GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optical Techniques in Medicine, PG_00068808		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	3.0
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	30.0	0.0	15.0	0.0	0.0	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	5.0	25.0	75

Subject objectives	The aim of the course is to obtain by the student the knowledge and skills in the field of means and methods using the achievements in optics in medicine, in particular in diagnostics and medical therapy.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	knows and understands the structure and principle of operation of selected devices and devices using optical radiation in medicine, in particular in medical diagnostics and therapy.	[SW1] Assessment of factual knowledge
[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	knows and understands theories related to the propagation of optical radiation in free space and a material medium, the mechanisms of optical radiation influence on tissues, physical phenomena accompanying the propagation of optical radiation in tissues.	[SW1] Assessment of factual knowledge
[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	able to analyze the functioning of optical systems used in medicine and to apply them in measuring selected biomedical parameters, such as optical spectra, optical properties of highly scattering tissues, and wavefront curvature for ophthalmic applications.	[SU1] Assessment of task fulfilment
[K7_W53] knows and understands, to an increased extent, selected aspects of biomedical diagnostics	knows and understands selected aspects of using optical radiation in biomedical diagnostics, including, in particular, optical imaging methods (optical coherence tomography, photoacoustic tomography, etc.).	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

1. Introduction.
2. Basic information on the knowledge of optics used in optical techniques in medicine.
3. Basic optical properties of tissues.
4. Methods of describing radiation propagation in tissues.
5. Phenomena and effects of the influence of optical radiation on tissues.
6. Safety standards related to the use of optical radiation sources.
7. Optical technical means used in medicine.
8. Physical basis of operation and parameters of optical radiation sources used in medicine, with particular emphasis on continuous and pulsed lasers.
9. Advantages of using lasers in medicine.
10. Optical detectors used in medicine.
11. Optical diagnostic systems.
12. Optical diagnostic methods.

Course content – laboratory

1. Optical tweezers.
2. Construction of an interferometer.
3. Raman spectroscopy.
4. ShackHartmann sensor.
5. Measurement of scattering medium parameters.
6. Construction of an optical spectrometer.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	50.0%	60.0%
Laboratory exercises	50.0%	40.0%

Recommended reading	Basic literature	1. O. Svelto, D. C. Hanna: Principles of Lasers, 5th Ed. Springer, New York, 2010. 2. H. Jelinková: Lasers for medical applications: Diagnostics, therapy and surgery. Woodhead Publishing, Oxford, 2013. 3. J. Popp, V.V. Tuchin: Handbook of Biophotonics, Vol. 1-3. Wiley-VCH, Bellingham, Washington, 2011. 4. M. H. Niemz: Laser-Tissue Interactions: Fundamentals and Applications, 3rd Ed, Springer, Berlin, 2007. 5. B. Saleh: Introduction to Subsurface Imaging. Cambridge University Press, Cambridge, 2011. 6. K. Barat: Laser Safety Management. CRC, Boca Raton, 2006.
	Supplementary literature	1. M. Born, E. Wolf: Principles of Optics, 60th Anniversary Edition. Cambridge University Press, Cambridge, 2019. 2. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 3rd Edition. John Wiley & Sons, New York, 2019. 3. F. L. Pedrotti, L. M. Pedrotti, L. S. Pedrotti: Introduction to Optics, 3rd Ed. Pearson, New York, 2006. 4. E. Hecht: Optyka. PWN, Warszawa, 2016. 5. E. Hecht: Optics, 5th Edition. Pearson, Essex, 2017. 6. I. M. Sobol: Primer for the Monte Carlo Method. CRC Press, Boca Raton, 1994. 7. R. A. Chipman - Polarized Light and Optical Systems. CRC Press, Boca Raton, 2018. 8. D.H. Goldstein - Polarized Light, 3rd Ed. CRC Press, Boca Raton, 2011. 9. S.O. Kasap: Optoelectronics and Photonics - Principles and Practices, 2nd Ed. Pearson Education Limited, Boston, 2013. 10. F. Täger: Springer Handbook of Lasers and Optics, Springer, Berlin, 2007. 11. J. Hecht: Understanding Lasers; An Entry-Level Guide, 3rd Ed. John Wiley & Sons, New York, 2008.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Practical activites within the subject	Not applicable	

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