

# Introduction to atomic and molecular physics - course description

| General information |  |
|---------------------|--|
| Course name         | Introduction to atomic and molecular physics     |
| Course ID           | 13.2-WF-FizD-IAMP-S17                            |
| Faculty             | <a href="#">Faculty of Physics and Astronomy</a> |
| Field of study      | WFiA - oferta ERASMUS                            |
| Education profile   | -  |
| Level of studies    | Erasmus programme                                |
| Beginning semester  | winter term 2023/2024                            |

| Course information        |  |
|---------------------------|--|
| Semester                  | 2  |
| ECTS credits to win       | 7  |
| Available in specialities | Physics  |
| Course type               | obligatory   |
| Teaching language         | english  |
| Author of syllabus        | <ul style="list-style-type: none"><li>Anatol Nowicki</li></ul> |

| Classes forms  |                                |                            |                                |                            |                    |
|----------------|--------------------------------|----------------------------|--------------------------------|----------------------------|--------------------|
| The class form | Hours per semester (full-time) | Hours per week (full-time) | Hours per semester (part-time) | Hours per week (part-time) | Form of assignment |
| Class          | 30                             | 2                          | -                              | -                          | Credit with grade  |
| Lecture        | 30                             | 2                          | -                              | -                          | Exam               |

## Aim of the course

The aim of the course is to teach the students methods and applications of quantum mechanics in description of matter-matter interactions; at the scale of one or a few atoms and energy scales around several electron volts. In particular we present the approximated methods, method of self consistent field and variational methods in atomic physics.

## Prerequisites

Quantum mechanics and Classical electrodynamics courses.

## Scope

LECTURE: One-electron atoms. Eigenvalues, quantum numbers, degeneracy, Zeeman effect, spin. The orbit-spin interaction. Identical particles, Pauli rule Multielectron atoms. Hartree-Fock theory, the self consistent field. The periodic table. Optical excitations, atomic spectra. Molecules, Born-Oppenheimer theory, LCAO MO theory. Molecular spectra, rotation, vibration-rotation and electron spectra. Raman effect.

CLASS: A hydrogen atom, quantum numbers, atom orbitals, spin. Multielectron atoms, the periodic table. The orbit-spin interaction, atomic spectra. Molecules spectra.

## Teaching methods

Conventional lectures, calculate class.

## Learning outcomes and methods of theirs verification

| Outcome description  | Outcome symbols | Methods of verification  | The class form  |
|--|-----------------|--|---|
| Skill of theoretical interpretation of experimental facts        |                 | <ul style="list-style-type: none"><li>an exam - oral, descriptive, test and other</li><li>an ongoing monitoring during classes</li></ul> | <ul style="list-style-type: none"><li>Lecture</li><li>Class</li></ul> |
| Application of mathematical methods in solving physical problems |                 | <ul style="list-style-type: none"><li>an exam - oral, descriptive, test and other</li><li>an ongoing monitoring during classes</li></ul> | <ul style="list-style-type: none"><li>Lecture</li><li>Class</li></ul> |

## Assignment conditions

LECTURE: The exam

CLASS: Credits of exercises

## Recommended reading

[1] W. Kołos, J. Sadlej, Atom i cząsteczka, WNT, Warszawa 2007.

[2] J. Ginter, Wstęp do fizyki atomu, cząsteczki i ciała stałego, PWN, Warszawa 1986.

[3] I. Białyński-Birula, M. Cieplak, J. Kamiński, Teoria kwantów, PWN, Warszawa 1991.

[4] W. Kołos, Chemia kwantowa, PWN, Warszawa 1980.

[5] L. Schiff, Mechanika kwantowa, PWN, Warszawa 1977.

## Further reading

## Notes

Modified by dr Marcin Kośmider (last modification: 06-02-2023 22:55)

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