50:750:430 – Optical Microscopy

Instructor	Dr. Julie Griepenburg	**E-mail**	j.griepenburg@rutgers.edu
Phone	856-225-6293	**Office Hours**	By arrangement
Office	CNS 216E	**Final Exam**	TBA

Class meeting time: Tuesday, 6 p.m. – 8:50 p.m.

Description: Optical microscopy is an invaluable tool in a broad range of scientific research, ranging from geology to pharmacology, however, its foundations are planted in physics. This course is designed to provide students with a comprehensive survey of optical microscopy techniques through a series of lectures and hands-on demonstrations. Students will begin by learning the fundamentals of optical image formation and microscope design, and this foundation will be built upon with particulars that characterize specific techniques. Optical microscopy techniques that will be covered include brightfield, darkfield, and phase-contrast microscopy, fluorescence microscopy, confocal laser scanning microscopy, multiphoton laser scanning microscopy, as well as super-resolution techniques. Advanced topics in fluorescence microscopy will be discussed, including TIRF, FRET, FRAP, and probe selection.

Pre-requisite: N/A, but introductory physics II (General or Elements) is strongly recommended.

Specific Student Learning Outcomes (SLOs) Objectives:

1. Identify the basic components of a microscope and how they work together to form images.

2. Describe the function of different optics and how they relate to image formation

3. Understand different optical microscopy techniques in terms of how they work, what their benefits and limitations are for techniques including brightfield, darkfield, and phase-contrast microscopy, fluorescence microscopy, confocal laser scanning microscopy, multiphoton laser scanning microscopy, as well as super-resolution techniques.

4. Gain the ability to understand the use of optical microscopy techniques in scientific literature with a discerning eye. For example, was the technique well suited for the application?

Class Resources:

Our course website can be found on Canvas. All course materials, announcements, grades, and assignments will be posted here.

Required Book:

Fundamentals of Light Microscopy and Electronic Imaging

Douglas B. Murphy, Michael W. Davidson

2nd Edition, Wiley, 2012

Free access to this book is available through Proquest Ebook Central:

https://ebookcentral.proquest.com/lib/rutgers-ebooks/detail.action?docID=918267

Any supplemental readings will be posted on Canvas if they are not readily available through Rutgers University Library.

Grading

Your grade will be calculated based on the following activities:

Exams (1 mid-term, 1 final)	20% each, total of 40%
Journal club presentations (3 total)	10% each, total of 30%
Journal club written summaries (3 total)	~7% each, total of 20%
Attendance/participation for hands-on activities	10%

Letter grades will be assigned based on the following ranges:

A	89.50 - 100%	C	66.50 - 75.49%
B+	86.50 - 89.49%	D	55.50 - 66.49%
B	79.50 - 86.49%	F	<55.49%
C+	75.50 - 79.49%		

*Please note, these numbers already reflect rounding

Instructor's Statement:

- Do not engage in any form of academic dishonesty. I will report all violations of academic integrity to the University. If you do not know what academic dishonesty is, please consult this statement: Rutgers University Academic Integrity Policy
- Do not excessively use cell phones in class or disrupt class in any way. If you do so, you will be asked to leave.
- You are not permitted to record class.
- Attendance is strongly suggested at all class meetings, however will not count towards your final grade. Attendance for hands-on activities will count as your participation grade (10%).

Proposed topic by week (*subject to change based on pace/time availability):

Week	Date	Lecture	Suggested Reading	Exam	Assignment
1	Jan 25	Lecture 1: Fundamentals of microscopy Lecture 2: Light and color	Chapter 1 Chapter 2	--	
2	Feb 1	Hands on: Koehler Illumination Lecture 1: Filters and wavelength isolation Lecture 2: Lenses and Optics	 Chapter 3 Chapter 4	--	
3	Feb 8	Lecture 1: Diffraction and interference Lecture 2: Diffraction and spatial resolution	Chapter 5 Chapter 6	--	
4	Feb 15	Lecture 1: Phase contrast microscopy Lecture 2: Darkfield microscopy	Chapter 7	--	
5	Feb 22	Lecture 1: Properties of polarized light Lecture 2: Polarization microscopy	Chapters 8 Chapter 9	--	Journal Club Presentation and written summary

6	March 1	Lecture 1: Fluorescence Microscopy Lecture 2: Fluorescence imaging of dynamic processes	Chapter 11 Chapter 12	--	
7	Mar 7	Hands on demonstration: Fluorescence microscopy		Mid-term exam (in-class)	
8	Mar 15	Spring break – no class		--	
9	Mar 22	Lecture 1: Confocal laser scanning microscopy	Chapter 13		Journal Club presentation and written summary
10	Mar 29	Hands on demonstration: Confocal		--	
11	Apr 5	Lecture 1: Two-photon excitation microscopy	Chapter 14	--	
12	Apr 12	Lecture 1: Superresolution	Chapter 15	--	
13	Apr 19	Lecture 1: Digital imaging fundamentals	Chapter 17	--	
14	Apr 26	Lecture 2: Digital imaging processing	Chapter 18	--	Journal Club presentation and written summary
15	May 3	Reading day – no class		--	
16	May 10			Final exam (in-class)	