Biophysics

Code: 102962
ECTS Credits: 7

2025/2026

Degree	Type	Year
Medicine	FB	1

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

To profit the most from the course, the student should either possess or make the effort to acquire, the theoretical knowledge and the problem-solving competencies corresponding to higher secondary school courses in Physics and Mathematics.

Objectives and Contextualisation

The Biophysics course is part of the basic training in the first two years of the medical degree.

One of its main objectives is to explain the physical basis of the functioning of some of the organs and systems of the human body that have a strong physical component, both in health and under certain pathological conditions.

Another primary objective is to explain the physical bases of diagnostic and intervention techniques that define modern medicine, such as magnetic resonance imaging, ultrasound imaging, electrocardiograms, hemodialysis, and audiometric tests.

Finally, the course provides a physical foundation useful for other basic courses such as *Medical Physiology* or *Anatomy of the Musculoskeletal System*, as well as for clinical specialties such as Pathophysiology, Diagnostic and Interventional Radiology, Cardiology, Pulmonology, Otorhinolaryngology, and Ophthalmology.

Competences

- Communicate clearly, orally and in writing, with other professionals and the media.
- Critically assess and use clinical and biomedical information sources to obtain, organise, interpret and present information on science and health.
- Demonstrate a sufficient command of English, both oral and written, for effective scientific and professional communication.
- Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
- Demonstrate knowledge of the principles and physical, biochemical and biological processes that help to understand the functioning of the organism and its disorders.
- Demonstrate understanding of the basic sciences and the principles underpinning them.
- Demonstrate understanding of the mechanisms of alterations to the structure and function of the systems of the organism in illness.
- Demonstrate understanding of the structure and function of the body systems of the normal human organism at different stages in life and in both sexes.
- Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
- Use information and communication technologies in professional practice.

Learning Outcomes

1. Communicate clearly, orally and in writing, with other professionals and the media.
2. Demonstrate a sufficient command of English, both oral and written, for effective scientific and professional communication.
3. Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
4. Explain the physical bases of the structure and function of the systems of the human organism.
5. Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
6. Identify alterations to the structure and function of the biomolecules involved in vision.
7. Identify the basic processes of life on various levels of organisation: molecule, tissue, organ and individual.
8. Identify the physical principles that help to understand the functioning of the organism, at both cell and tissue level.
9. Identify the rules that govern energy transfer in the chemical processes of the human organism.
10. Use information and communication technologies in professional practice.
11. Use specific bibliographic sources and databases on biophysics to work independently on acquiring further knowledge.

Content

Unit 1. INTRODUCTION TO BIOMECHANICS AND ELASTICITY

Statics:
Balance of a body. Equilibrium conditions. Mechanical advantage of levers. Joints and degrees of freedom.

Gravity and balance:
Effects of gravity on the human body. Centre of gravity and body balance. Gravitational line and base of support.

Action of forces on solids:
Elasticity and Hooke's law. Energy of elastic deformation. Inelastic bodies and residual deformation. Viscoelasticity. Traction, compression, shearing, torsion and bending.

Physical properties of bones:
Bone elasticity and resistance. Architectural arrangement of bones.

Seminar:
Biomechanics of hip fracture.

Unit 2. BIOPHYSICS OF BLOOD CIRCULATION

Pressure:
Hydrostatic pressure as energy per unit of volume. Arterial pressures. Hydrostatic pressure in the systemic the pulmonary circuits. Ventricular pressures throughout the cardiac cycle. Opening and closing pressures of cardiac valves.

Viscous resistance and Poiseuille's equation:
Blood viscosity. Shear stress. Viscous resistance. Poiseuille's equation. Systemic vascular resistance. Resistances in series and parallel. Continuity equation. Effects of stenoses. Laminar and turbulent flows. Physics of aneurysm. Physics of atherogenesis.

Blood vessels:
Vascular wall tension and Laplace's law. Physics of vascular rupture. Vascular compliance.

Seminar:
Collaborative team work to apply the acquired theoretical foundations to understand various medically relevant scenarios. Physical principles of the electrocardiogram.

Unit 3. BIOPHYSICS OF RESPIRATION

Ventilatory mechanics:
Lung volumes and capacities. Mechanical pressures in ventilation. Basic respiratory cycle. Pulmonary compliance.

