Biophysics II

1.- Overview of molecular and cell biology

- Biological molecules
- Cell physiology
- Molecular devices
- Basics functions of the cell

2.- Physical chemistry of life

- Thermodynamics
- Chemical forces. Osmotic pressure. Chemical reactions
- The chemistry of water. The hydrogen bond. Dissociation
- Self-assembly

3.- Energy in the cell. Metabolism

- Metabolism
- Glucose catabolism. The Krebbs cycle
- Biochemistry of respiration

4.- Sensors and switches. Ligand-receptor binding and cooperativity

- Microscopic systems. Lattice models. Two-state systems.
- Ligand receptor binding
- Cooperativity. Phosphorylation

5.- Regulators. Enzyme kinetics

- Activation barriers and reaction rates. Rate equations.
- Enzymes. Michaelis-Menen kinetics. Inhibition

6.- Properties of DNA

- Thermodynamics of DNA. Meting. PCR
- Elasticity of polymers. Force-extension curve of DNA

7.- The cell membrane: properties and functions

- Membrane functions: receptors, signaling, and active ion pumping
- Brownian motion. Diffusion. Passive flow through membranes. Electroosmotic effects.
- Electrical properties: The resting and action potentials
- The Hodgkin-Huxley equations. The cable equation
- Nerve cells

8.- Molecular motors: Active transport

- Molecular devices in cells. Mechanical machines
- Molecular motors. Rectified Brownian motion. The diffusive and S-ratchet.

9.- Introduction to Techniques and Methods in Biophysics

- Microscopy
- Genetic tools: Polymerase Chain Reaction, DNA typing, Gene cloning, Chromosome Confromation Capture, High-throughput sequencing
- Electroencephalography
- Magnetic Resonance Imaging
- Patch and Voltage Clamp

Seminars:

Two or three seminars on advanced topics in biophysics will be given during the course

Instructors:

Blas Echebarria and Enric Álvarez-Lacalle

Exams and grading policy:

The students' evaluation will consist of a final exam (FE), a midterm exam (ME), and an evaluation of the student's participation in class through handed-in homework (HE). The final mark will be given by:

$$\text{Max}\{FE,\ 0.55*FE + 0.35*ME + 0.10*HE\}$$

Bibliography:

Basic:

- P. Nelson. *Biological Physics*. W. H. Freeman, 2007.
- R. Cotterill. *Biophysics: an introduction*. Chichester, West Sussex John Wiley & Sons, 2002.
- R. Phillips, J. Kondev, J. Theriot. *Physical Biology of the Cell***.** Garland Publishing Inc, 2008.

Complementary:

- R. Glaser. *Biophysics: An Introduction*. Springer, 2004.
- J.R. Claycomb, J.Q.P. Tran. *Introductory Biophysics: Perspectives on the Living State*. Jones & Bartlett Publishers, 2010.
- B. Nölting. *Methods in Modern Biophysics*. Berlin Springer Verlag, 2006.
- M.B. Jackson. *Molecular and Cellular Biophysics*. Cambridge University Press, 2006.
- M. Daune, W.J. Duffin, D. Blow. *Molecular biophysics : structures in motion*. Oxford University Press, 1999.
- B. Alberts et al. *Molecular Biology of the Cell*. Garland Science; 5 edition, 2007.
- A.V. Finkelstein, O. Ptitsyn. *Protein Physics: A Course of Lectures*. Academic Press Inc, 2002.