Universitat Autònoma de Barcelona

2021/2022

Physics, Abstraction and Computation

Code: 104402
ECTS Credits: 9

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OB	3	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: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Teachers

María del Pilar Casado Lechuga

Prerequisites

There are no prerequisites.

Objectives and Contextualisation

Introduction to Physics as a paradigm of empirical science. Exemplary problems from different physical disciplines will be presented. Theories that describe them will be introduced, analyzing and justifying the abstraction that they entail. The general principles of these theories and their mathematical formulation will be identified, and the numerical methods necessary to tackle complex problems of difficult analytical solution will be presented.

Competences

- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.
- Design, develop and evaluate efficient algorithmic solutions to computational problems in accordance with the established requirements.
- Make effective use of bibliographical resources and electronic resources to obtain information.
- Plan and carry out studies of physical system using analytical or numerical methods and interpret the results.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

- Using criteria of quality, critically evaluate the work carried out.

Learning Outcomes

1. Make effective use of bibliographical resources and electronic resources to obtain information.
2. Mathematically describe movement and identify the quantities conserved.
3. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
4. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
5. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
6. Understand physical concepts and their mathematical formulation in field theory and statistical mechanics.
7. Use numerical methods to solve problems in optics.
8. Use variational methods and disturbances and statistics to understand systems of more than two bodies, fluids and gases.
9. Using criteria of quality, critically evaluate the work carried out.

Content

1. Physical quantities: Units and dimensional analysis. Measurements, precision, significant figures, statistical and systematic uncertainties.
2. Coordinate systems. The conception of space and time from Newton to Einstein.
3. Mathematical description of motion. Newton's Laws and their applications.
4. Kinetic energy and work of a force. Potential energy. Potential for a conservative force.
5. Forces and potentials of gravitational, electrical and magnetic interactions. Effective forces and potentials.
6. Lagrange and Hamilton Mechanics. Principle of minimum action.
7. Oscillations and wave motion.
8. Light. Physical and Geometrical Optics.
9. Introduction to statistical mechanics. Phase space. Partition functions. Gases.
10. Introduction to quantum mechanics. The Hydrogen atom.

Methodology

Notice: The proposed teaching methodology and assessment may be subject to change depending on attendance restrictions imposed by health authorities.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercise resolution sessions	33	1.32	9, 6, 2, 3, 4, 7, 8
In-depth seminars	5	0.2	6, 2, 5, 1, 7, 8
Theory Classes	33	1.32	6, 2, 5, 1, 7, 8
Type: Autonomous			

Exercise resolution	60	2.4	9, 6, 2, 3, 4, 1, 7, 8
Study	60	2.4	6, 2, 5, 4, 1, 7, 8
Tutorials with professors	20	0.8	6, 2, 7, 8

Assessment

The competences acquired will be evaluated by the Continuous Assessment method, which will include two types: Deliveries of Exercises (individual or collective) and Continuous Evaluation Tests.

The Continuous Assessment will be carried out in a total of 6 actions distributed throughout the school period. The types of actions will be:

- 4 Delivery of Exercises (individual or collective) that will have a weight of 10.0% in the final grade each and will not be recoverable.
- 2 Continuous Assessment Test that will have a weight of 30.0% in the final grade each and will be recoverable.

Each Continuous Assessment Test will only contribute to the final grade if 35.0% of the maximum score for said test is reached.

Deliveries will consist of carrying out an analysis of a physical system before a deadline and summarizing said analysis in a report that will be delivered in writing or by telematic means. This will allow students to demonstrate their understanding of the contents of the theory classes and solving exercises and the acquisition of skills.

The Tests will consist of solving exercises and / or answering questions in writing or by telematic means, in person or virtually, with a limited time. This will allow students to demonstrate their understanding of the contents of the theory classes and solving exercises and the acquisition of skills.

The place and form of delivery, as well as the date and time of the tests or the deadline date and time of the deliveries will be announced through the Moodle Classroom at least one week in advance.

The place, date and time of the reviews of the results of the evaluations will be announced through the Moodle Classroom 48 hours in advance.

The condition to pass the course will be to obtain at least 50% of the maximum score.

The Honor grade will be assigned, within the allowed quotas, to students who demonstrate sustained very high academic performance throughout the school term.

The condition of Not Evaluable will be applied to students who do not take some or all of the Continuous Assessment Tests without just cause.

The correction of the Continuous Assessment Tests and the Exercise Deliveries will take into account the correct application of the contents of the subject to solve the proposed exercises and also the way in which the solutions and results are presented. In particular, solutions will be required to be presented in an orderly manner, with an appropriate level of detail, and to follow a logical flow of resolution.

Without prejudice to other disciplinary measures that are deemed appropriate, and in accordance with current academic regulations, irregularities committed by the student that may lead to a variation in the rating of an evaluation act will be graded with a zero. Therefore, copying or allowing a practice or any other assessment activity to be copied will imply failing with a zero, and if it is necessary to pass it to pass, the entire subject will be suspended. Assessment activities graded in this way and by this procedure will not be recoverable, and therefore the subject will be suspended directly without the opportunity to recover it in the same academic year.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous Assessment Tests	60	4	0.16	9, 6, 2, 5, 3, 4, 7, 8
Delivery of exercises (individual or collective)	40	10	0.4	6, 2, 5, 3, 4, 1, 7, 8

Bibliography

Any text of Introduction to Physics at the university level is suitable for the subject. Volumes 1 and 2 of the following bibliographic reference are taken as the standard reference:

AUTOR: Tipler, Paul Allen
TITOL: Física : para la ciencia y la tecnología / Paul A. Tipler, Gene Mosca
EDICIO: 6ª ed.
PUBLICACIO: Barcelona [etc.] : Reverté, 2010
ISBN: 9788429144291 (v. 1) (Vol. 1. Mecánica, oscilaciones y ondas, termodinámica) 9788429144307 (v. 2) (Vol. 2. Electricidad y magnetismo / Luz)

NOTE: Electronic version in Catalan available through the UAB Library.

Software

Open access or campus licensed software will be used:

- Spreadsheets (Excel, Libreoffice, Google Sheets)
- Free websites for graphing functions (desmos.com, GeoGebra)
- Programming environment (python recommended, C or C ++ accepted