SYL-TPG

香港城市大學
City University of Hong Kong

Course Syllabus

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

This form is for the completion by the *Course Leader*. The information provided on this form is the official record of the course. It will be used for the City University's database, various City University publications (including websites) and documentation for students and others as required.

Please refer to the Explanatory Notes on the various items of information required.

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Part I Course Overview

Course Title:	Advanced Optical Microscopy for Biomedical Engineering
Course Code:	BME6140
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
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)*	BME8140
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)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	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)

(TLAs designed to facilitate students' achievement of the CILOs.)

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)

(ATs are designed to assess how well the students achieve the CILOs.)

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

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester B 2023/24 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 B 2023/24

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

(An indication of the key topics of the course.)

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

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

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

(Additional references for students to learn to expand their knowledge about the subject.)

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