VNIVERSITAT DE VALÈNCIA

COURSE DATA

Data Subject	
Code	34266
Name	Introduction to experimental physics
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	1	Second term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	1 - Physics	Basic Training

Coordination

Name	Department
GONZALEZ DE LA HOZ, SANTIAGO	180 - Atomic, Molecular and Nuclear Physics
JIMENEZ MUÑOZ, JUAN CARLOS	345 - Earth Physics and Thermodynamics

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

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- 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.
- Ability to collect and interpret relevant data in order to make judgements.
- 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 .
- Theoretical understanding of physical phenomena: have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena).
- 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.
- 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.
- 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.
- 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.
- 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.
- Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.
- 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.
- 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 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 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.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

- Knowing the basic processes, techniques and measurement tools used in the different fields of physics.

- Applying the scientific method to the experimental work performed in the lab.

- Learning to design and perform a simple experiment, relating the concepts learned in the Physics I, II and III with the laboratory work.

- To acquire skills in the use of measuring instruments. Learning to read scales and establish uncertainty intervals for the measurements. To learn how to determine the necessary number of measurements depending of their deviation.

- Interpreting the measurements obtained in the laboratory and making the relevant analysis to obtain the final results and the desired physical quantities.

- To express the physical quantities correctly and evaluate their uncertainties. To distinguish between systematic errors and random errors. Applying error propagation and determine the accuracy of the results.

- Learning how to make tables and graphs, with information explained in a clear and concise way.

- Learning probability concepts and especially Gaussian distribution.

- Fitting data to lineal models and obtaining physical magnitudes from the parameters calculated.

- Being able to analyse the adequacy of the mathematical fits to the experimental data.

- Developing physical intuition, making preliminary estimations of quantities from the measurements to distinguish what is relevant.

- Distinguishing erroneous results and analyze their possible causes.

- Knowing how to interpret experimental results, on the basis of physics laws.

- Preparing report on the process of measurement, data analysis and interpretation of results.

- Using software applications, data processing equipment and data analysis.

DESCRIPTION OF CONTENTS

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.
Statistical analysis of uncertainties. Type A and Type B uncertainties.
Mean value and variance of a distribution.
Propagation of uncertainties
Linear interpolation.
Least squares fits.

2. LABORATORY CLASSES

The logbook.
Measurement of fundamental quantities.
Ohm's Law. Resistance association.
Hooke's law
Energy conservation: the Maxwells wheel
Elasticity
Moment of inertia
Density and viscosity
Calorimetry
Electromagnetic induction
Optics
Interference and Diffraction
Spectroscopy

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	45,00	100
Theory classes	15,00	100
Development of group work	0,00	0
Development of individual work	48,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	18,00	0
Resolution of case studies	4,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The course has two parts with a distinct methodology:

1) Lectures

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. 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 will have a logbook where he must record data, with tables and graphs, and any relevant comments on the implementation of the experiment. 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%

Written exam with practical exercises. Also, the exercises and questions solved by the students during the lectures or in "Aula Virtual" will be considered. The minimum score to pass in the written exam is 4/10.

LABORATORY: 75%

Each pair of students must submit a brief report with measurement data, the corresponding analysis (uncertainties, graphics, etc.), together with the results and conclusions.

Additionally, each pair of students must submit one complete report following the structure of a scientific paper (introduction, material and methods, results, discussion, and conclusions).

The minimum score to pass this part is 5/10.

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

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

TEACHING METHODOLOGY:

In case that health situation requires blended teaching, the teaching model approved by the Academic Degree Committee on July 23, 2020 will be adopted, consisting of 100% student attendance in all activities, with 50% capacity in classrooms for lectures.

If a total reduction in attendance is necessary, classes will be broadcast by synchronous videoconference at their regular schedule, along the period determined by the Health Authority.