City University of Hong Kong
Course Syllabus

offered by Department of Biomedical Engineering
with effect from Semester B 2023/24

Part I Course Overview

Course Title:	Advanced Optical Microscopy for Biomedical Engineering
Course Code:	BME8140
Course Duration:	1 semester
Credit Units:	3 credits
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	BME6140 Advanced Optical Microscopy for Biomedical Engineering
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course will provide students with a comprehensive overview of optical microscopy and various imaging technologies, including the latest advances. The course will start with basic concepts in optics, explaining how light-matter interactions generate contrast for imaging, and cover practical basics in optical microscopy. The course will then cover various optical microscopy modalities: widefield, structured illumination, confocal, multiphoton, and light sheet microscopies. The course will also introduce other advanced imaging techniques, including adaptive optics, label-free microscopy, and super-resolution imaging methods. In addition, the course will introduce recent advances in how artificial intelligence (AI) is applied in optical imaging. Upon completion of this course, students will become familiar with all the available options and develop the ability to choose the right tool for their future studies.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs	Weighting	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	**Understand** basic concepts in optics, different contrast mechanisms, and practical basics in optical microscopy.		✓	✓	
2.	**Understand** the principles of various imaging modalities and advanced imaging techniques.		✓	✓	
3.	**Understand** how AI is applied for optical biomedical imaging.		✓	✓	
4.	**Evaluate** current literature and **present** scientific written and oral reports on relevant topics.		✓	✓	✓
		N.A.			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Explain concepts and principles of optical imaging	✓	✓	✓	✓	2 hours/week
Tutorial / Quiz	Solve problems based on concepts discussed during lectures	✓	✓	✓	✓	1 hour/week
Mini-project	Prepare oral and written proposals on topic of choice through literature review.		✓	✓	✓	N.A.

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 60%						
Assignments & Quizzes	✓	✓	✓	✓	25 %	Assignments & Quizzes based on course modules discussed during the lectures
Individual term project (report + presentation)	✓	✓	✓	✓	35 %	Individual term project based on written report and/or oral presentation. The project will focus on review of a student-selected imaging technology and its biomedical applications
Examination: 40% (duration: 2 hours)						
Examination	✓	✓	✓	✓	40%	Final exam at the end of semester on questions based on coursework discussed in the lectures
					100%	

5. Assessment Rubrics

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C,)	Failure (F)
1. Assignment	Ability to describe in detail concepts in optics and optical microscopy, principles of different imaging modalities / techniques, and their advantages & limitations.	High	Significant	Basic	Not even reaching marginal levels.
2. Project	Capacity for self-directed learning; quality of literature review; ability to critically assess the topic; quality of scientific presentation: written and oral.	High	Significant	Basic	Not even reaching marginal levels.
3. Examination	Ability to describe in detail concepts in optics and optical microscopy, principles of different imaging modalities / techniques, and their advantages & limitations Ability to choose the most suitable tool for a specific study.	High	Significant	Basic	Not even reaching marginal levels.

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Ability to describe in detail concepts in optics and optical microscopy, principles of different imaging modalities / techniques, and their advantages & limitations.	High	Significant	Moderate	Basic	Not even reaching marginal levels.
2. Project	Capacity for self-directed learning; quality of literature review; ability to critically assess the topic; quality of scientific presentation: written and oral.	High	Significant	Moderate	Basic	Not even reaching marginal levels.
3. Examination	Ability to describe in detail concepts in optics and optical microscopy, principles of different imaging modalities / techniques, and their advantages & limitations Ability to choose the most suitable tool for a specific study.	High	Significant	Moderate	Basic	Not even reaching marginal levels.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Optical microscopy, Fluorescence microscopy, Label-free imaging, High-resolution imaging, Super-resolution imaging, AI in optical imaging

2. Reading List

2.1 Compulsory Readings

1.	Fundamentals of Light Microscopy and Electronic Imaging 2nd Edition, Douglas B. Murphy, Michael W. Davidson,
2.	Introduction to Optical Microscopy, Jerome Mertz
3.	Scientific articles

2.2 Additional Readings

1.	Introduction to Fourier Optics, Joseph W. Goodman
2.	Introduction to Biophotonics, Paras N. Prasad