GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fundamentals of Optical Fibers and Photonics, PG_00048292		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Metrology and Electronic Systems Department -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jerzy Pluciński	
	Teachers	dr hab. inż. Jerzy Pluciński	

Lesson types							
	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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 familiarize students with complex physical phenomena occurring in optical fibers, affecting their performance, with optical fibers used in telecommunications, specialty optical fibers, as well with advanced techniques of optical signal transmission, the construction of photonic devices, including chirp filters and devices using nonlinear optical phenomena.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W08] knows and understands, to an increased extent, the fundamental dilemmas of modern civilisation, the main development trends of scientific disciplines relevant to the field of education	He knows development trends related to increasing the fiber transmission speed and requirements for photonic devices used in systems with high binary rates.	[SW1] Assessment of factual knowledge
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	He can use the knowledge of optics in the interpretation of measurement results of modern fiber optic and photonic components or systems.	[SU1] Assessment of task fulfilment
[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 associated 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 and understands, to a greater extent, the structure and operation of fiber optics, chirp filters, elements that use non-linear optical phenomena.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

1. Introduction (recommended literature, historic outline of developments in the fields of fibre optics and photonics).
2. Wave and electromagnetic description of modal propagation in optical fibre.
3. Analysis of mode coupling in optical fibres and its applications (directional couplers, Fibre Bragg Gratings).
4. Nonlinear phenomena in optical fibres.
5. Optical solitons and their applications.
6. Optical noise (intensity, phase and modal noise) and their impact on the transmission properties of optical fibres.
7. Photonic Crystals and Photonic Crystal Fibres.
8. Introduction to photonics definition of a photonic circuit and device, physical phenomena, transmission bandwidth of photonics circuits.
9. Nonlinear phenomena in photonic circuits.
10. Optical mixers gain, phase matching.
11. Optical amplifiers using stimulated emission and Raman scattering.
12. Selected photonic devices (logic gates, (de)multiplexers, optical routers).
13. Photonic measurement methods.
14. Optical interconnects in microelectronics.

Course content – laboratory

1. Risks associated with the use of laser devices.
2. Connecting optical fibers.
3. Optical fiber Bragg gratings.
4. Optical time-domain reflectometer.
5. Quantum cryptography.
6. Optical tweezers.

Prerequisites and co-requisites

No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Active participation during laboratory exercises - all laboratory exercises must be passed	50.0%	20.0%
Colloquium - all topics from lectures	50.0%	80.0%

Recommended reading	Basic literature	1. Y. S. Kivshar, G. P. Agrawal: Optical Solitons: From Fibers to Photonic Crystals. Academic Press, San Diego, 2003. 2. J. D. Joannopoulos, S. G. Johnson, J. N. Winn, R. D. Meade: Photonic Crystals: Molding the Flow of Light, 2nd Edition. Princeton University Press, Princeton, 2008. 3. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 3rd Edition. John Wiley & Sons, New York, 2019. 4. G. P. Agrawal: Nonlinear Fiber Optics, 4th Edition (Optics and Photonics). Academic Press, London, 2006. 5. F. Täger: Springer Handbook of Lasers and Optics. Springer, Berlin, 2007. 6. K. Sakai - Terahertz Optoelectronics. Springer, Berlin, 2005. 7. B. Ziętek: Lasery, wyd. 2 rozszerzone i poprawione. Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, Toruń 2009.
	Supplementary literature	1. J. Pluciński: Lasery w medycynie, Rozdział 8 - Warunki bezpieczeństwa stosowania laserów, klasy laserów. Wydawnictwo Politechniki Gdańskiej, 137 s., Gdańsk, 2015.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Practical activites within the subject	Not applicable	

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