COURSE DATA

DATA SUBJECT

Code: 34254
Name: Quantum physics laboratory
Cycle: Undergraduate Studies
ECTS Credits: 5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Facultat de Física	3	First quarter, Annual
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	4	First quarter, Annual
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	4	First quarter, Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
1105 - Degree in Physics	Experimental physics laboratory	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Cuarto Curso (Obligatorio)	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Cuarto Curso (Obligatorio)	COMPULSORY

COORDINATION

SANTAMARIA LUNA ARCADI

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 for collecting and processing experimental data (measurements, errors, graphic representations, fits ...) for having taken other laboratory subjects, particularly the Physics laboratory in the first year. The necessary theoretical background is provided by the Quantum Physics subject that must be taken either simultaneously or previously.

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.

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.

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

LABORATORY EXPERIMENTS

1- Black body: Stefan-Boltzmann Law. Determination of Planck's constant.

2- Millikan's experiment. Electron's 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.

8- Radiation from an incandescent filament.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	0,00
Laboratory	50,00
Total hours	**50,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	55,00
Preparation of lessons	12,00
Preparation for assessment activities	8,00
Resolution of case studies	0,00
Total hours	**75,00**

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.

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.

- Attendance to laboratory sessions is mandatory and a necessary condition to pass the subject (the activity can not be made up).

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.

Evaluation criteria are the same in both the first and the second call.

REFERENCES

- R. P. Feynman, *The Feynman Lectures on Physics III*, Addison-Wesley, 1964, 2005.

- C. Sánchez del Río (Coord.), *Física Cuántica*, Ediciones Pirámide, 2003.

- P. A. Tipler, R. A. Llewellyn, *Modern Physics*, 5th edition, W. H. Freeman, 2007.