# COURSE DATA

## DATA SUBJECT

**Code:** 34266
**Name:** Introduction to experimental physics
**Cycle:** Undergraduate Studies
**ECTS Credits:** 6
**Academic year:** 2025-26

## STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1105 - Degree in Physics | Facultat de Física | 1 | Second quarter |

## SUBJECT-MATTER

| Degree | Subject-matter | Character |
|---|---|---|
| 1105 - Degree in Physics | Physics | BASIC |

## COORDINATION

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# SUMMARY

*Introduction to Practical Physics* is a basic training course in the first year of the Degree in Physics. It is complemented by Physics I (first semester), II and III (second semester). It consist of 15 hours of lecture classes and 45 hours of laboratory work.

This is a basic subject in at least two aspects: the first one is the consolidation and experimental realization of the abstract concepts introduced in the lectures; the second one is the achievement of correct practice in laboratory work (taking data and analyzing it), which leads to the statistical treatment and analysis of uncertainties. Do not forget that physics is an experimental science, and that through the current teaching plan, students will meet with several laboratories in the coming years. Another fundamental aim of this course is to familiarize the student with handling measurement devices and managing quantities, units and uncertainties.

Curriculum keywords:

Laboratory work is based on simple experiments in different branches of physics, chosen for their experimental and conceptual
relevance. Introduction to data analysis: direct measurements, determination and propagation of

uncertainties, statistical analysis, linear fit, data registration, presentation and analysis of data, basic instrumentation, references and scientific communication of results.

## PREVIOUS KNOWLEDGE

### RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

### OTHER REQUIREMENTS

Most of the students in the first year of the Degree in Physics have scarcely had contact with experiments in a laboratory in physics, so this course should serve to establish the basis of experimental skills in further laboratory courses

## COMPETENCES / LEARNING OUTCOMES

### -

Ability to collect and interpret relevant data in order to make judgements.

Basic & applied Research: acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.

Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.

Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.

Have become familiar with most important experimental methods and be able to perform experiments independently, estimate uncertainties, as well as to describe, analyse and critically evaluate experimental data according to the physical models involved. Know how to use basic instrumentation.

Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.

Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.

Literature Search: be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.

Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.

Physics general culture: Be familiar with the most important areas of physics and with those approaches which span many areas in physics, or connections of physics with other sciences.

Prob. solving and computer skills: be able to perform calculations independently, even when a small PC or a large computer is needed, including the development of software programmes.

Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

Theoretical understanding of physical phenomena: have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena).

To know how to apply the knowledge acquired to professional activity, to know how to
solve problems and develop and defend arguments, relying on this knowledge.

## DESCRIPTION OF CONTENTS

Dimensional analysis. Orders of magnitude. SI: International System of Units
Fundamental and derived quantities
Direct measurements. Estimation of uncertainties. Absolute and relative uncertainties:
Significant digits.
Statistical analysis of uncertainties. Type A and Type B uncertainties.
Mean value and variance of a distribution.
Propagation of uncertainties
Linear interpolation.

## 1. THEORETICAL CLASSES

Dimensional analysis. Orders of magnitude. SI: International System of Units
Fundamental and derived quantities
Direct measurements. Estimation of uncertainties. Absolute and relative uncertainties:
Significant digits.
Least squares fits.

## 2. LABORATORY

Experiments:
Measurement of fundamental quantities
Ohm's law and resistances
Hooke's law and oscillations
Geometrical optics: reflection and refraction
Density and viscosity
Calorimetry
Sonar-based movement analysis
Moments of inertia
Electromagnetic induction
Spectroscopy
Geometrical optics: Imaging
Interference and Diffraction

# WORKLOAD

## PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Theory | 15,00 |
| Laboratory | 45,00 |
| **Total hours** | **60,00** |

## NON PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Attendance at other activities | 0,00 |
| Individual or group project | 65,00 |
| Independent study and work | 0,00 |
| Preparation of lessons | 15,00 |
| Preparation for assessment activities | 10,00 |
| Resolution of case studies | 0,00 |
| **Total hours** | **90,00** |

# TEACHING METHODOLOGY

The course has two parts with a distinct methodology: 1) Lectures, and 2) Laboratory.

**Lectures**

The lectures are structured in sessions that take place during the first weeks of the course.

- The teacher explains the different topics interacting with students.
- Students will solve a series of exercises and problems.

**Laboratory work**

The course is structured in 3h/session. In each session 16 students are grouped in pairs and guided by one teacher. Attendance to these sessions is mandatory and a necessary condition for pass the course (non-recoverable activity).

The students must attend the lab having previously read the script of each experiment to be performed in each session (previously known). At the beginning of the session the teacher will monitor the understanding of that script and he will guide students on conceptual and technical aspects necessary to record experimental data.

Each student or pair will record (using a logbook or any digital format) data acquired in the laboratory, including estimations of the different magnitudes, tables and graphs, and any relevant comments on the implementation of the experiment. Teachers may request these annotations to students at any moment.

Students will be supervised during the session by the teacher, helping with correcting errors and work habits.

## EVALUATION

Attendance to all the lab sessions is mandatory and a necessary condition for passing the course.

**LECTURES: 25%**

Exercises and questions solved by the students during the lectures or in "Aula Virtual" will be considered. Also, a written test with practical exercises will be done. The minimum score in the written test is 4/10 to average with the laboratory score.

**LABORATORY: 75%**

Each pair of students must submit a brief report for all the laboratory practices, including measurement data, the corresponding analysis (uncertainties, graphics, statistical fits, etc.), together with the results, also including a results discussion and conclusions.

From two selected (by teachers) laboratory practices, a complete report with the following sections must be presented: introduction, material and methods, results, discussion, and conclusions. It is not necessary to submit a brief report for these two practices.

Lastly, an oral presentation of one of the laboratory practices will be evaluated, which will take place at the end of the course.

The minimum score for the work related to laboratory practices is 5/10 to average with the theory part.

In case of not passing the minimum grade in the written test or in the laboratory part, an exam will be carried out in the second call for the part not passed.

## REFERENCES

Basic:

- John R. Taylor. "Introducción al análisis de errores: el estudio de las incertidumbres en las mediciones físicas". Editorial Reverté, Barcelona, 2014.
- G.L. Squires. "Practical Physics", Third edition, Cambridge University Press, 1998.
- P.R. Bevington and D. K. Robinson. "Data Reduction and Error Analysis for the Physical Sciences", McGraw-Hill International Editions Physics Series, Second Edition 1994.

Additional:

- Carlos Sánchez del Río. "Análisis de errores", EUDEMA UNIVERSIDAD: Textos de Apoyo, 1989.