards. 		
Prerequisites and co-requisites	No requirements		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Presentation	50.0%	40.0%
	Exam	50.0%	60.0%

Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. S. O. Kasap: Optoelectronics and Photonics: Principles and Practices. Prentice Hall, Upper Saddle River, New Jersey, 2001. 2. F. Träger: Springer Handbook of Lasers and Optics. Springer, Berlin, 2007. 3. A. N. Luiten: Frequency Measurement and Control; Advanced Techniques and Future Trends. Springer, Berlin, 2001. 4. B. E. Bouma, G. J. Tearney: Handbook of Optical Coherence Tomography. Marcel Dekker Inc., New York, 2002. 5. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 2nd Edition. John Wiley & Sons, New York, 2007. 6. P. Kaye, R. Laflamme, M. Mosca: An Introduction to Quantum Computing. Oxford University Press, New York, 2007.
	Supplementary literature	No requirements
	eResources addresses	<p>Adresy na platformie eNauczenie:</p> <p>Współczesne przyrządy i układy fotoniczne 2023_2024 - Moodle ID: 32174</p> <p>https://enauczenie.pg.edu.pl/moodle/course/view.php?id=32174</p>
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	