

Physics, Abstraction and Computation

Code: 104402
ECTS Credits: 9

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OB	3	1

Contact

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Teaching groups languages

You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Maria del Pilar Casado Lechuga

Prerequisites

There are no prerequisites. It is recommended to have passed all first and second year mathematics subjects. Basic programming knowledge is recommended.

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 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

- Measurement units. Coordinates. Motion and Newton's laws.
- Energy and momentum. Conservation laws.
- Central forces: Gravity and electromagnetism.
- Analytical mechanics: Lagrange and Hamilton equations.
- Numerical methods in optics.
- Introduction to statistical mechanics.
- Introduction to quantum mechanics.

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
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Type: Directed

Exercise resolution sessions	34	1.36	9, 6, 2, 3, 4, 7, 8
Theory Classes	35	1.4	6, 2, 5, 1, 7, 8
Type: Autonomous			
Exercise resolution	80	3.2	9, 6, 2, 3, 4, 1, 7, 8
Study	54	2.16	6, 2, 5, 4, 1, 7, 8
Tutorials with professors	15	0.6	6, 2, 7, 8

Assessment

Continuous Evaluation:

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

The Continuous Evaluation will be carried out in a total of 7 actions distributed throughout the school period. The actions according to the typology will be:

- 2 Exercise Delivery actions (individual or collective) that will have a weight of 15.0% in the final grade each and will not be recoverable.
- 5 Assessment Test actions that will have a weight of 14.0% in the final grade each and will not be recoverable.

The Deliveries will consist of carrying out an analysis of a physical system before a deadline date and summarizing said analysis in a report that will be delivered in writing or by electronic means. This will allow students to demonstrate their understanding of the contents of the theory classes and resolution of 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 resolution of 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 Aula Moodle at least one week in advance.

The place, date and time of the reviews of the evaluation results 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 Matricula de Honor grade will be assigned, within the allowed quotas, to students who demonstrate a very high academic performance sustained throughout the school period.

The condition of Not Assessable will be applied to students who do not take any of the Continuous Assessment Tests without just cause.

The correction of the Continuous Assessment Tests and of the 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, it will be required that the solutions be presented in an orderly manner, with an appropriate level of detail, and that they follow a logical resolution flow.

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, irregularities committed by the student that may lead to a variation in the grade of an evaluation act will be graded with a zero. Therefore, copying or allowing a practice or any other evaluation 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 failed. The evaluation activities graded in this way and by this procedure will not be recoverable, and therefore the subject will be directly suspended without the opportunity to recover it in the same academic year.

Single Evaluation:

The competences of the subject will be evaluated, in an exceptional and justified way, by the Single Evaluation method, which will include the same typologies as the Continuous Evaluation.

The Single Assessment will be carried out on a single date, the Single Assessment day. On this day, evaluation actions similar to those of the Continuous Evaluation will be carried out, but concentrated in a single day:

- 2 actions of Delivery of Exercises that will have a weight of 15.0% in the final grade each and will not be recoverable. The Submissions will correspond in content to their counterparts in the Continuous Evaluation and will be delivered at the beginning of the Single Assessment day.
- 5 Assessment Test actions that will have a weight of 14.0% in the final grade each and will not be recoverable. The Tests will correspond in content to their counterparts in the Continuous Assessment and will be carried out in periods of 50 minutes interspersed with 10-minute breaks.

Apart from its execution over time, the Single Assessment will be governed by the same rules as the Continuous Assessment.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous Assessment Tests	70%	5	0.2	9, 6, 2, 5, 3, 4, 7, 8
Delivery of exercises (individual or collective)	30%	2	0.08	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)