
PHYS-301 Biophysics I

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Course: Mondays, 13:15-15

Exercises: Mondays, 15:15-16

Summary

In this course we will study the cell (minimum unit of life) and its components. We will study several key cellular features: Membranes, genomes, channels and receptors. We will apply the laws of physics to develop models to make quantitative and predictive statements.

Content

Introduction to cell biophysics

Topics (lectures):

1. Biological membranes: Hydrophobic effect, 2D elasticity (2-4)
2. Molecular events: Ligand binding, ion channel function (5-7)
3. Transport in cellular systems: Diffusive, directed, crowded (8-11)
4. Genomes: 1D elasticity, regulation, transcription, synthetic biology (12-14)

Elements:

1. Introduction of biological systems and concepts
2. Description of observations and measurements
3. Estimates of relevant numbers / development of quantitative models
4. Exposure to current research articles

Learning Outcomes

- Synthesize information from textbook and article
- Elaborate a model of a biophysical phenomenon
- Justify simplifications to the model
- Develop the mathematical expressions corresponding to the model
- Interpret the results of the model

Assessment methods

The course assessment will be the final exam.

PHYS-301 Course Requirements

Your grade will be entirely based on a written exam during the exam period (June). On the exam, approximately 75% of the points will be attributed to exercise-based questions, and 25% will be attributed to journal article-based questions (subject to adjustment at the discretion of the instructor).

How to succeed in the course:

- Prepare for class by reading the assigned chapters in advance.
- Prepare for the exercise sessions by:
 - Attempting exercises
 - Reading the journal article and filling in the related worksheets
- Volunteer to present an article during the exercises.
- Ask questions throughout the semester.

PHYS-301 Course Calendar

Date	Topic	To do
20.2	C: Introduction - syllabus review, basic components and models	Review course content, ask questions Support: PBoC Ch. 1
20.2	E: How to read an article	Look over worksheet, ask questions
27.2	C: Introduction - Construction plans for cells	Read PBoC Ch. 2.1, 2.2
27.2	E: Exercise Set 1	Exercise Set 1
6.3	C: Introduction – Mechanical and chemical equilibrium in the living cell	Read PBoC Ch. 5.2, 5.5.1
6.3	E: Exercise Set 2	Exercise Set 2
13.3	C: Biological membranes - Elasticity models	Read PBoC Ch. 11.1, 11.2
13.3	E: Article 1	Read Article 1, complete worksheet
20.3	C: Biological membranes, RBC shape and ion channels	Read PBoC Ch. 11.3, 11.4
20.3	E: Exercise Set 3	Exercise Set 3
27.3	C: Proteins - Stat mech models, protein binding	Read PBoC Ch. 6.1.1, 6.4 (except 6.4.4)
27.3	E: Article 2	Read Article 2, complete worksheet
3.4	C: Proteins – Ion channels	Read PBoC Ch. 7.1.2, 11.5
3.4	E: Overview of the course so far	Bring questions
17.4	C: Proteins - Dynamics, diffusion	Read PBoC Ch. 13.1, 13.2.1-13.2.3
17.4	E: Exercise Set 4	Exercise Set 4
24.4	C: Proteins - Dynamics, directed transport	Read PBoC Ch. 16.1.1, 16.3.3.
24.4	E: Article 3	Read Article 3, complete worksheet
1.5	C: Genomes - Central dogma, gene regulation	Read PBoC Ch. 3.2.1, 6.1.2, 19.2 (except 19.2.5)
1.5	E: Exercise Set 5	Exercise Set 5
8.5	C: Genomes – Networks and circuits	Read PBoC Ch. 19.3.2, 19.3.3
8.5	E: Article 4	Read Article 4, complete worksheet
15.5	C: Genomes – Networks and circuits	Read .pdf
15.5	E: Exercise Set 6	Exercise Set 6
22.5	C: Overview of the course	Bring questions
22.5	E: Overview of the course	Bring questions

This schedule is subject to change at the discretion of the instructor.
