COURSE DATA

Data Subject	
Code	34254
Name	Quantum physics laboratory
Cycle	Grade
ECTS Credits	5.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	3	Annual

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	10 - Experimental physics laboratory	Obligatory

Coordination

Name	Department
PEREZ CAÑELLAS, ARMANDO	185 - Theoretical Physics

SUMMARY

Experimentation plays an essential role in physics, not only as a direct source of knowledge but also as a means to validate or refute the theories proposed. Laboratory work in physics studies should be designed primarily to make students understand this crucial role. The subject of "Quantum Physics Laboratory" is designed to try to achieve this goal in a field of physics that requires, at a theoretical level, a high level of mental abstraction. Thus, laboratory experiments proposed aim, on the one hand, a phenomenological-historical introduction to quantum ideas (photon energy levels in atoms, momentum - wavelength relationship...) that led to the birth of quantum mechanics and, moreover, a better conceptual understanding of it.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is assumed that the student knows some general techniques of collecting and processing experimental data (measurements, errors, graphics, settings ...) have studied other subjects for laboratory, particularly physics laboratory in the first year. Regarding the necessary theoretical background is provided by the field of quantum physics to be studied simultaneously in Grade.

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 .
- 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.
- 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 processes, techniques and tools of basic quantum physics.

Developing an intuition about quantum physics concepts of the physical processes involved in the experiments.

Developing criticism through reasoned interpretation, from the quantum theory to the experimental results.

DESCRIPTION OF CONTENTS

1. LABORATORY EXPERIMENTS

1 Black body: Stefan-Boltzmann Law. Determination of Planck's constant
2 Millikans experiment. Electrons charge.
3 Photoelectric Effect: Measurement of stopping potential and determination of Planck's constant
4 Franck-Hertz experiment with mercury and neon. Estimation of the cross section for the inelastic collision of electrons with atoms.
5 X-ray: spectrum, determination of Planck's constant and characteristic peaks
6 Electron diffraction: determination of distances between atomic planes of graphite.
7 Diffraction through a slit and Heisenberg's uncertainty principle.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	50,00	100
Study and independent work	55,00	0
Preparation of evaluation activities	8,00	0
Preparation of practical classes and problem	12,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

- Laboratory sessions in small groups in which students conduct experimental work in groups and individually, taking measurements in experimental devices, and the recording of data and its preliminary analysis.
- Preparation of the experimental sessions and study of the theoretical aspects.
- Personal work for the study and interpretation of the observed phenomenology and
data processing, basic statistics, results, interpretations, conclusions and communication.

During the same year, theoretical training courses take place.

EVALUATION

1) Continuous assessment based on:

- Attendance, attitude and skills showed in the lab sessions as well as preparation and

prior to the laboratory sessions documentation.

- Notebook practices or logbook to collect experimental work, both in terms of collecting data as graphs,

analysis and more immediate results and their justification and argument. Special care will be paid the

appropriate management of orders of magnitude and units of measure.

- Practical tests in the laboratory.

2) An oral or writen examination, or a presentation.

70% of the grade will be based on those aspects included in the ongoing evaluation, plus 30% from the examination.

REFERENCES

Basic

- P. A. Tipler: Física Moderna, Ed. Reverté 1980
- C. Sánchez del Río: Física Cuántica, vol. I, Ed. Eudema Universidad 1991
- M. Alonso y E. J. Finn: Física, vols. II y III. Ed. Fondo Educativo Interamericano 1971

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. For lectures this model consist of 50% student attendance in the classroom, while the rest of students attend the class in streaming broadcast. Two groups will be set with alternate days attendance to the classroom in order to guarantee 50% of teaching hours attendance for all students. The rest of the teaching activities (laboratories and tutorials) will have a 100% attendance.

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.