PHYS-468 **Physics of life**

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Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.
Physics of living systems minor	E	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Life has emerged on our planet from physical principles such as molecular self-organization, thermodynamics, stochastics and iterative refinement. This course will introduce the physical methods to study life and will discuss the quantitative and physical concepts that make life possible.

Content

- The structural organization of life
- Digitalization, Fourier transforms, error propagation, measurement methods
- Energy forms in life: Membrane potential, ATP, concentration gradients, protein folding
- Protein purification: Chromatography, Electrophoresis, Lab Overview
- Hydrodynamic methods, viscosity, cell sorting
- Surface effects, Osmosis, Calorimetry, ITC
- Spectroscopy with light
- Radiation Biophysics, Spectroscopy with NMR and SPR
- Mass Spectrometry
- Electron Microscopy in life sciences
- AFM
- Interactions between particle beams and living matter (Light, X-rays, OCT), Free Electron Laser

Learning Prerequisites

Recommended courses

- Biophysics: physics of the cell (P. De Los Rios, S. Manley, BA6)
- Biophysics: physics of biological systems (S. Rahi, MA1)

Important concepts to start the course

- Thermodynamics, Fourier transformation

Learning Outcomes

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

- Describe the molecules and structural arrangement of modern biological cells
- Describe and quantitatively understand the physical mechanisms that drive living organisms.
- Explain the biophysical tools used to study the molecules of life and interpret their data.

Teaching methods

- 2 hours of class + 2 hour of exercises
- Students are invited to give one 10-min presentation on one of several possible topics during the semester.

Expected student activities

Homework will be given every week. Solutions will be handed out. Homework will not be graded. It is strongly advised to make the effort to do the homework weekly.

Assessment methods

- The course grading is composed of a final written exam
- Students should give a 10-min presentation on one of a given list of topics. Failure to give the presentation will lower the final grade by 0.5.

Resources

Bibliography

- David Sheehan: *Physical Biochemistry, Principles and Applications* (Wiley, 2013)

Ressources en bibliothèque

- Physical Biochemistry / Sheehan

Moodle Link

- https://go.epfl.ch/PHYS-468