City University of Hong Kong
Course Syllabus

offered by Department of Mechanical and Biomedical Engineering
with effect from Semester B 2017/18

Part I Course Overview

Course Title:	**Biomedical Photonics**
Course Code:	**MBE6118**
Course Duration:	**1 semester**
Credit Units:	**3 credits**
Level:	**P6**
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)*	**Nil**
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 biophotonics and their applications to real-world devices. The topical coverage includes single-scatterer theories, Monte Carlo modelling of photon transport in biological tissue, sensing of optical properties and spectroscopy, ballistic imaging and microscopy, and photoacoustic imaging. Following the completion of this course, students will have a good understanding of photon-tissue interaction and the various methods and instruments used in biomedical optical research and clinical applications.

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.	**Describe** the concepts and principles of photon-tissue interaction, optical absorption and scattering, Rayleigh and Mie theories.			✓	
2.	**Employ** Monte Carlo method to simulate photon propagation in biological tissues.			✓	
3.	**Explain** the concepts of optical sensing and spectroscopy methods for biomedical detection, **analyse** the pros and cons of existing techniques, and propose improved methods.			✓	
4.	**Interpret** the principles of major microscopic imaging techniques, select proper imaging techniques for different biomedical imaging applications.			✓	
5	**Discuss** photoacoustic imaging and design imaging systems for biomedical applications.			✓	✓
		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	5	
Lectures	Discuss the key concepts and mathematical models related to photon-tissue interaction, optical imaging and sensing technologies in biological tissue.	✓	✓	✓	✓	✓	**3 hrs/week**
Assignments	Require students to apply the theories and models to solve simplified problems in biomedical applications.	✓		✓	✓		**N.A.**
Project report	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)

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

Assessment Tasks/Activities	**CILO No.**					**Weighting**	**Remarks**
	1	2	3	4	5		
Continuous Assessment: 60%							
Project		✓*	✓*	✓*	✓*	40%	
Assignments	✓		✓	✓		20%	
Examination: 40% (duration: 2 hours)							
						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

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

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Ability to describe and analyze problems in biomedical optical imaging, and ability to apply optical principles to solve simplified biomedical problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Project	Ability to acquire knowledge related to an optical imaging or sensing technique, identify a problem, and propose a new method to solve or improve the problem.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Assignment	Ability to apply the theories and models to solve simplified problems in biomedical applications.	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.)

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

(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.	Biomedical optics: principles and imaging. Wang, Lihong V., and Hsin-I. Wu. 2012.

2.2 Additional Readings

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

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.