City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Fundamentals and Applications of Single-molecule Biophysics in Rapid Diagnostics
Course Code:	BME6141
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)*	BME8141 Fundamentals and Applications of Single-molecule Biophysics in Rapid Diagnostics
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Biophysical methods, especially at single-molecule level, is an essential tool in biomedical research and paves the way for numerous cutting-edge high-sensitivity, rapid diagnostic and detection techniques in healthcare. This course aims to provide students with an overview of fundamental concepts and methods in biophysics, including single-molecule dynamics and spectroscopy, protein folding, optical/magnetic tweezer, etc. After having a good understanding of the fundamental concepts and models, related applications in biomedicine and healthcare will be discussed, such as rapid diagnostic, ultrasensitive sensing for diseases, high throughput sequencing, point-of-care diagnostics, etc. Students will be able to learn critical knowledge and skills that can be used in their research, as well as in solving actual problems in healthcare field. A group project will be assigned at the end of the course for students to explore literatures for the most up-to-date progress of biophysical applications in healthcare.

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 basic concepts in single-molecule biophysics.		✓		
2.	**Understand** working mechanisms and models of important biophysical processes in biomedical research.		✓		
3.	**Relate** conceptual knowledge to real medical applications including rapid diagnostic, sensing, sequencing, etc.			✓	
4.	**Follow** most recent progress by studying literatures. Integrate learned biophysical knowledge in biomedical engineering research and practices.			✓	

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 real-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. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Lecture	Introduction of key concepts.	✓	✓	✓				2 hrs/week
Tutorial	Discussion of assignments.	✓	✓	✓				1 hr/week
Group-based Projects	Report and presentation on selected topics.		✓	✓	✓			3 hrs/week for 2 weeks

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	6		
	Continuous Assessment: 50%								
Projects			✓	✓	✓			25%	
Assignments		✓	✓	✓				25%	
	Examination: 50%								
Examination		✓	✓	✓				50%	Duration: 2 hours
								100%	

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.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
Projects	Ability to identify scientific and engineering problems, review relevant literatures and technologies, propose potential solutions for real biomedical problems using concepts and knowledge learned in class.	High	Significant	Moderate	Basic	Below marginal level
Assignments	Solve practice questions based on the lecture contents.	High	Significant	Moderate	Basic	Below marginal level
Examination	Capability of applying the concepts introduced in lectures for answering exam questions; understand key concepts and mechanisms in single-molecule analysis; understand the application of biophysical knowledge and tools in biomedical field, such as rapid diagnostic, ultrasensitive sensing, next-generation sequencing, etc.	High	Significant	Moderate	Basic	Below marginal level

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
Projects	Ability to identify scientific and engineering problems, review relevant literatures and technologies, propose potential solutions for real biomedical problems using concepts and knowledge learned in class.	High	Significant	Basic	Below marginal level
Assignments	Solve practice questions based on the lecture contents.	High	Significant	Basic	Below marginal level
Examination	Capability of applying the concepts introduced in lectures for answering exam questions; understand key concepts and mechanisms in single-molecule analysis; understand the application of biophysical knowledge and tools in biomedical field, such as rapid diagnostic, ultrasensitive sensing, next-generation sequencing, etc.	High	Significant	Basic	Below marginal level

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.)

Biophysics
Rapid diagnostics
Molecular diagnostics
Biomarker
Point-of-care
Ultrasensitive sensing
Microfluidics
Single-molecule detection
Single-molecule spectroscopy
Protein folding
Protein structure and function
Protein-DNA interaction
Reaction kinetics and dynamics
Next-generation sequencing

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.)

NIL

2.2 Additional Readings

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

NIL