



Asignatura: Fundamentos Físicos
 Código: 33118
 Centro: Facultad de Ciencias
 Titulación: Master en Física de la Materia Condensada y de los
 Sistemas Biológicos
 Nivel: Máster
 Tipo: Obligatoria
 Nº de créditos: 6 ECTS

- ⤴ *Microscopic view: Brownian motion. Langevin dynamics.*
- ⤴ *Applications in biology. Active and passive transport. Kinetic equations. Turing patterns, activator-repressor dynamics.*

4 Molecular interactions and forces

- ⤴ *Forces of quantum origin: dispersion (van der Waals), hydrogen bond, ionic and covalent bonds. Relevance of hydrogen bond in biology. Energetic bonds: ATP, NADH, etc.*
- ⤴ *Entropic forces: Entropic spring, depletion, solvation, hydrophobic forces. Entropic forces in crowded systems (proteins). Electrostatic forces (Debye length, Nerst equation, Poisson-Boltzmann equation).*
- ⤴ *Applications: membrane potential, ionic channels. Patch clamp. Transmission of electric impulse in neurons.*

5. Polymers

- ⤴ *Types of polymers: analogies with Brownian motion, entropic spring, excluded volume, globular polymers. Diffusion and relaxation times.*
- ⤴ *Flexibility. Worm-like chain model. Bending energy. Free energy of proteins and stability. Role of hydrophobic forces in proteins. DNA origami.*

6. Membranes

- ⤴ *Types of lipids and their effect in the membrane structure. Model systems.*
- ⤴ *Membrane elasticity: stretching, bending. Morphologies.*
- ⤴ *Experiments to study the mechanical properties of membranes: micropipette aspiration, optic tweezers, fluctuations.*

7. Hydrodynamics

- ⤴ *Navier Stokes equation: stress, viscosity and inertia. Non-dimensional numbers: Peclet and Reynolds*
- ⤴ *Applications: Swimming at different Reynolds numbers. Flying with different mass. Purcell. A brief review of microfluidics.*

8. Molecular motors

- ⤴ *Cytoskeleton proteins (structure and dynamics) ATP-ase. Experimental techniques.*
- ⤴ *Probabilistic description of molecular engines.*

9. Energy transduction in living systems

- ⤴ *Cellular respiration. Photosynthesis (quantum description). Hydrogenases. Applications in nanotechnology.*

10. Self-assembly: Some seminars including some of the following subjects. Entropy production as creator of order (dissipative structures) bio: actine microtubules (creation and destruction). Active soft matter. Nano-structured inorganic systems

1.13. Referencias de consulta / Course bibliography

- ⤴ **Howard Reiss, Methods of Thermodynamics, Dover**
- ⤴ **Rob Phillips, Jane Kondev, Julie Theriot, Physical Biology of the Cell, Second Edition, Garland Science, 2008.**
 (<http://microsite.garlandscience.com/pboc2/>)

