CH-311

Molecular and cellular biophysics I

Fierz Beat

Cursus	Sem.	Type
Chemistry	BA5	Opt.
HES - CGC	H	Opt.

Language of teaching	English
Credits	2
Session	Winter
Semester	Fall
Exam	Written
Workload	60h
Weeks	14
Hours	**2 weekly**
Courses	2 weekly
Number of positions	

Summary

This course covers the basic biophysical principles governing the thermodynamic and kinetic properties of biomacromolecules involved in chemical processes of life. The course is held in English.

Content

1. **The conformation of biological macromolecules and membranes**
   1. Forces in biomolecules
   2. Protein primary and secondary structure
   3. Tertiary structure of proteins
   4. DNA structure
   5. Conformations of unstructured polymers in solution (Gaussian chain models, freely-jointed chain, wormlike chain)
2. **Spectroscopy of Biomolecules**
   1. Biomolecular absorption spectroscopy (UV absorption, circular dichroism)
   2. Biomolecular fluorescence
   3. X-ray crystallography of proteins
3. **Conformational equilibria and dynamics of polypeptides and proteins**
   1. Thermodynamics of protein folding (folding equilibria, calorimetry of protein folding transitions)
   2. Kinetics of protein folding (folding pathways, intermediates)
   3. Conformational transitions in proteins (native state fluctuations, allostery, structural rearrangements in enzyme catalysis)
   4. Thermodynamics and kinetics of alpha-helix -## coil transitions
4. **Transport phenomena and stochastic processes in biology**
   1. Fluctuations in biology
   2. Macromolecular diffusion
5. **Thermodynamics and kinetics of ligand-receptor interactions**
   1. Equilibrium binding reactions
   2. Binding inhibition
   3. Kinetics of ligand binding

Keywords

biophysics, biophysical chemistry, protein, nucleic acid, structure, thermodynamics, kinetics, protein folding, spectroscopy, fluorescence, absorption, helix-coil, fluctuations, receptor, ligand

Learning Prerequisites

Required courses

Biochemistry I
Chemical thermodynamics

Important concepts to start the course

General chemical and biochemical concepts

Learning Outcomes

By the end of the course, the student must be able to:

- Describe the molecular forces governing biomolecular structure
- Explain experimental strategies to investigate structure and dynamics of biomolecules
- Judge the quality, validity and significance of biophysical experiments in the research literature
- Make order of magnitude estimates for biophysical processes
- Apply kinetic models to understand dynamic processes in biomolecules
- Establish basic knowledge on kinetic processes in proteins and in protein-ligand interactions
- Implement models to rationalize ligand binding processes and interference with inhibitor compounds
- Design quantitative experimental approaches to investigate biological processes

Transversal skills

- Access and evaluate appropriate sources of information.
- Summarize an article or a technical report.

Teaching methods

ex cathedra

Expected student activities

Attendance of the lectures
Study of indicated materials

Assessment methods

Written exam

Resources

Bibliography

"Biophysical Chemistry", Cantor and Schimmel, Vols 1-3 (Freeman, New York 1980)
"Molecular and Cellular Biophysics", Meyer B. Jackson (Cambridge University Press, 2006)

Ressources en bibliothèque

- Molecular and Cellular Biophysics / Meyer
- Biophysical Chemistry / Cantor

Prerequisite for

Molecular biophysics II
Experimental biological & biophysical chemistry
Nanobiotechnology and Biophysics
Cellular Signaling