University of Gdańsk

Subject card

Subject name and code	Microscopy Techniques, PG_00207071						
Field of study	Medical Physics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2026/2027			
Education level	Bachelor's studies		Subject group	Obligatory subject group in the field of study Optional subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	3		Language of instruction	Polish			
Semester of study	6		ECTS credits	3.0			
Learning profile	academic		Assessment form	credit			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Anna Synak				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	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		0.0		0.0	30
Subject objectives	The aim of the course *Microscopy Techniques* is to familiarize students with the physical principles underlying the operation of various types of microscopes, including optical, electron, ion, ultrasonic, and other advanced imaging systems. Students will learn the principles of image formation in different microscopy techniques as well as the factors affecting image resolution. The course covers the research capabilities of individual microscopy methods and the limitations associated with their application to different types of samples and materials. It also addresses the use of microscopy techniques in the natural sciences, engineering, and medicine.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_K01] knows the limitations of his own knowledge and understands the need for further education	The student: -is aware of the limitations of their own knowledge in the field of microscopy techniques and is able to identify areas requiring further study and development; -understands the need for continuous updating of knowledge regarding modern microscopy methods and their applications in medical and natural sciences; -demonstrates readiness to independently seek scientific information and improve competencies related to microscopic imaging techniques; -recognizes the importance of lifelong learning in the context of the dynamic development of research methods and microscopy instrumentation.	[SK4] test/exam - oral or written
FIZMEDL3_W32	The student: -knows the physical principles underlying microscopy techniques used in biomedical research and medical diagnostics; -understands image formation processes in optical, electron, ion, and scanning probe microscopy; -knows the factors affecting the quality and resolution of microscopic images and understands their importance in the analysis of biological specimens; -understands the capabilities and limitations of various microscopy methods applied in medicine, biology, and biomedical sciences; -knows the applications of modern microscopy techniques in the study of cells, tissues, biomaterials, and medical diagnostics; -understands the importance of selecting an appropriate microscopy technique according to the type of specimen and the purpose of the investigation.	[SW4] test/exam - oral or written

Subject contents

- Fundamental principles of geometrical and wave optics used in microscopic imaging techniques.
- Resolving power of optical systems and factors limiting image resolution.
- Lens and mirror aberrations and methods for their correction.
- Structure, operating principles, and performance parameters of optical microscopes.
- Advanced optical microscopy techniques, including stereoscopic, phase-contrast, polarized light, interference-polarization, fluorescence, and confocal microscopy.
- Electron microscopy (SEM, TEM) and ion microscopy: principles of operation, capabilities, and areas of application.
- Scanning probe microscopy techniques, including scanning tunneling microscopy (STM) and atomic force microscopy (AFM).
- Holographic and ultrasonic microscopy.
- Technical limitations of various microscopy methods.
- Sample preparation for microscopic examinations and the impact of specimen preparation on image quality.
- Applications of microscopy techniques in natural sciences, medicine, biomedical sciences, and engineering.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
test	51.0%	100.0%

Recommended reading	Basic literature	LITERATURA [1] M. Pluta, Mikroskopia optyczna, PWN, W-wa, 1980. [2] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, t. 4, PWN, 2012. [3] E. Hecht, Optyka, PWN, 2012. [4] R. Howland, L. Benater, STM/AFM Mikroskopy ze skanującą sondą. Elementy teorii ipraktyki, W-waa, 2002. [5] P. Eaton, P. West, Atomic Force Microscopy, Oxford University Press, 2010. [6] A. Barbacki, Mikroskopia elektronowa, Wyd. Politechniki Poznańskiej, 2005. [7] W. Dziadur, J. Mikuła, Mikroskopia elektronowa, transmisyjna, skaningowa, tom 1, tom 2,Kraków 2016. [8] E. U. Kurczyńska, D. Borowska-Wykręt, Mikroskopia świetlna w badaniach komórkiroślinnej, PWN, 2007. [9] J.Liu, J.Tan, Confocal Microscopy, Morgan&Claypool Publishers, 2016r. [10] A. Ho-Pui Ho, D. Kim, M.G.Somekh (Editors) Handbook of Photonics for BiomedicalEngineering, Springer, 2017. [11]D.B. Murphy, Fundamentals of Light Microscopy and Imaging, John Wiley and Sons,2001r [12] J.A.Litwin, M. Gajda, Podstawy technik mikroskopowych, Wydawnictwo UniwersytetuJagiellońskiego, 2011. [13] Strony producentów mikroskopów np.:Nikon andOlympus: http://www.microscopyu.com/ , http://www.olympusmicro.com/A , https://www.ntmdt-si.com/page/resources [14]Springer Handbook of Microscopy
	Supplementary literature	[1] T.P.Gotszalk, Systemy mikroskopii bliskich oddziaływań w badaniach mikro inanostruktur, Oficyna Wydawnicza Politechniki Gdańskiej, 2004. [2] M. Abramowicz a M. W. Davidson, Microscope Objectives: Numerical Aperture andResolution. Florida State University. [3] M. W. Davidson, Basic Concepts and Formulas in Microscopy: Numerical Aperture. [4] M. Wędzony, Mikroskopia fluorescencyjna dla botaników, Kraków, 1996. [5] P. Schwille and E. Haustein, Fluorescence correlation spectroscopy, an introduction to itsconcepts and applications, Biophysics Textbook Online (BTOL), 133, 2004. [6] J. Pawley (Editor), Handbook of Biological Confocal Microscopy (any edition). [7] L.W. Kessler, Acoustic Microscopy, Metals Handbook, vol.17, ASM International,465-482,1989. [8] P. Zinin, W. Weise, Theory and application of acoustic microscopy, (ed. T. Kundu)Ultrasonic Nondestructive Evaluation: Engineering and Biological Material Characterization,CRC Press, ch.11, 654-724, 2004. [9] A. Kałużny, Mikroskopia fluorescencyjna w badaniach struktury i funkcji komórek,Kraków,2011. [10] J. Dobrucki, Skaningowa, fluorescencyjna mikroskopia konfokalna. MikrobiologiaMedycyna, 34-38, 1996.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

Document generated electronically. Does not require a seal or signature.