Study programmes: BACHELOR STUDIES – Astronomy and Astrophysics

Course name: Physics of Atoms

Lecturers: Ivan Dojčinović and other lecturers

Status: Optional

ECTS: 10

Attendance prerequisites: Quantum Mechanics 1.

Course aims: Understanding the mean features of the atomic physics with the aim of applying these results in the Molecular Physics, Solid State Physics, Physics of Lasers, Physics of Plasma and Ionized Gases

Course outcome: The adoption of the basic concepts related to atomic structure and atomic features, primarily hidrogen and helium atoms. Understanding and applying the basic principles of Quantum Mechanics in the Physics of Atoms. Understanding the basic theory of the black body radiation (continual spectra) and atomic radiation (discrete spectra). The adoption of the basic concepts of interaction between atom and electric and magnetic field.

Course content:

Lectures: Rutherford`s atomic model; Spectra of hidrogen atom; Bohr`s atomic model; The Rydberg`s constant; Spectra of X rays; Interactions within atom; The Schrodinger equation; Expectation values; Operators; Time independent Schrodinger equation; Schrodinger equation for the hidrogen atom and hidrogen like ions; Ground state of the hidrogen atom; Orbital and magnetic quantum numbers; Excited states of the hidrogen atom; Einstein`s coefficients; Transitions probabilities; Electric-dipole approximation; Selection rules for orbital and magnetic quantum number; Higher order radiation; Orbital magnetic moment; Electron spin and magnetic moment of the electron; Fine structure of spectral lines; Vector model of the atom; Lamb shift; Exchange degeneration; Ground state of the helium atom; Excited states of the helium atom; Electron spin function and the Pauli exclusion principle; The periodic system of elements; The central-field approximation; Thomas-Fermi potential; Spectra of alkali atoms; The LS coupling; Fine structure in LS coupling; The jj coupling; Hyperfine structure of spectral lines; The normal Zeeman effect and the anomalous Zeeman effect.; The Stark effect.

Examples/ practical classes: 1. Introduction: Experimental devices in Atomic physics labaratory, handling with devices and data processing; 2. The Milikan experiment; 2. Determination of the specific charge of the electron; 3. Determination of the Plank`s constant 4. Determiantion of the Rydberg`s constant 5. Absorption spectroscopy; 6. Emission spectroscopy; 7. The Stark effect; 8. The normal Zeeman effect and the anomalous Zeeman effect; 9. The Rutherford`s experiment; 10. Electron diffraction; 11. The Frank-Herz experiment; 12. The Doppler effect.

Literature:

1. Purić J., Dojčinović I., Fizika atoma, Zavod za udzbenike, Beograd, 2013.
2. Demtroder W., Atoms, Molecules and Photons, Springer, Berlin, 2006.
3. Foot C.J., Atomic Physics, Oxford University Press, Oxford, 2005.
4. Woodgate G.K., Elementary Atomic Structure, Clarendon Press, Oxford, 1983.
5. Purić J., Đeniže S., Zbirka zadataka iz atomske fizike, Naučna knjiga, Beograd, 1991.

Number of hours: 9	**Lectures**: 4	**Tutorials**: 2	**Laboratory**: 3	**Research**: -

Teaching and learning methods:

Lectures; Solving problems; Homeworks; Seminars; Practical classes.

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	5	Written exam	30
Exercises / Tutorials	10	Oral exam	40
Colloquia	-	Written-oral exam	-
Essay / Project	5+10		