LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Teoretisk biofysik
Theoretical Biophysics

EXTQ01, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Elective for: BME5-bf, F4, F4-tf, F4-bm, N4
Language of instruction: The course will be given in English

Aim

Learning outcomes

Knowledge and understanding
For a passing grade the student must

Cell composition and content: The student can describe the composition of the cell and its content of molecules and molecular mechanisms.

Fundamentals of statistics and statistical molecular kinematics: The student can describe and use statistical distributions, in particular the Gaussian distribution, average value and standard deviation. The student can describe and use the Boltzmann distribution in various applications.

Brownian motion, random walks and diffusion: The student can describe random walks and is able to derive their characteristic behaviour. The student can demonstrate how random walks give rise to the diffusion equation, and how diffusion is related to viscosity. The student can describe various biological applications of diffusion.

Viscous media: The student can explain the Reynolds number and Stokes' law, and describe various biological applications of viscous flows.

Entropy, free energy and two-level systems: The student can explain the concepts statistical weight and entropy and their relation. The student can describe free energy and calculate

the behaviour of two-level systems.

Entropic forces: The student can explain the following concepts: osmotic pressure, hydrogen bonds, hydrophilic and hydrophobic groups.

Chemical forces: The student can explain chemical potential and describe chemical equilibrium. The student can describe how micelles are formed and is familiar with various applications.

Macromolecules: The student can describe the fundamental structure formation of proteins and DNA.

Molecular mechanisms and machines: The student can describe nerve signals or a molecular machine of his/her own choice, e.g. motor proteins or ion channels.

Typical problems that the student should be able to handle:

- Applications of diffusion (Fick's law and the diffusion equation).
- Viscous flow in vascular networks (Hagen-Poiseuille's law).
- Extension vs. force for chains of given length and persistence length (wormlike chains).

Contents

Cell composition and content; fundamentals of statistics and statistical molecular kinematics; Brownian motion, random walks and diffusion; viscous media; entropy, free energy and two-level systems; entropic forces; chemical forces; macromolecules; molecular mechanisms and machines.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Hand-in assignment, oral presentation and oral exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0117. **Name:** Seminar Problem.
Credits: 1,5. **Grading scale:** UG. **Assessment:** Passed seminar problem.
Code: 0217. **Name:** Hand-ins.
Credits: 2,5. **Grading scale:** TH. **Assessment:** Passed hand-ins.
Code: 0317. **Name:** Oral Examination.
Credits: 3,5. **Grading scale:** TH. **Assessment:** Oral examination.

Admission

Assumed prior knowledge: Compulsory courses, nanoscience engineering programme, or comparable courses.
The number of participants is limited to: No
The course might be cancelled: If the number of applicants is less than 5.
The course overlaps following course/s: TEK267

Reading list

- Rob Phillips, Jane Kondev, Julie Therot, Hernan G. Garcia: Physical Biology of the Cell, second edition. Garland Science , 2013.

Contact and other information

Course coordinator: Carl Troein, carl.troein@thep.lu.se
Course homepage:
http://www.atp.lu.se/english/education/courses/theoretical_biophysics/
Further information: The course is given by the Faculty of Science and does not follow the study period structure.