Course Unit Descriptor

Study Programme: Physics, Professor of Physics

Course Unit Title: Quantum mechanics

Course Unit Code: F18KM

Name of Lecturer(s): Full Professor Milan Pantić

Type and Level of Studies: Bachelor Academic Degree

Course Status (compulsory/elective): Compulsory

Semester (winter/summer): Summer

Language of instruction: English

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

Number of ECTS Allocated: 7

Prerequisites: Theoretical mechanics, Fundamentals of mathematical physics

Course Aims: Study of Quantum Mechanics using more abstract mathematical formalism introducing the basic quantum field theory and systems of identical particles.

Learning Outcomes: After taking the course, the students should have developed:
General abilities: basic knowledge of this field, following the literature, analysis of various solutions and the choice of the most adequate solution, application in practice and other subjects. **Subject-specific abilities:** knowledge of abstract mathematical formalism of Quantum Mechanics; knowledge of the basic quantum Filed Theory (second quantization).

Syllabus:

Theory

Historical development of quantum mechanics. Superposition principle. De Broglie hypothesis. Heisenberg uncertainty relations. Postulates of quantum mechanics. Hilbert space. Operators of physical quantities. Measurement problem in quantum mechanics. Schroedinger equation. One-dimensional problems: potential well, step and barier. Linear harmonic oscillator. Hydrogen atom. Eigenproblem of orbital (angular) momentum operator. Spherical harmonics. Electron spin. Theory of stationary perturbations: nondegenerated and degenerated spectrum. Identical particles. Pauli's principle. Exchange interaction. Orto- and parahelium. Schrödinger, Heisenberg and interaction picture. Heisenberg's motion equations and quantisation of classical systems. Theory of measurement (in quantum mechanic). Representation theory. Kinetic momentum and momentum addition. Variation principle. Nonstationary perturbations. S-matrix and transition probability. Systems of identical particles. Hartree–Fock approximation. Scattering theory. Elastic and inelastic scattering. Scattering of identical particles. The elements of relativistic quantum mechanics. Dirac electron theory and Pauli equation. Introduction to quantum field theory. Second quantisation of electromagnetic field. Interaction of radiation with matter.

Practice

Problem solving.

Required Reading:

1. L.D. Landau, E.M. Lifshitz, Quantum mechanics, Pergamon, Oxfordm 1977.
2. Clod Cohen-Tannoudji, B. Diu, F. Laloe, Introduction to quantum mechanics (I and II part), Wiley Interscience, 1992.
3. F. Schwabl, Quantum mechanics, IV ed. Springer, Berlin (2007)

Weekly Contact Hours:	**Lectures:** 4	**Practical work:** 3

Teaching Methods: Lectures

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points
Active class	5	written exam	20

participation			
Practical work		oral exam	50
Preliminary exam(s)	20	…….	
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.			