Matrix quantum mechanics

Academic Year: (2023 / 2024) **Review date: 19/04/2023 08:46:34**

Department assigned to the subject: Physics Department

Coordinating teacher: IÑARREA LAS HERAS, JESUS

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Mathematics

DESCRIPTION OF CONTENTS: PROGRAMME

Contents common to all courses:
- - Postulates of Quantum Mechanics.
- - Quantum state. Space of quantum states.
- - Physical magnitudes and operators. Eigenvalues and Eigenstates.
- - Quantum measurement.
- - Quantum entanglement.

Contents specific to each course:
Matrix quantum mechanics:
- - Finite vector spaces. Bras and kets. Inner product. Basis of the space. Orthogonality, orthonormality and completeness. Decompositions.
- - Operators. Representations of operators on a space basis. Eigenvalues and eigenvectors. Adjoint operator. Hermitian, unitary and normal operator. Projector operators, Commutators. Tensor products
- - Postulates of quantum mechanics. Space of states. Operators and physical observables. Quantum measurement and uncertainties. Evolution of the quantum state.
- - Pure and mixed states. Examples of 2D quantum states: qubits; Bell states. Quantum entanglement.

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried

out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

* Laboratory sessions (15% of final mark)

Attendance to the laboratory sessions is compulsory. The students must also write a report on each of the experiments carried out in every session. The mark will be common for all the members of each group.

* Activities in groups (25% of final mark)

The evaluation will take into account attendance and student attitude, short test exams periodically proposed, as well as the student performance in the proposed activities.

* Written exam (60% of final mark)

The exam will take place at the end of the semester and it will be common for all the students.
Contents:

- Problems to be solved covering the main topics of the program.
- Short theoretical questions.

A minimum score of 3 over 10 will be required to pass the course.

BASIC BIBLIOGRAPHY

- Claude Cohen-Tannoudji, Bernard Diu, and Franck Laloë Quantum Mechanics, Ed. Wiley-Vch.

- Nouredine Zettili. Quantum Mechanics: Concepts and Applications. , Ed. Wiley.

ADDITIONAL BIBLIOGRAPHY

- David A. B. Miller.. Quantum Mechanics for Scientists and Engineers, Ed. Cambridge University Press..

- David Ferry. Quantum Mechanics. An Introduction for Device Physicists and Electrical Engineers. Third Edition. , CRC press 2001, 2001