האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

QUANTUM THEORY IN APPLIED PHYSICS - 83880

Last update 20-05-2015

HU Credits: *5*

Degree/Cycle: *2nd degree (Master)*

Responsible Department: *Applied Phyisics*

Academic year: *1*

Semester: *2nd Semester*

Teaching Languages: *Hebrew*

Campus: *E. Safra*

Course/Module Coordinator: *Prof. Ronen Rapaport*

Coordinator Email: *paltiel@mail.huji.ac.il*

Coordinator Office Hours: *Prof. Ronen Rapaport*

Teaching Staff:

Prof Ronen Rapaport
Cohen Eyal

Course/Module description:

Basic concepts.
Non-locality and Bell inequalities. Pure and mixed quantum states. The density matrix. The dipole approximation, Optical Bloch equations, and the interaction of a 2-level atom with a clasicall EM field. Idensical particles, symmetries of the many-particle wavefunction. Variational method and the Helium atom. Exchange density and energy. Hrtree and Hartree-Fock approximations, interacting electrons in a metal. Second quantization. light-matter interaction and the quantization of the electromagnetic field and the photon.
Spontaneous and stimulated emission.
Particle under external electric and magnetic field. The Aharonov-Bohm effect and the Quantum Hall effect.

For each subjects possible applications will be discussed.

Course/Module aims:

See learning outcomes

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

Advanced knowledge quantum physics, identical many particle physics,
Second quantization
And applications

Attendance requirements(%):

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Teaching arrangement and method of instruction: Frontal lecture + Exercise

Course/Module Content:

- *Review of concepts and mathematical background*

o History and Background
o Show operators by matrices
o marks Dirk
o View Sridingr Wizenberg
o spins

o Possible applications (encryption, QWIP)

• quantum systems (magnetic field)
o free particle
o particle motion in a magnetic field
o Quantum Hall Effect
Aharonov- Bohm effect o

• approximation methods
o MB -time perturbation theory
o Time-dependent perturbation theory
o Fermi's golden rule
o WKB
o Feynman's path integral
o density matrices

• Second quantization
o Second quantization of fields
o second quantization of the electromagnetic field
o coherent states (states uncompressed) classical and quantum coherence .
o photon and spin
o coupled modes (quantum computers , encrypted communication)

• radiation and matter
o the interaction of radiation and matter roughly two levels
o spontaneous and stimulated emission
o Interaction of radiation and Sound
o Feynman diagrams
o Raman scattering , Bragg scattering and Brillouin scattering

Required Reading:
NA

Additional Reading Material:
Formalistic books:
• J. J. Sakurai, Modern Quantum Mechanics
• Albert Messiah, Quantum Mechanics

General
• Leonard Schiff, Quantum Mechanics
• Gordon Baym, Lectures on Quantum Mechanics

Quantum Optics
• A Yariv, Quantum Electronics

• C Cohen-Tanoudji et. al., Atom-Photon Interactions
• L Mandel & E Wolf, Optical Coherence and Quatum Optics
• MO Scully & MS Zubairy, Quantum Optics

Applied Quantum Mechanics
Herbert Kroemer, Quantum Mechanic for Engineering: Materials Science and Applied Physics

Web
http://aphquantum.weebly.com

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 80 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 20 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:
NA