GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optical Data Transmission and Information Processing, PG_00048094		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2024/2025
Education level	first-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	4	Language of instruction	Polish
Semester of study	7	ECTS credits	4.0
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 hab. inż. Jerzy Pluciński	
	Teachers	dr hab. inż. Jerzy Pluciński	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	15.0	0.0	60
	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	60	4.0	36.0	100

Subject objectives	The aim of the course is to familiarize the student with the problems associated with optical processing of information and its transmission from the point of view of optical devices and systems, as well as to teach students to design these systems, taking into account these phenomena. In particular, the aim of the course is to familiarize students with problems resulting from diffraction and its impact on the transmission of optical signals in space, as well as optical information processing methods, including methods that use holograms (e.g. in optical correlators).

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W02] Knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	He knows the concept of Fresnel and Fraunhofer diffraction. He knows the concept of spatial frequencies of electromagnetic waves and the impact of optical elements on changes in their distribution as a result of the phenomenon of diffraction.	[SW1] Assessment of factual knowledge
[K6_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	He able to perform experiments related to optical radiation diffraction in near and far field and able to build a simple 4f optical correlator and filter spatial frequencies on it.	[SU1] Assessment of task fulfilment
[K6_U03] can design, according to required specifications, and make a simple 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 able to design measuring systems using the phenomenon of diffraction. He able to design an optical system for sending information in free space.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
[K6_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	Using the phenomenon of diffraction, he can determine the dimensions of submillimeter objects (e.g., dimensions of slits, diameter of microspheres, optical fibers, thin wires).	[SU1] Assessment of task fulfilment
[K6_W03] Knows and understands, to an advanced 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 explains the rules for recording and reproducing holograms, explains the principle of coherent optical processors, including optical correlators for image recognition.	[SW1] Assessment of factual knowledge

Subject contents

1. Description of optical signals for optical data transmission and processing.
2. Monochromatic plane waves, spatial frequency.
3. Description of optical radiation using the analytical signal model, relationships between the analytical signal and physical fields.
4. Linear optical systems, transfer function of an optical system in the spatial frequency domain.
5. Impulse response of and optical system in the time and space domain.
6. Comparison of the transmission of optical signals in the free space and in optical fiber.
7. Optical system as a filter of spectral and spatial frequencies.
8. Diffraction as a result of the Huyghensa-Fresnel principle.
9. Fresnel and Fraunhofer diffraction.
10. Optical beam having extremely small divergence.
11. Transformation properties of lens and mirrors.
12. Principles of optical holography for information processing.
13. Setups for recording of holograms: Gabor hologram, Leith-Upatnieks hologram, Denisiuk hologram; reconstruction of holograms.
14. Plane holograms definition, properties, real object image, virtual object image.
15. Basic holographic equations.
16. Volume holograms definition, properties, real object image, virtual object image.
17. Hologram as a spatial filter for information processing.
18. Computer-generated holograms by Lohmann's method.
19. Computer-generated holograms by Lee's method.
20. Coherent processing of optical signals: optical processors, pattern recognition.
21. 4f optical processor.
22. Spatial frequencies filtering by Van der Lugt fitted filters.

Prerequisites and co-requisites

No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Project	50.0%	20.0%
Written exam	50.0%	50.0%
Activity/presence	50.0%	15.0%
Practical exercise	50.0%	15.0%

Recommended reading	Basic literature	1. M. Born, E. Wolf: Principles of Optics, 7th (expanded) Edition. Cambridge University Press, Cambridge, 2003. 2. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 2nd Edition. John Wiley & Sons, New York, 2007. 3. K. Gniadek: Optyczne przetwarzanie informacji. PWN, Warszawa, 1992.
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	