Physics

Code: 100920
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500253 Biotechnology	FB	1

Contact

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Teaching groups languages

You can view this information at the end of this document.

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 high 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 fluoescent 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.

Learning Outcomes

1. CM04 (Competence) Calculate physical parameters and magnitudes associated with the field of physics, with special relevance to those related to biotechnology.
2. CM05 (Competence) Compare magnitudes and units of physical observables.

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3. CM06 (Competence) Work collaboratively in teams to solve problems and case studies in the field of physics.
4. KM04 (Knowledge) Define the basic principles of mechanics in biological systems.
5. KM05 (Knowledge) Relate the basic mechanisms of electric current to nerve impulses.
6. KM06 (Knowledge) Describe the basis of electromagnetic radiation emission and the principles of thermodynamics.
7. SM04 (Skill) Apply the fundamentals of general physics to the resolution of experimental problems and phenomena.
8. SM05 (Skill) Correctly interpret data and observations in the field of experimental physics.
9. SM06 (Skill) Correctly interpret the magnitudes and units associated with fundamental physical observations.

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

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Quantification of energy levels: particle in a box
Bohr's atomic model; Absorption and emission spectra. Fluorescence
Some ideas of nuclear physics
Radioactivity

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem solving classes	12	0.48	CM04, CM05, KM05, SM04, SM05, SM06
Theory classes	30	1.2	CM05, KM04, KM05, KM06, SM05, SM06
Type: Supervised			
Practices	4	0.16	
Type: Autonomous			
Experimental work at home	5	0.2	SM04
Homework	35	1.4	
Reading of educational material	10	0.4	KM04
Resolution of computer assisted questionaries	20	0.8	CM04, CM06, KM05, KM06, SM04, SM05, SM06

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.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

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Computer assisted practices	20$	30	1.2	CM04, CM05, SM05, SM06
Exams	80%	4	0.16	CM04, CM05, CM06, KM04, KM05, KM06, SM04, SM05, SM06

Ordinary assessment:

The assessment is composed of two mid-term tests and a set of online practices. The weighting of each partial test will be around 40% each. These weights may vary slightly depending on the amount of topics contained in each one. The rest of the mark (20%) will come from the marks obtained in the practices carried out during the course. The student must obtain a grade higher than 3.5 in the partial tests so that he can perform the average with the practices. If this grade is not obtained, the final grade will not be approved even if the overall average is greater than 5.

Recovery exam:

At the end of the semester there will be a second exam for each of the partial tests. This will be for all those students who have not passed the ordinary tests or who want to improve their grade. If a student takes one of these make-up tests, they will forfeit the grade obtained in the regular part test. The final grade will be calculated as in the ordinary assessment with the make-up marks replacing the previous ones. To participate in this exam, students must have previously been assessed in a set of activities with a weight of at least two thirds of the subject. Students will receive a grade of "Not Assessed" when the assessment activities performed have a weighting of less than 67% in the final grade.

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

Software

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Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	411	Catalan	first semester	afternoon
(PAUL) Classroom practices	412	Catalan	first semester	afternoon

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(TE) Theory	41	Catalan	first semester	afternoon

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