Universitat Autònoma de Barcelona

2020/2021

Physics

Code: 100908
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	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

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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

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 Biotechemistry, 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.

Competences

- Be able to self-evaluate.
- Interpret experimental results and identify consistent and inconsistent elements.
- Understand the language and proposals of other specialists.
- Use the basics of mathematics, physics and chemistry that are required to understand, develop and evaluate the chemical procedures of living matter.

Learning Outcomes

1. Be able to self-evaluate.
2. Define the emission of electromagnetic radiation.
3. Describe the atomic and nuclear structure of matter.
4. Describe the physical properties of a macroscopic system.
5. Describe the properties of muscle fibres and body fluids in terms of physics.
6. Enumerate the basic principles of mechanics apply them to biological systems.
7. Estimate the biological damage produced by radiation.
8. Explain the different processes by which atomic nuclei emit radiation and the principal characteristics of the interaction between radiation and matter.
9. Identify the principles of thermodynamics.
10. Interpret experimental results and identify consistent and inconsistent elements.
11. Relate the basic mechanisms of electric currents and relate them to nerve impulses.
12. Understand the language and proposals of other specialists.

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

<palign="LEFT">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

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

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.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem solving classes	12	0.48	
Theory classes	29	1.16	
Type: Supervised			
Practices	5	0.2	
Type: Autonomous			
Experimental work at home	5	0.2	
Homework	35	1.4	
Reading of educational material	10	0.4	
Resolution of computer assisted questionaries	20	0.8	

Assessment

Ordinary assessment:

The assessemnt consists of two partial tests and a set of online practices. The weight of each partial test will be around 40% each. These weights may vary a bit depending on the number of topics contained in each one. The rest of the note (20%) will come out of 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. In case this grade is not obtained, the final grade will not be approved even if the total average is greater than 5.

Recovery assessment:

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 grades. If a student presents to one of these recovery tests, he will renounce the qualification obtained in the test of the ordinary part. The final grade will be calculated as in the ordinary evaluation with the recovery grades replacing the previous ones. To participate in the second exam, students must have been previously evaluated in a set of activities whose weight is at least 2/3 of the subject. The students will obtain a grade of "Not evaluated" when the evaluation activities carried out have a weight of less than 67% in the final grade.

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Computer assisted practices	20%	30	1.2	12, 10, 1
Exams	80%	4	0.16	2, 5, 3, 4, 6, 7, 8, 9, 10, 11

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