



## *The Hebrew University of Jerusalem*

### *Syllabus*

## **QUANTUM THEORY IN APPLIED PHYSICS - 83880**

*Last update 28-10-2015*

*HU Credits:* 5

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

*Responsible Department:* applied physics

*Academic year:* 0

*Semester:* 2nd Semester

*Teaching Languages:* Hebrew

*Campus:* E. Safra

*Course/Module Coordinator:* Prof. Ronen Rapaport

*Coordinator Email:* [paltiel@mail.huji.ac.il](mailto:paltiel@mail.huji.ac.il)

*Coordinator Office Hours:* Prof. Ronen Rapaport

*Teaching Staff:*

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Prof Ronen Rapaport  
Mr. 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 classical EM field. Identical particles, symmetries of the many-particle wavefunction. Variational method and the Helium atom. Exchange density and energy. Hartree 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 subject 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(%):

0

Teaching arrangement and method of instruction: Frontal lecture + Exercise

Course/Module Content:

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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.

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 Quantum Optics*
- MO Scully & MS Zubairy, *Quantum Optics*

Applied Quantum Mechanics

Herbert Kroemer, *Quantum Mechanics 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 %

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*Research project 0 %*  
*Quizzes 0 %*  
*Other 0 %*

*Additional information:*  
*NA*