UAB
Universitat Autònoma de Barcelona

Physics

Code: 100810
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500250 Biology	FB	1

Contact

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Teaching groups languages

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

Prerequisites

It is recommended to take the propaedeutic course on Physics offered by the Faculty, which makes more accessible the understanding of the matter. The main requirement is a strong will of learning and a commitment to work. Having a genuine interest in biological systems. In fact, the course requires previous elementary knowledge of Physics learned in high secondary courses, 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 the instruments 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,...

Learning Outcomes

1. CM03 (Competence) Judge narratives and images used to facilitate communication and the conceptualisation of concepts in Physics that contain gender stereotypes.
2. CM04 (Competence) Explain popular articles on physics applied to biology.
3. KM05 (Knowledge) Explain the basic principles of physics applied to biology.
4. KM06 (Knowledge) Identify some current frontiers of biophysics.
5. KM07 (Knowledge) Describe how physical theories are used to pose, with greater precision, problems in biology.
6. SM03 (Skill) Solve simple physics problems related to situations of biological interest.
7. SM04 (Skill) Apply physical theories in the approach and resolution of biological problems.

Content

Block 1: 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. The 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. Synapse. Neural networks.

Block 2: Biofísica de los sentidos

1. Propagation waves. Standing waves.
2. Acoustics. Speed of sound. The intensity of sound. Decibel scale.
3. Auditon. 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.

Block 3: Ionizing radiations

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

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	35	1.4	KM06, KM07, SM03, SM04
Type: Supervised			
Problem solving classes	20	0.8	SM03, SM04
Type: Autonomous			
Personal study, problems solving, classwork, participation in forums on the virtual campus	86	3.44	CM03, CM04, KM05, KM06

Each class is motivated by some questions of biological interest. The objective of the course is to learn through simple physical equations, that physics is useful to know more biology.

The development of the subject is based on interactive face-to-face activities in the classroom as well as on the virtual campus through homework assignments, exercises, and participation in the forums. The activities will be directed, supervised, and autonomous.

For the problems solving classes, the students will prepare some of them on their own before each session. The professor will solve the key problems and will assist the students with doubts and difficulties.

In all cases, will be used support material, where the student can consult the contents, the programming of activities for both continuous assessment and directed learning, and the list of references.

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
Classwork and exercises	30%	2	0.08	CM03, CM04, KM05, KM06, KM07, SM03, SM04
First midterm exam	40%	2.5	0.1	KM07, SM03, SM04
Retake exam	Allows to raise the grade obtained in the midterm exams	2.5	0.1	KM07, SM03, SM04
Second midterm exam	30%	2	0.08	KM07, SM03, SM04

The correct achievement of the competencies by the students will be assessed through 3 types of assessment activities, each with a specific weight in the final grade, and with specific requirements, a fourth activity will be for students who have failed some of the midterm exams.

1. *Midterm exams (70%)*: Throughout the course, there will be 2 written partial exams (theory and problems). The first midterm exam must evaluate Block 1 and will have a weight of 40%, the second midterm exam must evaluate Blocks 2 and 3 and will have a weight of 30%. You will need to get a 4 out of 10 from each of the two midterm exams to average with the remaining grades.

2. *Continuous assessment activities (30%)*: Throughout the semester, additional activities will be proposed, such as solving exercises other than those in the problem class, moodle quizzes, classwork exercises, forums (for each thematic block). These activities will be evaluated, and their average will have a weight of 15% in the overall grade. There are no minimum grade requirements but there is a restriction for exercise deliveries, they must be individual.
3. Final exam (recovery of the failed exams, or the possibility of increasing the grade, keeping the previous grade in case the final exam is lower). Only students who have taken the two midterm exams at the time will be able to take this exam.

The overall grade will be calculated as:

Overall Grade = First midterm exam*0,40 + Second midterm exam*0,30 + Classwork and exercises*0,30

The subject will be considered passed when the overall grade is equal to or higher than 5 points out of 10

Repeaters will be required to do the same assessment activities as newly enrolled students.

The Honor grade may only be awarded to students who have obtained a final grade equal to or greater than 9. A maximum of 1 for every 20 enrolled students may be awarded.

This subject does not include the single assessment system.

Bibliography

Different reference books are proposed for most of the topics, including some of a basic nature for general consultation and others advanced for students who would like to expand their knowledge. In addition, access links for some of them are provided. Many concepts as mathematical as they are physical or physicochemical are introduced intuitively and illustrated with numerous practical examples. These books allow you to delve into the most important topics of the course.

- 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
- R. Cotterill, Biophysics: An Introduction, John Willey & Sons, LTD. 2002.
- P. Davidovits, Physics in Biology and Medicine, Third Edition, Elsevier-Academic Press, 2008.
- B. Rubin. Compendium of Biophysics. Wiley, 2017. Online access: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119160281
- T. A. Waigh. The Physics of Living Processes - A Mesoscopic Approach. Wiley, 2015. Online access: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118698310
- T. Bécherrawy. Vibrations and Waves. Wiley, 2011. Online access: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118586525
- M. W. McCall Classical Mechanics - From Newton to Einstein - A Modern Introduction 2e. Wiley, 2010. Online access: https://onlinelibrary.wiley.com/doi/book/10.1002/9780470972502

Advanced

- R. Phillips, J. Kondev, J. Theriot, H. G. Garcia, Physical biology of the cell, Garland Science (Taylor and Francis Gropuo), Londres, 2013
- D. and H. Yevik. Fundamental Math and Physics for Scientists and Engineers. Wiley, 2014. Online access: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118979792

Software

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Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	111	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	112	Catalan	second semester	morning-mixed
(TE) Theory	11	Catalan	second semester	afternoon