BME6141: FUNDAMENTALS AND APPLICATIONS OF SINGLE-MOLECULE BIOPHYSICS IN RAPID DIAGNOSTICS

Effective Term
Semester A 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
6141

Academic Unit
Biomedical Engineering (BME)

College/School
College of Biomedicine (BD)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BME8141 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

Assessment Task
Projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

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) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Below marginal level

Assessment Task
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Solve practice questions based on the lecture contents.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

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(F) Below marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

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
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(B-, C+, C) Basic

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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