Partial pressures and alveolar exchange:
Partial pressure. Inspired air conditioning. Alveolar diffusion and Fick's law. Principles of oxygen therapy. P/F ratio. Blood oxygenation in health and limitations in pathological alterations. V/Q ratio.

Respiratory resistance:
Airway resistance. Alveolar surface tension and Laplace's law. Role of the pulmonary surfactant.

Seminar:
Collaborative team work to apply the acquired theoretical bases to understand different medically relevant scenarios. Physical principles of mechanical ventilation. Practice with a mechanical ventilation training simulator.

Unit 4. PHYSICAL FOUNDATIONS OF RADIATION - MEDICAL APPLICATIONS

Nature and properties of electromagnetic waves:
Electromagnetic spectrum. Production and properties of X-rays.

Fundamentals of radiology:
Radioactive emission. Activity. Particles types and interaction with matter. Ionization. Biological effects. Dosimetry and survival curves.

Medical applications:
Gamma imaging. DXA (Dual energy X-ray Absorptiometry). PET (Proton Emission Tomography).

Seminars (three):
Physics of imaging techniques with cases and examples (X-rays, DEXA, MRI, PET, scintigraphy). Radiation effects on the human body. Radiotherapy case studies.

Unit 5. BIOPHYSICS OF VISION

Geometric optics:
Principles of optical physics. Converging and diverging lenses. Image formation. Power-focal distance relationship.

The eye as an optical system:
Ocular structure and optical parameters. Crystalline lens accommodation mechanism. Maximum and minimum power. Near point and far point. Accommodation range. Presbyopia.

Ametropias - optical disorders:
Most common disorders: presbyopia, myopia, hyperopia and astigmatism. Correction ofthe different ametropias. Cataracts.

Photoreceptors and colour vision:
Retinal photoreceptors. Visual acuity. Molecular mechanisms of vision. Colour vision and anomalies.

Seminar:
Practical exercises will be conducted aimed at interpreting the basic information in optical vision evaluation, as well as calculating the different parameters involved as explained in the theory. We will understand, for example, what a "VL UD -1.5" prescription means and what would be, in this case, the farthest distance at which the eye could focus on objects without wearing corrective lenses.

Unit 6. DIFFUSION PHENOMENA - OSMOSIS AND DIALYSIS

Physical principles:
Simple diffusion and kinetic-molecular theory. Fick's law and diffusion coefficient. Diffusion through membranes. Osmosis, principles and applications. Dialysis, mechanisms and applications.

Seminar:
Study of clinical cases involving diffusion disorders. Osmotic imbalance case studies.

Unit 7. BIOPHYSICS OF VOICE PRODUCTION AND HEARING

Physics of Hearing and Audiometry:
Sound intensity and its perception. Decibel scale. Auditory thresholds. Damage threshold. The audiogram. Acoustic alterations in the most prevalent hearing losses. Equal-loudness contours. Recruitment.

Physics of voice production:
Aerodynamic-myoelastic explanation of phonation. Simple vs. complex sounds. Harmonics. Frequency spectrum and cochlear stimulus. Vocal tract resonances and vocal formants.

Audiology and physical principles of auditory analysis of speech sounds:
Acoustic impedance. Middle ear impedance matching. The Eustachian tube as an acoustic impedance equalizer. Inner ear: Tonotopic organization of the basilar membrane and analysis of complex sounds.

Seminar:

Simulation of hearing in patients with some of the most prevalent hearing losses; discussion of the consequences. Physics of tympanometry. Physics of cochlear implant; simulation of hearing with a cochlear implant.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices (PLAB)	15.5	0.62	1, 4, 5, 7, 6, 8
Seminars (SEM)	15.5	0.62	1, 3, 2, 4, 5, 7, 6, 8, 9, 11, 10
Theory classes (TE)	31	1.24	4, 5, 7, 6, 8
Type: Supervised			
Tutorials	3.5	0.14	1, 4, 7, 6, 8, 9
Type: Autonomous			
Study	64	2.56	2, 4, 5, 7, 6, 8, 9, 11, 10
Work to prepare the cases and problems for the seminar sessions; preparation of the laboratory practices	35	1.4	4, 5, 8, 11

Theory classes (TE): Plenary lectures.

Seminars (SEM): Active, meaningful, collaborative peer-learning, to transform knowledge into competencies. Study and discussion of scenarios, cases and problems of medical interest. Work is carried out in collaborative teams of 4-5 students. It is of utmost importance that the student studies the theory of the corresponding unit prior to the session -access to the session will not be permitted without verification of this preparatory work. In some cases, contents not covered in the theory classes will also be addressed and evaluated. There are 10 seminars associated with the different units. Although attendance is not compulsory, many of the competencies evaluated in the exams are acquired through the work that the student performs in the seminars.

