14/07/2019

Quantum Mechanics I

86-311-04

Lecturer: Prof. Eli Barkai
Course type: Lecture + Practice

Date: 2019-2020 **semester:** A **weekly hours:** 3L + 2P

Aim of the course:

Quantum theory is one of the two theories that changed the face of physics at the beginning of the 20th century and is the basis for understanding modern physics. Quantum theory is characterized by a unique language both mathematically and conceptually - physically. Quantum Theory 1 and 2 are intended to train students to describe physical problems using the tools of quantum mechanics.

Thus students will learn the mathematical tools used in the theory, understand the physical concepts at its base and see its application to various physical systems - from the electromagnetic moment of the electron to the hydrogen atom.

Details of subjects to be covered:

- Introduction: short historical survey (1900-1930); waves vs particles; some introductory problems - Bohr atom, de Broglie wavelengths, diffraction of particles
- Basic concepts of quantum mechanics: wavefunctions and operators; eigenfunctions and eigenvalues; Hermitian operators; commutation of operators; relation between quantum and classical mechanics
- Energy and momentum: Hamiltonian; stationary states; development of states with time; momentum; waves and wave packets; probability current density;
- uncertainty principle
- Schroedinger equation: general properties of motion in 1D; potential well; linear oscillator; variational principle; tunneling; transmission and reflection coefficients
- Angular momentum (part one): commutation properties; eigenvalues and eigenfunctions; planar and spatial rotators

- Motion in a central field: reduction to 1D Schroedinger equation; three quantum numbers; hydrogen atom

Prerequisites:

Required courses of first year.

Course mandatories:

Exam and homework.

Grading:

Exam 80%, Homework 20%

Bibliography:

(textbooks)

"Quantum Mechanics" Cohen-Tanuji
"Quantum Mechanics" Landau and Lifshitz
Liboff Introductory to quantum mechanics
Griffits Introduction to quantum mechanics
Saxon Elementary quantum mechanics
Tannor Introduction to quantum mechanics: a time dependent perspective