# COURSE DESCRIPTION

## COURSE DETAILS

Title (of the course): **FÍSICA ATÓMICA Y MOLECULAR**
Code: 100515
Degree/Master: **GRADO DE FÍSICA** Year: 4
Name of the module to which it belongs: MÓDULO ESPECÍFICO
Field: AMPLIACIÓN DE FÍSICA
Character: OBLIGATORIA Duration: FIRST TERM
ECTS Credits: 6 Classroom hours: 60
Face-to-face classroom percentage: 40% Study hours: 90
Online platform: http://www3.uco.es/moodlemap/

## LECTURER INFORMATION

Name: SARSA RUBIO, ANTONIO JESÚS (Coordinator)
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Area: FÍSICA ATÓMICA, MOLECULAR Y NUCLEAR
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Name: CUESTA VAZQUEZ, ANTONIO JOSE
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## PREREQUISITES AND RECOMMENDATIONS

**Prerequisites established in the study plan**

Se recomienda:
-Conocimientos de matemáticas y métodos numéricos a nivel de hasta 2º curso.
-Conocimientos de Física Cuántica.
-Haber adquirido cierto nivel en las competencias transversales y específicas propias de la titulación.
Esta es una asignatura de último curso que comparte muchas de las competencias con asignaturas de cursos anteriores. Esto significa que se supone una cierta soltura y destreza en tales competencias, de forma que nuestro objetivo es afianzar y perfeccionar su grado de adquisición.

**Recommendations**

To have, at least, B1 Level in English to take this course in the bilingual group.

## INTENDED LEARNING OUTCOMES

| | |
|---|---|
| CB1 | Capacity to analyse and synthesise. |
| CB2 | Capacity to organise and plan. |
| CB3 | Oral and/or written communication. |
| CB4 | Capable of information management. |
| CB5 | Resolution of problems. |
| CB6 | Team work. |
| CB8 | Independent learning. |
| CB9 | Creativity. |
| CE1 | Knowledge and comprehension of phenomena and the most important physical theories. |

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| | |
|---|---|
| CE2 | Capacity to estimate orders of magnitude to interpret different phenomena. |
| CE5 | Capacity to model complex phenomena, translating a physical problem into mathematical lanaguage. |
| CE7 | Capacity to transmit knowledge in a clear manner both in educational and in non-educational environments. |
| CE8 | Capacity to use computing tools to resolve and model problems and to present the results. |

## OBJECTIVES

Study the electronic strurcture of many electron atoms (mean field model and variational approimation) and understand its role in the periodic properties of the elements. Multiplets. Selectrion rules and phenomenology of atomic spectra.
Study the phenomenology of the molecular spectra and identify the excitation modes giving rise to the molecular band structure. Born-Oppenheimer approximation. Quantum grounds of the chemical bond.

## CONTENT

**1. Theory contents**

Electronic structure of two electron atoms
Electronic structure of many electron atoms
Atomic spectra
Molecular structure

**2. Practical contents**

In each subject, both theory and exercises will be worked out. Some proposed problems will be solved in the sesions. It is expected that the students solve other exercises provided.
More complicated problems will be boarded under the guidance of the teachers and the use of some computer codes provided to the students. A paper describing the problem, the work done to solve it and the results obtained, including a discussion will be asked.

## METHODOLOGY

**Methodological adaptations for part-time students and students with disabilities and special educational needs**

Specific methodology for these students will be developed and it will be designed in work sesions with the students in order to apply the specific metodology more appropiate to the particular circumstances.

**Face-to-face activities**

| Activity | Large group | Medium group | Total |
|---|---|---|---|
| *Assessment activities* | 3 | - | *3* |
| *Group work (cooperative )* | - | 8 | *8* |
| *Lectures* | 33 | - | *33* |
| *Seminar* | - | 16 | *16* |
| **Total hours:** | ***36*** | ***24*** | ***60*** |

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**Off-site activities**

| Activity | Total |
|---|---|
| *Exercises* | *30* |
| *Group work* | *12* |
| *Information search* | *4* |
| *Reference search* | *4* |
| *Self-study* | *40* |
| **Total hours:** | **90** |

## WORK MATERIALS FOR STUDENTS

Exercises and activities
Coursebook
References

**Clarifications:**

Material will be provided through the moodle web page.

