Course Unit Descriptor

Study Programme: Physics

Course Unit Title: Atomic and Molecular Physics

Course Unit Code: F18FAM

Name of Lecturer(s): Full Professor Stevica Đurović

Type and Level of Studies: Bachelor Academic Degree

Course Status (compulsory/elective): Compulsory

Semester (winter/summer): Winter

Language of instruction: English

Mode of course unit delivery (face-to-face/distance learning): Face-to-face

Number of ECTS Allocated: 7

Prerequisites: Electromagnetism, Optics, Fundaments of electronics, Quantum mechanics, Introduction to Atomic physics

Course Aims:

To introduce students to mastering the basics of atomic physics.

Learning Outcomes:

After completion of the course, students should possess:

- General skills: knowledge which is applicable in chemistry, molecular physics, gas discharges and in astrophysics, nuclear physics and condensed matter physics.
- Specific skills: developing the ability to understand the specific atomic structure of matter. Students are trained to follow a higher course of atomic physics.

Syllabus:

Theory

Schrödinger equation. Linear harmonic oscillator in quantum mechanics. Hydrogen-like atoms in quantum mechanics. Interpretation of the Schrödinger equation solution. Valence electron model of atoms. Spectral series of alkali metals. Electron orbit magnetic moment. Electron spin. Total electron angular momentum. Theory of atoms with more than one electron. Vector atom model. Magnetic momentum of the atom. Multiplet structure of the LS terms. Periodic table of elements. Superfine structure of spectral lines.

Atom in external magnetic and electric field. Excitation and deexcitation of atomic energy levels. Lifetime of excited states. Emission and absorption of the radiation. Intensity and spectral line broadening. Stimulated emission of radiation. Quantum amplifier and quantum generator. Lasers. Some effects of nonlinear optics. Molecule formation. Molecular vibration energy. Molecular rotation energy. Molecular vibration rotation spectrum. Electronic spectra of diatomic molecules. Electronic spectra of multiatomic molecules. Photo-fluorescence and phosphorescence. Combination scattering of light, Raman effect. Spectroscopy.

Practice

Emission spectra of atoms. Quantitative spectral analysis. Fabry-Perot interferometer, Zeeman effect. Electronic spectrum of cyan. Absorption spectrum of multiatomic molecules. Fluorescent spectrum of multiatomic molecules. He-Ne laser.

Required Reading:

1. M. Born, Atomic physics, Blackie and Son Limited, 1969.

2. G. K. Woodgate, Elementary atomic structure, McGraw-Hill, 1970.
3. J. C. Willmot, Atomic physics, John Wiley and Sons Ltd., 1975

Weekly Contact Hours:	**Lectures:** 3	**Practical work:** 3

Teaching Methods:

Lectures and students group work

Knowledge Assessment (maximum of 100 points): 100

Pre-exam obligations	points	**Final exam**	points
Active class participation	5	written exam	20
Test I and Test II	10	oral exam	50
Preliminary exam(s)	10	…….	
Seminar(s)	5		

The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.