Introduction to Atomic and Molecular Physics

Academic Year: (2023 / 2024) **Review date: 29-03-2023**

Department assigned to the subject: Physics Department

Coordinating teacher: MARTIN SOLIS, JOSE RAMON

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Classical physics (Mechanics and Electromagnetism). Basic modern and quantum physics

OBJECTIVES

The course is an introduction to the subject for physicists and engineers that have not taken a full course on quantum mechanics, and a preliminary to more advanced courses on atomic and molecular physics and dynamics, as a mean to acquire a heuristic comprehension of the topics. For this purpose, principal ideas of wave mechanics are introduced, followed by elementary presentations of methodological aspects, as well of descriptions of atomic and molecular structure and interactions.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- Introduction to quantum mechanics. Theoretical basis of atomic and molecular physics
2.- Basic tools of quantum mechanics: wave functions, operators, Schrödinger equation, stationary states, uncertainty principle
3.- Elementary applications: free particle, particle-in-a-box, harmonic oscillator
4.- Central forces. Angular momentum. One-electron atom.
5.- Approximation methods. Variational and perturbational approaches
6.- Electrons as identical particles. Spin. Many-electron atoms. Orbitals
7.- Diatomic molecules. Born-Oppenheimer approximation. Introduction to chemical bond and molecular symmetry
8.- Interaction of atoms and molecules with e.m. radiation.

LEARNING ACTIVITIES AND METHODOLOGY

* Teaching Methods:

Classroom lectures and classroom problem and computational solving sessions. Homework assignments.

* Course Material

Lecture notes. Computational programs (included in a web page) will be also provided with the aim of solving elementary examples , and of improving the learning of the subjects.

ASSESSMENT SYSTEM

* Evaluation shall take into account attendance and class participation, including practical classes and the solution of questionnaries periodically proposed by the lecturers along the course (30%).

* Final Exam: Theory and numerical exercises (70%).

% end-of-term-examination:	70
% of continuous assessment (assigments, laboratory, practicals…):	30

BASIC BIBLIOGRAPHY

- B.H. Bransden and C.J. Joachain PHYSICS OF ATOMS AND MOLECULES, Prentice Hall, England , 2003

ADDITIONAL BIBLIOGRAPHY

- M. Karplus and R.N. Porter ATOMS & MOLECULES, Benjamin, Menlo Park , 1970
- N. Levine QUANTUM CHEMISTRY, Allyn and Bacon Inc. Boston, 1983