Universitat Autònoma de Barcelona

**2022/2023**

# Mechanics Laboratory

Code: 100150
ECTS Credits: 5

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2500097 Physics | OB | 2 | 1 |

## Contact

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## Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

## Other comments on languages

The teaching of the subject is done indistinctly in Catalan / Spanish

## Teachers

Lluís Font Guiteras
Markus Gaug
Immaculada Martinez Rovira
Miguel Ángel Caballero Pacheco

## Prerequisites

It is very convenient to have solid knowledge of the fundamental laws and the theoretical principles of General Physics, acquired during the first semesters of the Degree in Physics as well as the double degrees of Physics and Mathematics and Physics and Chemistry. It is recommended that each student review these knowledge to carry out this subject. It is also convenient to refresh the theoretical and practical knowledge acquired in the subject Initiation to Experimental Physics in the first year.

## Objectives and Contextualisation

The objectives of the Mechanics and Wave Laboratory can be summarized as follows:

1. To apply the fundamental laws and the theoretical principles of General Physics acquired by the student during the first semesters of the Physical Degree as well as of the Degree of Physics and Mathematics and of Physics and Chemistry
2. To consolidate the competences related to an experimental subject: importance of the instrumentation in the design of experiments, use of measuring devices, acquisition of data in the laboratory, introduction to the methods of data analysis, use of computers in the laboratory , etc.
3. Awakening in the student a critical mentality that refers to the level of confidence of their measurements, the calculation and the interpretation of the results.

4. To motivate the student in the bibliographic research to interpret the experimental results and / or deepen in other approaches on a given experiment.To

## Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts
- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Plan and perform, using appropriate methods, study, research or experimental measure and interpret and present the results.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Use computer tools (programming languages and software) suitable for the study of physical problems
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project
- Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.

## Learning Outcomes

1. Analyse and assess the adequacy of the assemblies prepared and carried out, in order to obtain measurements and the desired results.
2. Analyse the influence of various parameters on the simulation of an experiment.
3. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
4. Correctly assess the uncertainty associated with a measure or set of measures.
5. Describe physical phenomena, identify variables, analyse the influence, presenting the results and conclusions of the work developed in a clear and precise manner.
6. Describe the function and manner of operation of the measuring instruments used.
7. Determine and measure the variables that describe a physical system.
8. Discriminate to the most important dependencies and draw the most conclusions from a set of experimental measurements.
9. Explain the explicit or implicit code of practice of one's own area of knowledge.
10. Foster discussion and critical thinking, evaluating the precision and characteristics of the results obtained.
11. Identify the social, economic and environmental implications of academic and professional activities within one's own area of knowledge.
12. Suitably present the results of a series of measures through graphs and perform linear regressions.
13. Use basic programmes to write reports and carry out basic data processing.
14. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
15. Use digital sensors for measuring magnitudes.
16. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.
17. Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.
18. Write and present the results and conclusions of experimental work with rigor and conciseness.

## Content

This subject has a total teaching load of 5 ECTS credits, the attendance part of which is distributed in theory sessions at the beginning and the practical sessions below.

The theory classes represent 10 hours in person where the following points are discussed
1. General introduction: framework and objectives of the subject, general norms, evaluation criteria, practical and examinations, group formation.
2. Presentation of laboratory practices.
3. Procedures: elaboration of the report of practices, presentation and discussion of tables and graphs, notions of statistics, calculation of uncertainties, linear regressions, analysis and interpretation of the main results.

The final list of practices to be done in the laboratory will be uploaded to the virtual campus and will be delivered to the students at the start of the course. Provisional list of available practices (this list may vary depending on the availability of the material):

1. The sonometer.
2. Oscillations.
3. Non-relativistic collisions.
4. Relativistic collisions.
5. Coupled oscillations.
6. Rotation.
7. Analysis and synthesis of waves

## Methodology

- General rules

Student assistance is mandatory. An absence without previous justification will imply a qualification 0 in the corresponding practice. Two absences without justification imply the possibility of passing the subject. Justified absences should be recovered.

