

Physics

Code: 100920
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	FB	1	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: F. Xavier Alvarez Calafell
Email: Xavier.Alvarez@uab.cat

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

The student should be familiar with basic Physics knowledge, especially the topics related to forces or energies. These topics are covered in the secondary school courses. If the student has never studied them it would be good to do the propedéutic course of Physics for Biosciences. It is also recommended at least to read a secondary grade textbook including them.

Physical concepts like electromagnetic fields and waves, although important, are not required because they are introduced again during the course.

Objectives and Contextualisation

Because of its fundamental nature, knowledge in physics is very often a necessary tool for the correct understanding of the phenomena described in other sciences. In the specific case of Biotechnology, for example, to correctly understand the dynamics of chemical reactions within cells, it is completely indispensable to know the physics of diffusion, the field and electrical current or thermodynamics. Without this knowledge a misunderstanding of the biochemistry of the cell is possible.

On the other hand, Physics is required to understand some of the experimental methods that biochemists use daily. In our case, for example, radioactive or fluorescent marking of molecules, centrifugation or magnetic resonance are examples of methods that are clearly based on fundamental physical principles.

The objective of this subject will be the introductory study of all the necessary physical concepts for both, modeling and experimental design in Biochemistry.

Some of the topics will be the starting point of other courses such as Thermodynamics, Bioenergetics and other topics will be fundamental for the practices included in Integrated Laboratories.

Competences

- Learn new knowledge and techniques autonomously.
- Make decisions.
- Reason in a critical manner

- Use the fundamental principles of mathematics, physics and chemistry to understand, develop and evaluate a biotechnological process.

Learning Outcomes

1. Describe the atomic and nuclear structure of matter. Know the different processes by which atomic nuclei emit radiation and the principal characteristics of the interaction between radiation and matter. Estimate the biological damage produced by radiation.
2. Describe the principles of thermodynamics and the physical properties of a macroscopic system.
3. Describe the properties of muscle fibres and body fluids in terms of physics.
4. Explain the basic mechanisms of electric current and relate them to nerve impulses.
5. Explain the basic principles of mechanics and apply them to biological systems.
6. Explain the principles behind the emission of electromagnetic radiation.
7. Learn new knowledge and techniques autonomously.
8. Make decisions.
9. Reason in a critical manner

Content

1 Introduction to the physical characteristics of the molecules

Electrical charge, dipole: polar and non-polar amino acids

Magnetic properties, magnetic resonance

Interaction forces and links between atoms

Energy of interaction

Structure: DNA, proteins, sugars, lipids

2 Basic concepts in kinematics and dynamics.

Speed, acceleration, angular acceleration, centripetal and centrifugal acceleration.

Newton's law: relationship between strength and acceleration

Hooke's Law. Optical tweezers

3 Transport of molecules in fluids

Viscosity; sedimentation

Centrifugation; separation of macromolecules

Diffusion; Fick's law; brownian motion

4 Energy

Kinetic energy, potential energy, work-energy theorem

Conservation of energy

Intramolecular energy; molecular machines

Internal energy, temperature

Dissipation of energy. Entropy Implication in molecular dynamics and chemical reactions

5 oscillations

Elasticity; Harmonic oscillator, damped oscillations

Oscillations typical of molecules; energy absorption; resonance

H₂O oscillations and warming with microwave; CO₂ oscillations and greenhouse effect

Macromolecular experiments: stretching of DNA and proteins

6 Electricity

Coulomb Law; forces between charges; atoms; molecules; electrostatic contribution to the energy of the ATP

Dipoles; polar molecules; hydrogen bridges

Electrophoresis

Membrane potential

Ion pumps; ATP-handle and oxidative phosphorylation

7 Magnetism

Magnetic forces; forces in a magnetic field; mass spectrometry

Magnetic dipole

Nuclear magnetic resonance: applications to chemistry, to molecular structure; to medical images

8 Physical optics

Wave nature of light; electromagnetic waves

Interference and diffraction

Diffraction of light in crystals and molecules; molecular structure
 Synchrotron radiation
 9 Some ideas of quantum physics
 Einstein-Planck and de Broglie equations
 Quantification of energy levels: particle in a box
 Bohr's atomic model; Absorption and emission spectra. Fluorescence
 Some ideas of nuclear physics
 Radioactivity

Methodology

The subject will be given alternating different types of methodologies:

- Master classes where the general concepts of the different topics will be introduced
- Solving problems where the teachers will solve the exercises previously selected in previous days
- Practices where questions will be proposed where Physics is related to biosciences and where the student will have to solve certain questions in a group
- Resolution of autocorrection questionnaires through a computer using the Moodle platform
- Reading of didactic material in biosciences where physical concepts are applicable
- Experimental practices at home.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem solving classes	12	0.48	
Theory classes	30	1.2	
Type: Supervised			
Practices	4	0.16	
Type: Autonomous			
Experimental work at home	5	0.2	
Homework	35	1.4	
Reading of educational material	10	0.4	
Resolution of computer assisted questionnaires	20	0.8	

Assessment

Assessment Activities



Title	Weighting	Hours	ECTS	Learning Outcomes
Computer assisted practices	20%	30	1.2	7, 2, 1, 4, 6, 8
Exams	80%	4	0.16	2, 3, 1, 4, 5, 6, 9

Bibliography

Basic bibliography

- Jou, D, Llebot, J.E. y Pérez Garcia, C. *Física para ciencias de la vida*. Mc Graw-Hill.

Further reading

- Kane, J.W. y Sternheim, M.M. *Física*. Ed. Reverté.
- Tipler, P.A. y Mosca, G. *Física para la ciencia y la tecnología*. Ed. Reverté