Mathematical foundations of quantum mechanics

Academic Year: (2022 / 2023) **Review date: 20-06-2022**

Department assigned to the subject: Department of Mathematics

Coordinating teacher: IBORT LATRE, LUIS ALBERTO

Type: Electives ECTS Credits : 6.0

Year : Semester :

DESCRIPTION OF CONTENTS: PROGRAMME

On the many pictures of Quantum Mechanics: Schrödinger, Heisenberg and Dirac. An introduction to the theory of Hilbert spaces.

Von Neumann's picture of Quantum Mechanics. The theory of operators, observables and the spectral theorem.

Perturbation theory: stationary and time-dependent perturbation theory, adiabatic theorem, semiclassical approximation, scattering theory.

Weyl's picture of Quantum Mechanics. Weyl's quantization. Coherent states and quantum optics: Wigner's transform and quantum tomography.

Feynman's picture of Quantum Mechanics. The double slit experiment. Feynman's path integral and Dirac's Lagrangian description of Quantum Mechanics.

From particles to fields.

The measurement problem in Quantum Mechanics. Measurement and reversibility. Quantum cloning. Quantum Zeno effect. The nature of quantum states.

EPR. Bell inequalities. Quantum non-locality

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

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

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