



The Hebrew University of Jerusalem

Syllabus

QUANTUM OPTICS - 83836

Last update 24-03-2025

HU Credits: 3

Degree/Cycle: 2nd degree (Master)

Responsible Department: Applied Physics

Academic year: 0

Semester: 2nd Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Dr. Adi Pick

Coordinator Email: adi.pick@mail.huji.ac.il

Coordinator Office Hours: Wed 15:45 - 16:45 upon appointment

Teaching Staff:

Dr. Adi Pick

Course/Module description:

Quantum optics is a theory that describes the quantum properties of light, which manifest at very low light intensities. We will learn about the photon, the fundamental particle of light. We will get to know coherent states of light and learn about quantum correlations. We will learn how the interaction between light and matter occurs and how absorption and emission processes of light are described. We will deepen our understanding of theoretical phenomena and learn how they can be applied in technology.

Course/Module aims:

1. Providing an understanding of the field of quantum optics and developing the technical ability to solve problems in the field, forming a foundation for experimental and theoretical work.
2. Providing the necessary background for conducting research and development in the field of quantum technologies.

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

1. Students will become familiar with basic concepts in quantum optics.
2. Students will acquire tools to solve analytical problems in quantum optics.
3. Students will develop the ability to engage with professional literature in the field.
4. Students will learn to use computers for calculation and simulation.

Attendance requirements(%):

0

Teaching arrangement and method of instruction: Lecture with students participation, home assignments.

Course/Module Content:

1. Quantization of the electromagnetic field
2. Coherent states of light

3. *Light-matter interaction: absorption and emission of light*

4. *Quantum coherence*

5. *Beam splitters and interferometers*

6. *Non-classical states of light*

Additional topics depending on time.

Required Reading:

Gerry and Knight, Introductory Quantum Optics.

Additional Reading Material:

- *Scully and Zubairy, Quantum Optics*
- *Lukin and Greiner, Advanced topics in AMO*
- *Cohen-Tannoudji, Photons and Atoms*

Grading Scheme:

Written / Oral / Practical Exam 80 %
Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 10 %
Mid-terms exams 10 %

Additional information:

Homework exercises are important. Please make sure to complete the exercises and internalize their solutions throughout the semester, not just before the exam. Please use artificial intelligence wisely, utilizing it as a tool to enhance learning, not as a tool for preparing solutions that hinder learning.