Last update: 11-10-2019

230859 - FAM - Atomic and Molecular Physics

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Teaching unit Optional)
ECTS credits: 4 Teaching languages: English

Teaching staff

Coordinator: Massignan, Pietro Alberto

Others: Rey Oriol, Rosendo

Opening hours

Timetable: By appointment

Requirements

Mechanics, Probability and Statistics, Thermodynamics, Quantum Physics

Degree competences to which the subject contributes

Basic:

CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación
CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.
CB9. (ENG) Que los estudiantes sepan comunicar sus conclusiones ¿y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades
CB10. (ENG) Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

Teaching methodology

There will be six hours per week of lectures, addressing both theory and practical exercises.

Learning objectives of the subject

• Know how to describe what an atom is, and how it can be treated quantum mechanically
• Understand the behavior of atoms in electromagnetic fields
• Know the reasons that lead to the appearance of the fine and hyperfine structures
• Understand how the symmetries of the wave function and of the orbitals lead to the periodic table of the elements
• Fundamentals of molecular physics
• Approach to recent discoveries and state-of-the-art experimental techniques

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Study load

Total learning time: 100h	Hours large group:	36h	36.00%
	Self study:	64h	64.00%

Content

Topics

Learning time: 100h

Theory classes: 28h
Practical classes: 4h
Guided activities: 20h
Self study : 48h

Description:

- Introduction: the hydrogen atom
- Interaction between atoms and external fields (static, and oscillating)
- Fine and hyperfine structure
- Selection rules
- Symmetries of the wave function
- Atoms with many electrons (Thomas Fermi model, and Hartree-Fock method)
- Understanding the periodic table of the elements
- Molecular structure and degrees of freedom
- Advanced spectroscopy techniques: infra-red, Raman, and nuclear magnetic resonance
- Laser cooling and preparation of ultra-cold quantum gases of bosons and fermions

Qualification system

The final score will result from the weighted average of three marks (or "evaluation systems"):
E1 (50%): written tests and/or homework assignments.
E3 (30%): written report of a personal project.
E2 (20%): oral presentation and defense of the aforementioned personal project.

Bibliography

Basic:

Bransden, B.H.; Joachain, C.J. Physics of atoms and molecules. 2nd ed. Upper Saddle River, N.J.: Prentice Hall, 2002. ISBN 058235692X.

Demtröder, W. Atoms, molecules and photons: an introduction to atomic-, molecular- and quantum physics. 3rd ed. Springer, 2018. ISBN 9783662555217.