BIOPHYSICS

By A. Pelizzola

Subject fundamentals

Elective course for the Master in Physics of Complex Systems (international track), 1st year, 2nd term. In this course the methodologies of statistical physics are applied to the physics of biological systems. To this end, a few basic elements of molecular biology are also introduced.

Expected learning outcomes

The student must acquire some basic elements of molecular biology and must learn to apply the techniques of statistical physics to some problems from the physics of biological systems, mainly in the field of biopolymers.

Prerequisites / Assumed knowledge

Statistical physics.

Contents

Introduction to molecular biology: the cell; small molecules; proteins and nucleic acids.
Stretching a single DNA molecule: experiments, the Freely Jointed Chain, the one-dimensional cooperative chain, the worm-like chain.
DNA melting: experiments, zipper model, Poland-Scheraga model.
The helix-coil transition. Polymer collapse: Flory's theory. Collapse of semiflexible polymers: lattice models and the tube model. The self-avoiding walk and the O(n) model.
An introduction to protein folding and design. RNA folding and secondary structure. Protein and RNA mechanical unfolding.
Molecular motors.

Texts, readings, handouts and other learning resources

K. Sneppen and G. Zocchi, *Physics in molecular biology*, Cambridge
P. Nelson, *Biological Physics*, Freeman
B. Alberts et al, *Molecular biology of the cell*, Garland
Lecture notes and slides will be provided

Assessment and grading criteria

The exam is based on an oral test which typically involves questions on 2-3 topics, the first one being chosen by the student.