COURSE CONTENT

(1) GENERAL INFO

SCHOOL	ENGINEERING			
DEPARTMENT	BIOMEDICAL ENGINEERING			
MSc PROGRAM	BIOMEDICAL ENGINEERING AND TECHNOLOGY			
STUDY LEVEL	POSTGRADUATE, MSc			
COURSE CODE	**BMET1010**	**SEMESTER**	**A**	
COURSE TITLE	**Optical Microscopy**			
TEACHING			**HOURS**	**ECTS**
	LECTURES AND WORKSHOPS		26	5
COURSE TYPE	SPECIALIZATION			
COURSE REUIREMENTS:	-			
TEACHING AND EXAMINATION LANGUAGE:	ENGLISH			
IS THIS COURSE OFFER TO ERASMUS STUDENTS	YES (IN ENGLISH)			
COURSE WEBPAGE (URL)	https://eclass.uniwa.gr/courses/306/			

(2) LEARNING OUTCOMES

Learning outcomes

Course Objectives:
This course provides a comprehensive introduction to optical microscopy, covering fundamental concepts, historical developments, and the essential technologies and components of optical microscopes. It extends to the physics of light, the interaction of light with matter, and the function of the human visual system. The course discusses the fundamental optical elements and concepts crucial for microscopy, including lenses, filters, magnification, focus, diffraction, and resolution. Students will gain insights into various types of optical microscopes and their components, with a focus on practical applications in medicine and biology. Additionally, the course addresses advanced topics in digital image processing and analysis tailored for microscopy images.

Learning Outcomes:
By the end of this course, students should be able to:

1. Demonstrate a solid understanding of the fundamental concepts of optical microscopy,
2. Understand the physics of light, the human visual system and the interaction of light with matter,
3. Recognize and differentiate between various types of optical microscopes, such as bright-field, phase-contrast, dark-field, polarization, fluorescence, confocal, and super-resolution microscopes,
4. Recognize, differentiate and understand the functions of basic elements of the microscope, such as filters, prisms, diaphragms, objectives, eyepieces, condensers, lenses, microscope stage, digital detectors, and light sources,
5. Evaluate and engage in a critical analysis to differentiate the application domain in medicine and biology of each different microscopy technique,
6. Develop analytical and problem-solving skills in digital image processing and analysis, allowing for the extraction of meaningful information from microscopy images.

Achievement of Course Objectives and Learning Outcomes:
To achieve the above, the course will provide students with a systematic introduction to the basic concepts of optical microscopy, demonstration and experimentation of optical microscopes with real-world medical data.

General abilities
• Search, analysis and synthesis of data and information, using the necessary technologies • Adaptation to new situations • Decision-making • Autonomous work • Teamwork • Working in an international environment • Working in an interdisciplinary environment

(3) COURSE CONTENT

"Introduction to Optical Microscopy"
Fundamental concepts, historical evaluation, basic parts of an optical microscope.

"Light and Color, Human Visual System, Light and Matter Interaction"
Physics of light, nature of light, color spectrum, interaction of light with matter, human visual system.

"Magnification, and Resolution"
Role of lenses in image formation, magnification, resolution, diffraction and resolution, focus.

"Optical Microscopes Technologies, microscope elements"
Bright-field microscopes, phase-contrast microscopes, dark-field microscopes, polarization microscopes, fluorescence microscopes, confocal microscopes, super-resolution microscopes, filters, prisms, diaphragms, objectives, eyepieces, condensers, lenses, microscope stage, digital detectors, light sources, etc.

"Applications of Microscopy in Medicine and Biology"
Applications of microscopy in the fields of medicine and biology, such as applications in cytology (the study of cells) and histopathology (the study of tissues). Biological sample preparation and processing.

"Digital Image Processing and Analysis for Microscopy Images"
Contrast enhancement, filtering, deconvolution, segmentation, classification.

(4) TEACHING AND LEARNING METHODS - EXAMINATIONS

<table>
<tr><td>COURSE DELIVERY</td><td>Physical presence, face to face at the auditorium</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</td><td>The course involves the use of a projector for presenting fundamental concepts and is supplemented by the use of the blackboard at the auditorium.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Teaching / lectures</td><td>26</td></tr>
<tr><td>Lecture material study</td><td>30</td></tr>
<tr><td>Unsupervised literature review and preparation of the final project</td><td>69</td></tr>
<tr><td>Total</td><td>125</td></tr>
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<tr><td>STUNDET EVALUATION</td><td>100% Final examination with multiple-choice, short-answer and problem-solving questions, and/or individual written work and presentation.</td></tr>
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(5) SUGGESTED LITERATURE

Books, scientific articles and related scientific resources:

[1] Microscopy Primer, Olympus, https://www.olympus-lifescience.com/en/microscope-resource/primer/.
[2] Murphy D., Fundamentals of light microscopy and electronic imaging, John Wiley & Sons, 2001 (http://www.biology.uoc.gr/courses/BIOL493/documents/book.pdf).
[3] Tuan Vo-Dinh et al, Biomedical Photonics Handbook, CRC PRESS, 2003.
[4] Fercher et al, Optical coherence tomography—principles and applications**,** Rep. Prog. Phys. 66:239–303, 2003.
[5] So et al, Two photon excitation fluorescence microscopy, Annu Rev Biomed Eng 02:399–429, 2000.
[6] Peter W. Hawkes, John C.H. Spence, Science of microscopy, Springer, 2007.
[7] David L. Spector, Robert D. Goldman, Basic methods in microscopy: protocols and concepts from cells: a laboratory manual, Cold Spring Harbor Laboratory Press, 2006.

Scientific journals:

[1] Microscopy Research and Technique, https://analyticalsciencejournals.onlinelibrary.wiley.com/journal/10970029.
[2] Imaging & Microscopy, https://analyticalscience.wiley.com/publication/imaging-and-microscopy.
[3] Journal of Biomedical Optics, https://www.spiedigitallibrary.org/journals/journal-of-biomedical-optics?SSO=1.
[4] Journal of Advanced Microscopy Research, http://www.aspbs.com/jamr.html.