UAB
Universitat Autònoma de Barcelona

Biophysics

Code: 101892
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biomedical Sciences	FB	1

Contact

Name: Josep Bartomeu Cladera Cerdà

Email: josep.cladera@uab.cat

Teachers

Josep Bartomeu Cladera Cerdà

Silvia Lope Piedrafita

Nuria Benseny Cases

Teaching groups languages

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

Prerequisites

Students should have achieved a basic knowledge in general Physics, mastering concepts such as pressure, energy, power and intensity. It is important to have a previous knowledge of mechanical waves and optics. That is, to have acquired the theoretical knowledge and problem solving capacity as it is implemented for Physics in the 'Batxillerat' (Spanish/Catalan) program.

Objectives and Contextualisation

First year Biophysics for Biomedical Sciences students aims at explaining the structure-function of living organisms, especially the human body in its health and disease states, from the point of view of the application of the fundamental laws and principles of Physics. Emphasis is made on the use of tools to solve numerical problems and for the acquisition of a critical capacity to evaluate scientific results.

Learning Outcomes

1. CM20 (Competence) Draw on knowledge and skills from the field of biophysics to develop a critical review of relevant theories and studies in the field.
2. CM21 (Competence) Describe the physical foundations that govern how the healthy and pathological human body functions.

3. KM24 (Knowledge) Describe the physical bases of the function of healthy and unhealthy human organs and systems.
4. KM25 (Knowledge) Define the effects of the interaction between radiation and particles with living organisms, based on physical principles.
5. KM26 (Knowledge) Identify the mechanisms and physical foundations of the technologies that enable the use of radiation and particles in diagnosis and therapy.
6. SM21 (Skill) Apply general safety standards in the performance of common techniques in the biophysics laboratory.
7. SM22 (Skill) Critically analyse experimental results of biophysical variables in the field of biomedical sciences.

Content

1. RADIATIONS I. FUNDAMENTALS (5 hours theory + 1 hour classroom practicals)

1.1. Nature and some properties.

1.2. X-rays.

1.3. Radioactive emission.

1.4. Interactions with living beings.

1.5. Biological effects.

1.6. Dose.

2. BIOPHYSICS OF THE CIRCULATORY SYSTEM (5 h theory + 1 h classroom practices + 2.5 h laboratory)

2.1. Fundamental principles of fluid statics and dynamics.

2.2.Energetics of laminar flow. Bernoulli equation.

2.3 Laws of circulation of real liquids. Traffic regimes. Viscosity. Pressure loss. Poiseuille Law. Hydrodynamic resistance.

2.4. Tension in the vascular wall. Laplace's law.

2.5. Effect of gravity on blood circulation.

3. FUNDAMENTALS OF MECHANICALS WAVES: VOICE PRODUCTION, AUDITION AND ULTRASOUNDS (5 H THEORY + 1 h classroom practical + 3 h laboratory practical)

3.1. Sound quality: intensity, tone and timbre. Ultrasounds.

3.2. Voice production.

3.3. Auditory transmission mechanisms. The middle ear as an impedance adaptor. Frequance discrimination and localization in the inner ear. Sound sensation thresholds.

4. BIOPHYSICS OF VISION (5 H THEORY + 1 h numerical problems + 3.5 h lab teaching)

4.1 The eye as an optical system. Ocular Dioptric. Resting eye power. Accommodation. The crystalline. Image formation in the retina. Presbyopia. Refraction defects: Myopia, hypermetropia. Correction. Visual acuity.

4.2 The eye as a sensory receptor.

Visual fototransduction. Cones and rods. Rhodopsin and iodopsines. Transduction and signal amplification. Membrane hyperpolarization. Retina sensibility. Photopic and Scotopic vision. Sensibility curve. Light/darkness adaptation.

4.3 Color vision. Visual trivariance. Iodopsines absorption curves. Color vision anomalies.

5. BIOPHYSICS OF THE RESPIRATORY SYSTEM. (5 hours of theory + 1 hour of classroom practices)

5.1 Structure of the respiratory tract.

5.2 Types of breathing. Effects of the external environment on respiration. Temperature and relative humidity regulation.

5.4 Respiratory mechanics.

5.5 The pulmonary surfactant.

5.6 Alveolar diffusion. Henry's law. Fick's law. Oxygenation of the blood in the states of health and disease.

6. RADIATIONS II. DIAGNOSTIC IMAGING (4 hours theory + 2 hours classroom practicals)

6.1. Tomographies.

6.2. Gammagraphy.

6.3. Positron Emission Tomography (PET).

6.4. Dual-Energy X-ray Absorptiometry (DXA).

6.5. Magnetic Resonance Imaging (MRI).

7. TRANSPORT PHENOMENA (6h theory + 2h numerical problems + 4h lab teaching)

7.1. Simple diffusion

7.2. Diffusion through membranes.

7.3 Osmosis and dialysis phenomena.

7.4. Biomedical examples.

Laboratory teaching program.

Practice 1.- Application of the laws of circulation of real liquids and elasticity to the blood circulation. Check for the loss of pressure throughout the circulatory system, blood pressure and venous, effect of the elasticity of the vessels on the arterial and venous pressures. Establish the relationships between the elasticity of the vessels, flow, pressure and hemodynamic resistance.

Practice 2.- Medical applications of ultrasounds - ecography

Practice 3.- Optics of the eye. Formation of images in an eye model. Ametropic simulation: myopia, hypermetropia, presbyopia.