Laboratory practices (PLAB): Five sessions where phenomena studied in theory classes and seminars are visualized and manipulated. Depending on the practice, work is carried out either in pairs or in collaborative teams. It is of utmost importance that the student studies the theory of the corresponding unit prior to the session.

- PLAB1 - Biomechanics of the Ankle (associated with Unit 1).
- PLAB2 - Model of the Systemic Vascular Circulation (associated with Unit 2).
- PLAB3 - Physics of Medical Ultrasound (autonomous unit, theoretical basis acquired during the practice).
- PLAB4 - Vision Optics (associated with Unit 5).
- PLAB5 - Voice and Hearing (associated with Unit 7).

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 1- Objective multiple choice test to evaluate theoretical and practical knowledge, and reasoning and problem solving competencies, Units 1, 2 and 3 Temes 1, 2 i 3 (lectures, seminars and labs) + ultrasound imaging lab.	42%	3.5	0.14	4, 7, 6, 8, 11
Partial 2- Objective multiple choice test to evaluate theoretical and practical knowledge, and reasoning and problem solving competencies, Units 4 and 5 (lectures, seminars and lab session).	34%	2.5	0.1	4, 7, 6, 8, 11
Partial 3- Objective multiple choice test to evaluate theoretical and practical knowledge, and reasoning and problem solving competencies, Units 6 and 7 (lectures, seminars and lab session).	24%	2	0.08	4, 7, 6, 11
Written reports - Laboratory practices results.	10%	2.5	0.1	1, 3, 2, 4, 5, 6, 8, 9, 11, 10

Continuous Assessment

The subject will be assessed throughout the course with three partial exams (P1, P2, and P3), which are eliminatory. Each of these partial exams will consist of an objective test aimed at demonstrating the integration of theoretical knowledge and the acquisition of practical skills from the corresponding seminars and laboratory practices. The tests will consist of multiple-choice questions with 4 answers, of which 1, 2, or 3 can be correct; incorrect answers will be penalized proportionally.

The scores for the partial exams must be equal to or greater than 4.5 to be averaged. This threshold, set below the passing grade (5.0), aims to ensure that no student feels penalized by a minimal difference of one or two tenths. Therefore, scores below 4.5 will not be negotiable.

The final grade for the subject will be obtained using the following formula: (P1*0.42 + P2*0.34 + P3*0.24)*0,9 + PLABs reports grade*0.1.

To pass the subject, the final grade must be equal to or greater than 5.0.

Make-up Exams

In the case of not passing the subject through continuous assessment, there is the option to re-evaluate the exams corresponding to the partials that have obtained a grade lower than 4.5.

It is important to note that, in accordance with Article 261.2 of the UAB Academic Regulations, to be eligible to participate in the makeup exam, students must have been previously assessed in a set of activities representing at least two-thirds of the total course grade.

The make-up exams will have the same format and objectives as the partial exams.

If more than one partial must be retaken, a single exam will be held with a single score, to which the combined percentage corresponding to those partials will be applied in the calculation of the overall grade. To be averaged, the score of this exam must be equal to or greater than 4.5. This threshold, set below the passing

grade (5.0), aims to ensure that no student feels penalized by a minimal difference of one or two tenths. Therefore, scores below 4.5 will not be negotiable.

To pass the subject after the make-up exams, the final average must reach a minimum grade of 5.0 (grade including the exams and practicals according to the same calculation indicated above). Otherwise, the maximum final grade obtained will be limited to 4.8.

Students with partial scores equal to or greater than 4.5, but with an overall average lower than 5.0 (grade including the practicals according to the formula indicated above), can opt for the make-up of the partial or partials they consider, by communicating their choice in advance to the coordinator by UAB email. In this case, the final score(s) of the partial(s) will always be the one obtained in the last exam.

Students with an overall grade equal to or higher than 5.0 from continuous evaluation, cannot take referral tests to improve their grade (UAB Academic Regulations, Article 266.6: "Once the course is passed, it cannot be re-evaluated. ")

Single evaluation

The single evaluation consists of a single synthesis test that covers all the contents in the course. Objective test with multiple choice items, with 4 answers, of which 1, 2 or 3 can be true; wrong answers subtract proportionally.

