Course Package

Soft and Biological Physics – 1A

Name module	Soft and Biological Physics - 1A
Educational programme	BSc Applied Physics
Course Code	202000717
Period	First block of the first semester (block 1A)
Study load	15 ECTS

Soft and Biological Physics			
block 1A	**block 1B**	**block 2A**	**block 2B**
Physical Biology **202001414** (5 EC)			
Electives: (2 of the 3)			
Soft and Biological Techniques - **201700187** (5 EC)			
Biophysical Techn.and Mol.Imaging - **193640020** (5EC)			
Advanced Colloids and Interfaces - **201800083** (5 EC)			

Required preliminary knowledge: Statistical Physics, Basic knowledge in biology (high school level), and thermodynamics (BSc level) are assumed to be present, The students should have a basic experience in a lab (and safety) skills, and know how to write a lab journal and report, A bachelor degree in applied physics, biomedical technology or advanced nanotechnology.

202001414 - Physical Biology

The complex behaviour of cells and bio-molecules cannot be fully understood without deep physical insight, triggering an increasing interest in physical biology. Generic physical concepts have given quantitative insight into how muscle cells convert the chemical energy of ATP into movement and into how DNA can replicate itself during cell division. In this course, we will discuss both the biochemistry and basic physical principles that help us understand and quantitatively describe biological phenomena and processes occurring in cells.

After an introduction into cellular and molecular biology, you will learn how the confluence of thermal, mechanical, chemical and entropic forces make the behaviour of cells and biological macromolecules so different from our everyday experience. Topics include: the central dogma in molecular biology, cellular transport mechanisms, different forms of intracellular signalling mechanisms, , diffusion, entropic forces, self-assembly, biopolymer elasticity, and molecular machines. The course consists of lectures, self-study, and 15 min presentation and peer review by students on a self-chosen subject related to the latest developments in one of the course topics

Electives: (2 of the 3)

201700187 - Soft and Biological Techniques

Soft and Biological Techniques is a lab course where the student gets hands-on experience with modern techniques used in the study of soft- and biological matter. Materials studied include surfactants, proteins, and colloids. Typical behaviors such as diffusion, wetting, and (supra)molecular interactions are studied with mostly optical and mechanical techniques. SBT is intimately connected to (and uses theory from) both the Soft and Biological Materials and Colloids and Interfaces courses in minor module TN-09.

193640020 - Biophysical Techniques & Molecular Imaging

Fundamentals fluorescence and vibrational transitions, related parameters; instrumentation spectroscopy and microscopy (widefield, confocal, fluorescrence, Raman); fluorophores (intrinsic, extrinsic, fluorescent proteins) and labeling strategies; monitoring molecular interactions (anisotropy, MST, FCS, quenching), molecular motion (FRAP, FLIP, FCS); single-molecule spectroscopy; superresolution microscopy (single molecule localization, STED); accessing molecular structure (fluorescence-based, electron microscopy).

201800083 - Advanced Colloids and Interfaces

Description of colloids, surfaces and interfaces. All kinds of interfaces between different phases are treated. Thermodynamic descriptions of these interfaces are deduced. Several techniques for characterizing interfaces are discussed. During contact hours, the contents of will be presented and discussed, and exercises will be made and discussed. For each topic, a case assignment will be offered. Topics include:

- Lifshitz-van der Waals Interactions
- Polar/Acid-Base Interactions
- Wetting and Contact Angles
- Electrostatics
- DLVO and XDLVO interaction
- Electrokinetic Phenomena
- Electrostatic and Polymeric Stabilization of Colloids
- Colloidal Phenomena (Marangoni-Effect, Ouzo effect, etc.)