

Physics

Code: 100810
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	FB	1	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

It is recommended to take the Propedeutic course on Physics offered by the Faculty, that makes more accessible the understanding of the matter. The main requirement is a strong will of learning and a commitment to work; to know addition, subtraction, multiplication, division, writing and working with logarithms and exponential functions. Having a genuine interest on biological systems. In fact, the course requires only a very elementary knowledge of Physics, and it is focused on illustrating the application of simple physical concepts to the understanding of biological problems.

Objectives and Contextualisation

To achieve an understanding of the utility of physics as a way of exploration and comprehension of biological systems, and of the devices used to observe it.

To identify some topics in biophysics and in medical physics in order to get a true appreciation of the relation between physics and biology as one of the most active current frontiers of knowledge.

To introduce some quantitative elements in the analysis of several biological situations, as for instance nervous signals, vision, audition, cellular motion, circulatory system, membrane transport, biological effects of radiations, ...

Competences

- Be able to analyse and synthesise
- Develop independent learning strategies.
- Understand and interpret the physicochemical bases of the basic processes of living beings

Learning Outcomes

1. Be able to analyse and synthesise.
2. Describe how physics theories serve to formulate problems in biology with greater precision.
3. Develop independent learning strategies.
4. Explain the basic ideas of physics.
5. Identify some present-day frontiers in biophysics.

6. Read, understand, summarise and explain popular-science articles on the application of physics to biology.
7. Solve simple physics problems referring to situation of biological interest.

Content

Physics of the biological cell

1. Review of elementary concepts of mechanics. Application to molecular machines.
2. Scaling laws. Size and form. Some physiological and evolutionary consequences.
3. Hydrostatics. Fluids at rest. Pressure distribution and circulatory system.
4. Viscous fluids. Stokes law. Sedimentation. Motion of organisms in fluids.
5. Poiseuille equation. Blood flow. Membrane permeability.
6. Diffusion. Fick's law and Brownian motion. Membrane transport.
7. Electric potential and field. Membranes as capacitors.
8. Ohm's law. Ionic channels. Membrane depolarization.
9. Membrane ionic transport. Nernst potential. Active transport. Molecular pumps.
10. Nervous current. Physics of action potential: form, duration and speed. Synapses. Neural networks.

Biofísica de los sentidos

1. Propagation waves. Standing waves.
2. Acoustics. Speed of sound. Intensity of sound. Decibelic scale.
3. Audition. External, medial and internal ear.
4. Physical optics. Interference. Diffraction. Polarization.
5. Geometrical optics. Refraction. Lenses. Microscopes.
6. Vision. The eye: focusing; defects; visual acuteness.

Ionizing radiations

1. Quantum physics. Einstein-Planck and de Broglie relations. Energy levels.
2. Physical and biological dosimetry. Biological effects of ionizing radiations.
3. Radioactive decay. Half life
4. Elementary ideas on nuclear physics: bond energy, nuclear levels, nuclear decays.

Methodology

Each class is motivated by some question of biological interest. The objective of the course is not to learn much physics, but to realize, using very simple physical equations, that physics is useful to know more biology.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	35	1.4	2, 4, 7
Type: Supervised			
Problems classes	15	0.6	3, 5, 7
Type: Autonomous			
Personal study, problems solving, course project	92	3.68	3, 5, 6, 1

Assessment

Two partial exams (4.25 points each)

Course projects (1.5 points)

Final exam (re-evaluation on the matter of suspended partial exams, or possibility of increasing the grade, keeping the previous grade in case the final grade is lower). Only students who have taken the two partial tests can be considered for this exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Course project and exercises	1,5 points/10 points (15 %)	1	0.04	3, 4, 5, 6, 7, 1
Partial exams	8,5 points/10 points (85 %)	4	0.16	2, 3, 4, 5, 6, 7, 1
Recovery exam	Allows to raise the grade obtained in the partial exams	3	0.12	2, 3, 4, 7, 1

Bibliography

D Jou, J E Llebot i C Pérez-García, Física para las ciencias de la vida, second edition, Mc Graw Hill, 2009

J W Kane i M M Sternheim, Física, Reverté, 1989

Advanced

R. Phillips, J. Kondev, J. Theriot, H. G. Garcia, Physical biology of the cell, Garland Science (Taylor and Francis Group), Londres, 2013