**City University of Hong Kong**
**Course Syllabus**

**offered by Department of Physics**
**with effect from Semester A 2024/25**

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## Part I Course Overview

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|---|---|
| **Course Title:** | **Introduction to Biophysics** |
| **Course Code**: | **PHY6253** |
| **Course Duration:** | **One semester** |
| **Credit Units**: | **3** |
| **Level**: | **P6** |
| **Medium of Instruction:** | **English** |
| **Medium of Assessment:** | **English** |
| **Prerequisites**: *(Course Code and Title)* | **NA** |
| **Precursors**: *(Course Code and Title)* | **NA** |
| **Equivalent Courses**: *(Course Code and Title)* | **NA** |
| **Exclusive Courses**: *(Course Code and Title)* | **PHY8253 Introduction to Biophysics** |

## Part II Course Details

### 1. Abstract

This course will introduce students to the interdisciplinary field of biophysics. After a short introduction to basic molecular and cellular biology, we will cover several physics topics and their relevance to biology. They include diffusion theory (important in cellular behavior), thermodynamics (important in understanding large molecules like proteins), and three physics-inspired methods to study biology [X-ray crystallography, Cryogenic electron microscopy (Cryo-EM), and molecular dynamics simulations].

### 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. | Understand the chemical compositions and roles of DNAs, RNAs, and proteins in cells. | 10 | ✓ | ✓ | |
| 2. | Understand diffusion theory and its relevance to cells. | 20 | | ✓ | |
| 3. | Understand thermodynamics and its relevance to biological macromolecule's structure and function. | 30 | | ✓ | ✓ |
| 4. | Understand relevant experimental and computational methods in Biophysics including X-ray crystallography, Cryo-EM, and molecular dynamics simulations. | 20 | | ✓ | ✓ |
| 5. | Practice researching the literature and giving academic presentations, or performing computer simulations and writing reports. | 20 | | | ✓ |
| | | 100% | | | |

*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 | | |
| Lectures | Presentation of course material | 0.3 | 0.6 | 0.9 | 0.6 | 0.6 | | 3 |

## 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: _50_% | | | | | | | | |
| Assignments | ✓ | ✓ | ✓ | ✓ | | | 20 | |
| Presentation or Project | ✓ | ✓ | ✓ | ✓ | ✓ | | 30 | Students can choose between (1) researching the literature and making a presentation, and (2) performing a computer-simulation project and submitting a report. |
| Examination: _50_% (duration: 2 hours, if applicable) | | | | | | | | |
| | | | | | | | 100% | |

## 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) |
|---|---|---|---|---|---|---|
| 1. Assignments | The student understands basic principles and can solve numerical problems. | High | Significant | Moderate | Basic | Not reaching marginal level |
| 2. Presentation or Project | The student shows strong evidence of original thinking, and is able to communicate ideas effectively and persuasively via written texts or oral presentation. | High | Significant | Moderate | Basic | Not reaching marginal level |
| 3. Examination | The student understands basic principles and can solve numerical problems. | High | Significant | Moderate | Basic | Not reaching 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) |
|---|---|---|---|---|---|
| 1. Assignments | The student understands basic principles and can solve numerical problems. | High | Significant | Basic | Not reaching marginal level. |
| 2. Presentation or Project | The student shows strong evidence of original thinking, and is able to communicate ideas effectively and persuasively via written texts or oral presentation. | High | Significant | Basic | Not reaching marginal level. |
| 3. Examination | The student understands basic principles and can solve numerical problems. | High | Significant | Basic | Not reaching 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.)*

Biological macromolecules; including proteins, DNAs, and RNAs; and their role in cells.

Physical theories and relevant biological phenomena:

- Random walks, diffusion, and viscosity.
- Thermodynamics, entropic forces, and hydrophilic/hydrophobic interactions.
- Protein structure and function.

Methods to study biophysics:

- X-ray crystallography.
- Cryogenic electron microscopy.
- Molecular dynamics simulations.

**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.)*

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|---|---|
| 1. | Lecture slides. |

**2.2 Additional Readings**

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

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|---|---|
| 1. | Biological Physics: Energy, Information, Life |
| 2. | The Protein-Folding Problem, 50 Years On |
| 3. | DeepMind's AI predicts structures for a vast trove of proteins |
| 4. | The coming of age of de novo protein design |
| 5. | How cryo-EM is revolutionizing structural biology |
| 6. | Optical tweezers in single-molecule biophysics |
| 7. | Liquid phase condensation in cell physiology and disease |