COURSE DATA

Data Subject	
Code	34266
Name	Introduction to experimental physics
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

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
CASTILLO GIMENEZ, M VICTORIA	180 - Atomic, Molecular and Nuclear Physics
HERNANDEZ LUCAS, MARIA JESUS	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.
- Capacity to communicate information, ideas, problems and solutions to a specialist and a general audience.
- Developing learning skills so as to undertake further studies with a high degree of autonomy.
- 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.
- 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.

- 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.
- Resolución de problemas: Ser capaz de evaluar claramente los órdenes de magnitud, de desarrollar una percepción de las situaciones que son físicamente diferentes pero que muestran analogías, permitiendo, por lo tanto, el uso de soluciones conocidas a nuevos problemas. Adquirir intuición física, evaluando la importancia relativa de las diferentes causas que intervienen en un fenómeno físico.
- Comprensión teórica de los fenómenos físicos: Conocer y comprender los fundamentos de la Física, así como del bagaje matemático para su formulación, de los fenómenos físicos involucrados y de las aplicaciones más relevantes.
- Modelización y resolución de problemas: Saber resolver problemas, siendo capaz de identificar los elementos esenciales de una situación y de realizar las aproximaciones requeridas con objeto de reducir los problemas a un nivel manejable.
- Destrezas Generales y Específicas de Lenguas extranjeras: Mejorar el dominio del inglés científico-técnico mediante la lectura y acceso a la bibliografía fundamental de la materia.
- Ser capaz de profundizar en las diferentes ramas de la física estudiadas en las materias de cursos posteriores, a partir de los conceptos básicos adquiridos en esta materia, integrando formalismos matemáticos y conceptos más complejos.
- Búsqueda de bibliografía: Ser capaz de buscar y utilizar bibliografía en Física y otra bibliografía técnica, así como cualquier fuente de información relevante para trabajos experimentales.

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

English version is not available

METODOLOGÍA DOCENTE:

Durante el mes de febrero 2021, la docencia de teorías y seminarios-trabajos tutelados, pasan a modalidad de videoconferencia síncrona impartida en el horario fijado por la asignatura y el grupo.

A partir del 1 de marzo, se seguirá la modalidad docente indicada en la Guía Docente y a las modalidades docentes aprobadas en las Comisiones Académicas de Título de los meses de julio 2020 y noviembre 2020, respectivamente, salvo que las autoridades sanitarias y Rectorado indican una nueva reducción de presencialidad, en cuyo caso se volvería a la modalidad de videoconferencia síncrona.