BME8141: FUNDAMENTALS AND APPLICATIONS OF SINGLE-MOLECULE BIOPHYSICS IN RAPID DIAGNOSTICS

Effective Term
Semester B 2025/26

Part I Course Overview

Course Title
Fundamentals and Applications of Single-molecule Biophysics in Rapid Diagnostics

Subject Code
BME - Biomedical Engineering
Course Number
8141

Academic Unit
Biomedical Engineering (BME)

College/School
College of Biomedicine (BD)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BME6141 Fundamentals and Applications of Single-molecule Biophysics in Rapid Diagnostics

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic concepts in single-molecule biophysics.		x		
2	Understand working mechanisms and models of important biophysical processes in biomedical research.		x		
3	Relate conceptual knowledge to real medical applications including rapid diagnostic, sensing, sequencing, etc.			x	
4	Follow most recent progress by studying literatures. Integrate learned biophysical knowledge in biomedical engineering research and practices.			x	

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.

Learning and Teaching Activities (LTAs)

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

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Projects	2, 3, 4	25	-	Yes
2	Assignments	1, 2, 3	25	-	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Projects (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

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.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Solve practice questions based on the lecture contents.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

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.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Part III Other Information

Keyword Syllabus

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

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nil