Practice 4.- Diffusion through membranes: dialysis and osmosis. Experimental verification of the laws of diffusion

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory teaching	10	0.4	
Problems seminars	9	0.36	
Theory lectures	35	1.4	
Type: Supervised			
Programmed mentoring sessions	8	0.32	
Type: Autonomous			
Individual study. Bibiolgraphy handling.	49	1.96	
Problem resolution	30	1.2	

The student acquires the knowledge of the subject attending the theory lectures where it will be also guided on how and where to look for the formative complements to reach the objectives of the subject.

Through the seminars the student will be able to solve exercises and problems previously presented, with a closef interaction with the teacher.

Finally, the abilities related to this knowledge will be carried out in the practical teaching in the laboratory.

The theory lectures will be given with the whole group. Partitions of the group will be maced for problem seminars (2 groups) and for laboratory taeching (3 groups).

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
Partial and recovery exams of the knowledge acquired in the laboratory practices and in solving written problems	40%	4	0.16	CM20, CM21, SM21, SM22
Partial and recovery tests: theory and problems	60%	5	0.2	CM20, CM21, KM24, KM25, KM26

Evaluation and qualification of the course

The course will be evaluated continuously throughout the course in two partial exams (P1 and P2) eliminatory of matter. It is necessary to obtain a grade equal to or greater than 4.5 in each partial to be able to do average. Each of these exams will have the same weight in the final grade of the course: 50% P1 + 50% P2. To pass the course, an average score of the 2 partial exams equal to or greater than 5.0 is required.

The characteristics of these exams will be similar and will consist of two different types: a multiple choice test where theoretical knowledge and short-resolution problems will be evaluated; and another written part where the knowledge acquired in laboratory practices and problem solving will be evaluated. The qualification of each of these parts will be:

- Evaluation of the multiple-choice typology: 60%. It will consist of multiple-choice questions, with 4 answers, of which 1, 2 or 3 may be true. The wrong answers will subtract proportionally.

- Evaluation of the written typology of the knowledge acquired in the laboratory and in problem solving: 40%.

Final recovery exam: In the case of not passing the course through continuous evaluation, there will be a final recovery evaluation of the partial exam with a grade lower than 4.5, mandatory to make average. Students with a mark higher than 4.5 and lower than 5.0 may choose to make the partial (or partials) they consider, knowing that, to pass the course, the final average must reach a minimum mark of 5.0. This exam will have similar characteristics to the ones carried out during the course. The student can perform this recovery exam as long as he has been previously evaluated for at least one of the partial exams. In this recovery exam, a score equal to or greater than 4.5 is necessary to average P1 and P2. In the case of recovering the entire course (P1 and P2), a grade $\geq$ 5.0 must be achieved to pass it.Students, who have passed the two eliminatory tests and want to improve their grade, will be able to take a final exam of the entire course (P1 and P2). In this case, the final grade will always be the one obtained in the last exam.

Evaluation result: Numerical note with one decimal, from 0 to 10. Qualification: failed, approved, remarkable, outstanding, honors.

Non-evaluable student: the student who does not meet the requirements to recover will be classified as "non-evaluable". The qualifications of "not evaluable" will be obtained when the student has not taken any of the partial evaluation exams (P1 or P2).

From the second enrollment: the student has the option of taking the final recovery exam directly, with no partials.

Exam review procedure: one day will be scheduled after each exam to review it. The review will be done individually with the students who request it.

Single evaluation.

The single evaluation will consist of a synthesis test that will have two parts: (1) an objective test-type exam that will assess theoretical knowledge and short problem-solving; and (2) a written part that will assess the knowledge acquired in laboratory practices and problem-solving. The grading for each of these parts will be as follows:

Evaluation of the objective test-type section: 60%. It will consist of multiple-choice questions, with 4 possible answers, of which 1, 2, or 3 may be correct. Incorrect answers will be penalized proportionally.

Evaluation of the written section on the knowledge acquired in laboratory practices and problem-solving: 40%.

To pass the subject, an average score of 5.0 or higher is required for both sections combined.

The single evaluation will take place on the same date as the scheduled second partial exam of the continuous evaluation.

Students who have not passed the subject through the single evaluation will have the opportunity to take a final recovery exam that will have the same characteristics as the recovery exam of the continuous evaluation.

Students who have chosen the single assessment and have not appeared for the exam or the resit will be considered as "not evaluable."

In this course, the use of Artificial Intelligence (AI) technologies is permitted as an integral part of the work's development, provided that the final result reflects a significant contribution from the student in terms of analysis and personal reflection. The student must clearly identify which parts have been generated with this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final outcome of the activity. Non-transparency in the use of AI will be considered a lack of academic honesty and may lead to a penalty in the activity's grade, or more severe sanctions in serious cases.

Bibliography

- BIOFÍSICA (tercera edició) A.Aurengo, T. Petitclerc. (2008), McGrawHill and digital version

- BIOFÍSICA (3a edició) A.S. Frumento. (1995), Mosby/Doyma Libros.

- FÍSICA PARA CIENCIAS DE LA VIDA (llibre de problemes) D. Jou, J.E. Llebot, C.Perez-García. (1994), Ed. McGraw-Hill.

- SPEECH SCIENCE PRIMER L.J. Raphael. (2007), Ed. Lippincott Williams & Wilkins.

- RADIOBIOLOGY FOR RADIOLOGIST E.J. Hall, AJ.Giaccia. (2006) Ed. Lippincott Williams & Wilkins

Software

No specific software is required.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	511	Catalan/Spanish	first semester	afternoon
(PAUL) Classroom practices	512	Catalan/Spanish	first semester	afternoon
(PLAB) Practical laboratories	511	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	512	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	513	Catalan/Spanish	first semester	morning-mixed
(TE) Theory	51	Catalan/Spanish	first semester	afternoon