## EVALUATION

| Intended learnig outcomes | Tools | | |
|---|---|---|---|
| | Final exam | Group work | Seminars |
| *CB1* | x | x | x |
| *CB2* | x | x | x |
| *CB3* | x | x | x |
| *CB4* | x | x | x |
| *CB5* | x | x | x |
| *CB6* | | x | |
| *CB8* | x | | x |
| *CB9* | x | x | x |
| *CE1* | x | x | x |
| *CE2* | x | x | x |
| *CE5* | x | x | x |
| *CE7* | x | x | x |
| *CE8* | | x | x |
| **Total (100%)** | **70%** | **15%** | **15%** |
| **Minimum grade.(*)** | **5** | **5** | **5** |

(*) Minimum grade necessary to pass the course

Valora la asistencia?: *No*

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General clarifications on instruments for evaluation:
On going evaluation is carried out in terms of "Group work", "Practical cases and examples" and "Attendance sheets" and gives 30% of the final qualification. The score here will be keeped for any of the exam callings of the current academic year.
The final exam consists on "Essay tests", "Short answer tests" and "Problem solving", providing the remaining 70% of the final qualification.
These criteria hold for all of the students, no matter if it is not the first time that they are taking this course.
An overall qualification of 3 will be adjudicated if the threshold is not reached in any of the items.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:
For part time students, special evaluation tools will be taylored according to the specific teaching methodology selected for them.

Qualifying criteria for obtaining honors: *Según la normativa de la universidad*

## BIBLIOGRAPHY

**1. Basic Bibliography:**

B.H. Bransden and C.J. Joachain, Physics of atoms and molecules, Prentice Hall 2003.
M. Weissbluth, Atoms and molecules, Academic 1978.
C. Sánchez del Río, Introducción a la teoría del átomo, Alhambra 1977.
A. Requena Rodríguez, Espectroscopía, Pearson 2004.
F.L. Pilar, Elementrary quantum chemistry, McGraw-Hill 1990.
P.F. Bernath, Spectra of atoms and molecules, Oxford 1995.

**2. Further reading:**

J.C. Slater, Quantum theory of atomic structure, Vols. I and II. McGraw-Hill 1960.
J.C. Slater, Quantum theory of molecules and solids, Vols I. McGraw-Hill 1964.
L. D. Landau and E. M. Lifshitz, Quantum Mechanics (Vol. 3 of a Course of Theoretical Physics). Pergamon Press 1965.
H.A. Bethe and R. Jackiw, Intermediate Quantum Mechanics. Addison-Wesley 1997.
M. Alonso y E.J. Finn, Física Vol. III: Fundamentos cuánticos y estadísticos. Fondo educativo interamericano 1971.

## COORDINATION CRITERIA

- Common evaluation criteria
- Tasks deadlines

# COURSE DESCRIPTION

## SCHEDULE

| Period | Activity | | | |
|---|---|---|---|---|
| | Assessment activities | Group work (cooperative ) | Lectures | Seminar |
| *1# Week* | 0 | 0 | 4 | 0 |
| *2# Week* | 0 | 0 | 4 | 0 |
| *3# Week* | 0 | 2 | 0 | 2 |
| *4# Week* | 0 | 0 | 2 | 2 |
| *5# Week* | 0 | 0 | 4 | 0 |
| *6# Week* | 0 | 0 | 4 | 0 |
| *7# Week* | 0 | 2 | 0 | 2 |
| *8# Week* | 0 | 0 | 2 | 2 |
| *9# Week* | 0 | 0 | 4 | 0 |
| *10# Week* | 0 | 2 | 2 | 0 |
| *11# Week* | 0 | 0 | 1 | 3 |
| *12# Week* | 0 | 0 | 2 | 2 |
| *13# Week* | 0 | 0 | 4 | 0 |
| *14# Week* | 0 | 2 | 0 | 3 |
| *15# Week* | 3 | 0 | 0 | 0 |
| **Total hours:** | ***3*** | ***8*** | ***33*** | ***16*** |

The methodological strategies and the evaluation system contemplated in this Course Description will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required.