The test consists of two blocks:

- Evaluation of the integrated learning of theoretical knowledge plus practical skills acquired in the seminars and in the laboratory practices. 90% of the mark.
- Specific evaluation of the understanding of the concepts visualized in the laboratory practices. 10% of the mark.

The test will coincide with the date and time set in the Medical School's calendar for the test corresponding to the third partial of the continuous assessment.

To pass the course, the final mark must be equal to or higher than 5.0.

In case the test does not reach the 5.0 mark, a retake test, with the same single evaluation format, will be held on the same day and time set in the Medical School's calendar for the continuous evaluation.

Language of Exam Questions

The questions for the first partial exam will be bilingual (Catalan and Spanish). The questions for the remaining exams will be provided in Catalan.

Not Evaluable Student

Students who have only taken one of the partial exams will be considered 'Not Evaluable'.

Exam marking review

After each exam, the solutions will be published and a period will be opened to submit appeals regarding possible discrepancies. Subsequently, once the provisional grades have been communicated, a new period will be opened for the review of individual grades.

Proof of participation

If needed for employment-related reasons, the student may request a document certifying the participation in the various evaluation activities. The request must be sent by UAB email to the course coordinator.

Misconduct

In the event of student misconduct, such as copying in an exam, plagiarism of an evaluated report, or faking a

compulsory participation, the corresponding mark will be 0, irrespective of any disciplinary proceedings that may be conducted. In the event of a second irregularity, the final grade of the subject will be 0, irrespective of any disciplinary proceedings that may be conducted.

Bibliography

GENERAL

Physics of the Human Body. I.P. Herman (2007). Springer.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010401169706709

Medical Physics. Physical Aspects of Organs and Imaging. H. Zabel (2017). De Gruyter Textbook.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010485419506709

Handbook of Physics in Medicine and Biology, R. Splinter (2010). Boca Raton, CRC Press/Taylor & Francis Group.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010483189506709

Tratado de Fisiología Médica. J.E. Hall & M.E. Hall (2021). Elsevier.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010357582706709

Hyperphysics, introductory resource to Physics:
http://hyperphysics.phy-astr.gsu.edu/hbase/index.html

ADDITIONAL SPECIFIC

Unit 1: Fundamentals of Biomechanics. D. Knudson (2021). Springer Books.
e-book:
https://bibcercador.uab.cat/discovery/fulldisplay/cdi_springer_books_10_1007_978_3_030_51838_7/34CSUC_UA

Unit 2: The Mechanics of the Circulation. C.G. Caro *et al.* (2011). Cambridge University Press.
e-book:
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_askewsholts_vlebooks_9781139013406

Unit 3: Fisiología respiratoria: lo esencial en la práctica clínica. W. Crisancho (2022). Ed. El Manual Moderno.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010619939306709

Unit 4: Radiobiology for the Radiologist. E.J. Hall et al. (2018), Ed. Lippincott Williams & Wilkins.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_proquest_ebookcentral_EBC5829217

Unit 5: Physics of the Human Body. I.P. Herman (2007). Springer. Chapter 11.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010401169706709

Unit 6: Medical Physics. Physical Aspects of Organs and Imaging. H. Zabel (2017). De Gruyter Textbook.
e-book: https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010485419506709

Unit 7: Tratado de Audiología. Enrique Salesa etal. (2013). Elsevier-Masson.
e-book:
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_askewsholts_vlebooks_9788445823958

Software

Praat software for voice analysis in auditory laboratory work.

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
(PLAB) Practical laboratories	101	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	102	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	103	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	104	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	105	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	106	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	107	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	108	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	109	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	110	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	111	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	112	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	113	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	114	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	115	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	116	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	117	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	118	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	119	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	120	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	101	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	102	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	103	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	104	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	105	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	106	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	107	Catalan/Spanish	annual	morning-mixed

(SEM) Seminars	108	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	109	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	110	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	111	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	112	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	113	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	114	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	115	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	116	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	117	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	118	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	119	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	120	Catalan/Spanish	annual	morning-mixed
(TE) Theory	101	Catalan/Spanish	annual	afternoon
(TE) Theory	102	Catalan/Spanish	annual	afternoon
(TE) Theory	103	Catalan/Spanish	annual	afternoon
(TE) Theory	104	Catalan/Spanish	annual	afternoon