PHY6253: INTRODUCTION TO BIOPHYSICS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Introduction to Biophysics

Subject Code
PHY - Physics
Course Number
6253

Academic Unit
Physics (PHY)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
NA

Precursors
NA

Equivalent Courses
NA

Exclusive Courses
PHY8253 Introduction to Biophysics

Part II Course Details

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].

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the chemical compositions and roles of DNAs, RNAs, and proteins in cells.	10	x	x	
2	Understand diffusion theory and its relevance to cells.	20		x	
3	Understand thermodynamics and its relevance to biological macromolecule’ s structure and function.	30		x	x
4	Understand relevant experimental and computational methods in Biophysics including X-ray crystallography Cryo-EM, and molecular dynamics simulations.	20		x	x
5	Practice researching the literature and giving academic presentations, or performing computer simulations and writing reports.	20			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	Lectures	Presentation of course material	1, 2, 3, 4, 5	3

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3, 4	20	-	Yes
2	Presentation or Project	1, 2, 3, 4, 5	30	Students can choose between (1) researching the literature and making a presentation, and (2) performing a computer-simulation project and submitting a report.	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Assessment Rubrics (AR)

Assessment Task

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

Criterion

The student understands basic principles and can solve numerical problems.

Excellent

(A+, A, A-) High (excellent accomplishment with creativity and correct understanding)

Good

(B+, B, B-) Significant (good accomplishment with mostly correct understanding)

Fair

(C+, C, C-) Moderate (fair accomplishment with some correct understanding)

Marginal

(D) Basic (essential accomplishment with basic understanding)

Failure

(F) Not reaching marginal level

Assessment Task

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

Criterion
The student shows strong evidence of original thinking, and is able to communicate ideas effectively and persuasively via written texts or oral presentation.

Excellent
(A+, A, A-) High (excellent accomplishment with creativity and correct understanding)

Good
(B+, B, B-) Significant (good accomplishment with mostly correct understanding)

Fair
(C+, C, C-) Moderate (fair accomplishment with some correct understanding)

Marginal
(D) Basic (essential accomplishment with basic understanding)

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

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Failure
(F) Not reaching marginal level

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

Criterion
The student understands basic principles and can solve numerical problems.

Excellent
(A+, A, A-) High (excellent accomplishment with creativity and correct understanding)

Good
(B+, B) Significant (good accomplishment with mostly correct understanding)

Marginal

(B-, C+, C) Basic (essential accomplishment with basic understanding)

Failure

(F) Not reaching marginal level.

Assessment Task

Presentation or Project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

The student shows strong evidence of original thinking, and is able to communicate ideas effectively and persuasively via written texts or oral presentation.

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Part III Other Information

Keyword Syllabus

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.

Reading List

Compulsory Readings

	Title
1	Lecture slides.

Additional Readings

	Title
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