GDAŃSK UNIVERSITY OF TECHNOLOGY

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 2024	Academic year of realisation of subject	2024/2025
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_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
[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.	[SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
[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"	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
[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

Subject contents

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
Exam	50.0%	60.0%
Presentation	50.0%	40.0%

Recommended reading	Basic literature	1. S. O. Kasap: Optoelectronics and Photonics: Principles and Practices. Prentice Hall, Upper Saddle River, New Jersey, 2001. 2. F. Täger: 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	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	