City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester A 2022 / 2023

Part I Course Overview

Course Title:	Biomedical Imaging and Biophotonics
Course Code:	BME8131
Course Duration:	1 Semester
Credit Units:	3
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)*	MBE6118/BME6118 Biomedical Imaging and Biophotonics
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This aim of this course is to develop students' knowledge and understanding about the fundamental principles of medical imaging technologies and biophotonics, and their applications to real-world devices. The topical coverage includes magnetic resonance imaging, x-ray computed tomography, ultrasonography, optical scattering theory and modelling, optical sensing and spectroscopy, optical microscopy, and photoacoustic tomography. Following the completion of this course, students will have a good understanding of various methods and instruments used in biomedical optical research and clinical applications.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	**Describe** the concepts and principles of major medical imaging technologies.			✓	
2.	**Employ** concepts of photon-tissue interaction in biological tissues.			✓	
3.	**Explain** principles of optical sensing, spectroscopy, and imaging techniques.		✓	✓	
4.	**Interpret** the principles of major imaging and their techniques, select proper imaging techniques for different biomedical imaging applications.			✓	
5	**Discuss** medical and biological photoacoustic imaging for biomedical applications technologies to clinical or preclinical problems.		✓	✓	✓
** If weighting is assigned to CILOs, they should add up to 100%.*		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	5	
Lectures/Tutorial	Explain key concepts and mathematical models related to medical and optical imaging and sensing technologies.	✓	✓	✓	✓		**3 hrs/week**
Homework/ Examination	Require students to solve the problems based on the theories and models discussed during lectures.	✓	✓	✓	✓	✓	**N.A.**
Project	Require students to propose an improvement or a new design of an optical imaging technology through literature survey	✓		✓	✓	✓	**N.A.**

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	**CILO No.**					**Weighting***	**Remarks**
	1	2	3	4	5		
Continuous Assessment: 40%							
Project	✓*		✓*	✓*	✓*	20%	
Assignments	✓	✓	✓	✓	✓	20%	
Examination: 60%							
Examination	✓		✓	✓	✓	60%	Duration: 2 hours
** The weightings should add up to 100%.*						100%	

*****Depending on the topic chosen by the student

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

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. Examination	1.1 Ability to analyze problems in medical imaging and biophotonics, 1.2 Ability to apply principles to solve biomedical problems.	High	Significant	Basic	Not even reaching marginal levels
2. Project	Ability to acquire knowledge related to a medical imaging or biophotonic technique, identify a problem, and propose a methodology to solve the problem.	High	Significant	Basic	Not even reaching marginal levels
3. Assignment	Ability to solve problems relevant to medical imaging, optical sensing, spectroscopy, and imaging.	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. Examination	1.1 Ability to analyze problems in medical imaging and biophotonics, 1.2 Ability to apply principles to solve biomedical problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Project	Ability to acquire knowledge related to a medical imaging or biophotonic technique, identify a problem, and propose a methodology to solve the problem.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Assignment	Ability to solve problems relevant to medical imaging, optical sensing, spectroscopy, and imaging.	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

Tissue-photon interaction, Optical absorption and scattering, Photon transport theory and models, Rayleigh theory, Mie theory, Monte Carlo method for numerical simulation of photon transportation in tissue, Optical sensor and spectroscopy, Confocal microscopy, Optical coherence tomography, Photoacoustic imaging.

2. Reading List

2.1 Compulsory Readings

1.	Biomedical optics: principles and imaging. Wang, Lihong V., and Hsin-I. Wu. 2012.
2.	Fundamentals of Medical Imaging. Suetens, Paul, 2009

2.2 Additional Readings

1.	Fundamentals of Photonics, 2nd Edition. Bahaa E. A. Saleh, Malvin Carl Teich. 2007
2.	P. N. Prasad, “Introduction to biophotonics”, John Wiley & Sons, Inc., New Jersey, 2003.
3.	Markolf H. Niemz, “Laser-Tissue Interactions”, Springer, Berlin, 2007.