FSI3720 Biophysics 7.5 credits

Biofysik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSI3720 valid from Spring 2018

Grading scale

Education cycle

Third cycle

Specific prerequisites

Phd student

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

With this general course in biophysics the student will learn fundamental physical, quantitative, and structural aspects of living systems. Importantly, the student will be equipped with a physics toolbox to understand biological experimental results and observations. After a completed course the student will be able to:

- describe how and why water molecules affect biological structure and reactions.
- discuss RNA, DNA and proteins with regards to structure, energetic stability and function.
- display and analyse protein structure using a computational approach.
- describe and compare biosystems at the structural levels of the cell, larger aggregates and assemblies, down to a single molecule.
- explain and exemplify how light interacts with biological matter to convey function and how this interaction can be used to study biological molecules and phenomena.
- demonstrate how the principles of classical and statistical mechanics can explain motion and dynamics of biological systems.
- analyse biological processes by using the principles of thermodynamics to quantify the associated energetics and kinetics.

Course contents

This course in Biophysics is aimed at phd students interested in learning about biological systems - regardless of the specific student programme/background. Biophysics describes the very fundamentals of biological structure and function. This means that we can understand why muscle tissue contracts, how plants convert solar energy to chemical energy, or why a certain drug molecule activates a protein receptor in the brain while another drug inactivates the same receptor. The course will be equally suitable for the physics student wanting to learn how to use the tools of physics to understand the biological world - and the more biologically oriented student who wants to understand his/her experiments/computations on a more fundamental level. In addition, this course was specifically designed to equip students with a solid biophysics background and a toolbox to be used either in academia or in an industrial biotech setting.

Specifically, this course in Biophysics will show how physical, mathematical, and computational tools, such as randomness, distributions, graphing, calculus, and visualization tools can be used to interpret experiments and model biological systems. The biological systems will be covered at different levels of structural detail; ranging from water molecules and ions surrounding these systems to the amino acids that build up the proteins, different sizes of soluble and membrane proteins, larger assemblies of proteins and ultimately the whole cell and its compartments. Describing the fundamental energetics governing these biological structures and their functions will provide the student with the necessary physical understanding to characterize living systems using theoretical and experimental methods.

Disposition

The Biophysics course is 7.5 credits, which is equivalent to 200 hours full-time study.

Lectures
A series of lectures will explain important concepts in the textbook and illustrate using recently published scientific discoveries. The lectures will be interactive with clickers and group discussions. To enable maximum outcome of the learning activities, it is strongly recommended for the students to acquaint themselves with the textbook material beforehand.

Assignments (1 credits each)
1. Brownian Motion - Random walk simulations

2. Bioimaging particle tracking
3. Understanding the free energy of protein folding and unfolding

Laboratory exercise - "Hands-on interaction with the molecules of life", 2 credits
The student will display and analyse fibrous, globular and membrane proteins using the visualization software Visual Molecular Dynamics (VMD) to understand fundamental concepts of protein structure, stability and function.

Course literature

The main source of literature for the course is "An Introduction to Biophysics", 1st ed.by Thomas M. Nordlund, CRC Press, ISBN 978-1-4200-8972-1, available for purchase at Amazon.com.Further reading will be distributed during the course.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

The written exam is replace by an oral exam on the PhD level. In addition, all assignments and the laboratory exercise need to be graded with grade E ("pass").

Other requirements for final grade

The written exam is replace by an oral exam on the PhD level. In addition, all assignments and the laboratory exercise need to be graded with grade E ("pass").

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.