The students will have to be punctual and delays will not be accepted. In the same way the time of completion of the practice session must be respected.
Before entering the laboratory, students must leave their personal belongings in the adequate spaces.
It is mandatory for each student to have the necessary material (laptop, notebook, pens, pencils, rules, calculator, memory pen, etc.) to perform the demonstrations. Each group must have a lab book that will be evaluable.
Given the fragility of the material used in the demonstrations, the highest attention and delicacy in handling is demanded and the corresponding recommendations have to be followed in order to prevent it from becoming damaged. This material will remain under the responsibility of the students, who can not leave the laboratory without the supervisors having checked their good condition.

The students should have an appropriate behavior within the laboratory. Therefore, it is strictly prohibited to smoke, eat, make noise and talk on a mobile phone.

The preparation of a practice begins before entering the laboratory and, therefore, it is indispensable to have previously read the practice guideline. The teachers reserve the right to qualify with 0 to the student who has not done this preparation properly.

- Completion of practices

In the laboratory, keep an active attitude and give maximum attention and delicacy in the realization of the experimental assemblies. The acquisition of data must be carried out in an orderly and clear manner, an essential aspect for its analysis and the interpretation of the corresponding results. At the beginning of the course, the number ofreports to be prepared, both individually and as a group, will be specified. The reports must consist of the following parts: introduction and objectives, results, conclusions, bibliography and an annex where the expressions used for the evaluation of uncertainties are detailed. All the results obtained in tables

with the uncertainties and corresponding units must be presented correctly. The uncertainties must have at most two significant figures. The graphs must be presented indicating the magnitudes represented, the corresponding units, the bars of uncertainties and the results of the adjustments if applicable.

All those students who have a laptop that use it for recording experimental data are advised, which greatly facilitates the subsequent work of the report.

- Presentiallity

Laboratory practices will be presential. In the event of contingencies due to possible access restrictions, procedures will be established to carry out a part of them virtually, using the Virtual Campus platform.

The activity "Introduction and preparation of the subject" will take place semi-presentially, with a virtual part, through the Virtual Campus platform.

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 | | | |
| Introduction and presentation of the subject | 10 | 0.4 | |
| Practical tasks at the laboratory | 30 | 1.2 | |
| Type: Supervised | | | |
| Supervision of the first practical report | 6 | 0.24 | |
| Type: Autonomous | | | |
| Preparing demonstrations | 15 | 0.6 | |
| Reports from demonstrations | 60 | 2.4 | |

## Assessment

The qualification of this subject will be based on the work done both in group and individually.

- Each student must carry out an individual practical examination at the laboratory (practical final exam).
- Students must submit an individual report about their practical work in the laboratory sessions..
- In addition, the professors evaluate the work done by each group in the laboratory, as well as their preparation of each practical session (laboratory note). This part of the assessment represents the continuous follow-up of the work done by each group.

The final grade of the subject is obtained as follows:

Final grade = Laboratory marks x 0.4 + Report's mark x 0.2 + Practical Exam x 0.4

In order to pass the subject, it is required to have an evaluation of all of the three (practical exam, report delivery and laboratory note). Professors reserve the right to conduct individual interviews when they deem it necessary.

At the beginning of the course, the specific evaluation criteria of each of the assessment activities will be specified.

Given the practical nature of the subject and given the follow-up in continuous evaluation throughout the course of the students, no repesca examination is foreseen.

## Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Final practical exam | 40% | 4 | 0.16 | 1, 4, 3, 6, 5, 7, 8, 10, 12, 14, 16, 15 |
| Laboratory qualification | 40% | 0 | 0 | 1, 2, 4, 6, 5, 7, 8, 10, 12, 18, 17, 13 |
| Reports from demonstrations | 20% | 0 | 0 | 1, 2, 4, 3, 6, 5, 8, 9, 10, 11, 12, 14, 18, 16, 17, 13 |

## Bibliography


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S. Burbano de Ercilla, E. Burbano García, C. Garcia Muñoz. Física general. Editorial Tébar, SL. Madrid, 32ª edició (2003).

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## Software

Specific software not required