האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Quantum Theory I - 77318

Last update 27-04-2024

HU Credits: 6

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Physics

Academic year: 0

Semester: 2nd Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Erez Zohar

Coordinator Email: erez.zohar@mail.huji.ac.il

Coordinator Office Hours: By appointment

Teaching Staff:

Prof Erez Zohar,
Mr. Simon Shahar,
Mr. Barak Rom

Course/Module description:

First introductory course in quantum mechanics, including the historical background and significance, the mathematical and physical basics and formalism, and important fundamental quantum problems.

Course/Module aims:

1. Getting acquainted with the background and importance of quantum theory, compared with the classical theory.
2. Learning the mathematical formalism of quantum mechanics.
3. Understanding elementary quantum mechanical models and their relation to the classical world.

Learning outcomes - On successful completion of this module, students should be able to:

1. Use the formalism of quantum mechanics.
2. Solve simple problems in finite Hilbert spaces.
3. Solve simple spectrum and scattering problems in one space dimension.
4. Use the quantum harmonic oscillator as an important quantum mechanical tool.
5. Solve simple few-particle problems in tensor product spaces.

Attendance requirements(%):

0

Teaching arrangement and method of instruction: Lecture and recitation.

Course/Module Content:

1. Historical introduction - key experiments and the need for "new" physics
2. The mathematical foundations of QM – The space of states, operators, representation in different bases, the postulates, expectation values, the uncertainty principle, the Schrödinger equation
3. Position and Momentum representation, particle as a wave packet, Ehernfest's theorem, the Heisenberg equation
4. A particle in one dimension – bound and free states, scattering, tunneling, probability current
5. The quantum harmonic Oscillator – eigenstates in the number, position and momentum bases, coherent states, the classical limit

6. Multiple degrees of freedom – tensor product spaces
representation, Coherent states
7. The WKB approximation

Required Reading:
None

Additional Reading Material:
Textbooks which match, fully or partially, the course's topics and level:

Quantum Mechanics, vol. 1 - Cohen-Tannoudji, Diu, Laloe

Principles of Quantum Mechanics - Shankar

Modern Quantum Mechanics - Sakurai, or Sakurai and Napolitano

Extra, deeper and very challenging (far beyond the course's scope) reading, for those interested:

The Principles of Quantum Mechanics - Dirac

Lectures on Quantum Mechanics - Weinberg

Grading Scheme:
Written / Oral / Practical Exam 90 %
Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 10 %

Additional information:
None