Course Syllabus

PHOT 222 Fundamentals of Quantum Photonics

2025 Spring

Instructor

Dr. Michaël Barbier

e-mail: michaelbarbier@iyte.edu.tr

Office: F-building, door on the right of Z5

Office hours: Friday 11:00 – 13:00 (or via appointment)

Teaching Assistants

Yağız Oyun

e-mail: yagizoyun@iyte.edu.tr

Office: Z9B

Office hours: TBA

Course Schedule

Wednesday	10:45 – 12:30	F-building - TBD
Friday	8:45 – 10:30	F-building - TBD

Course Fundamentals

Course Description

This course introduces the basics of the quantum mechanical description of light and matter. We will start with an overview of historical concepts such as the photoelectric effect and blackbody radiation, that led to modern quantum mechanics, particles as wave packets, and Schrödinger's equation. Afterwards Schrödinger's equation will be applied to standard quantum mechanics problems including: a particle in a box, tunneling through one-dimensional barriers, quantum wells, and the quantum harmonic oscillator. Next, the atomic structure of multi-electron atoms will be covered and the relation with atomic spectra. Finally, the energy spectra of molecules and solids will be introduced.

Course Objectives (Learning Outcomes)

At the end of the course, you should be able to:

1. Describe Blackbody radiation, the photoelectric effect, de Broglie hypothesis and Heisenberg's uncertainty relation.
2. Interpret the particle-wave duality qualitatively.

3. Explain the basic postulates of quantum physics.
4. Solve Schrödinger's equation for simple systems and interpret the results.
5. Understand and describe atomic and molecular spectra.
6. Describe the energy band structure of solids.

Prerequisites

Currently, there are no prerequisites for this course. However, knowledge of elementary calculus, as given in the courses MATH 141 and MATH 142, is assumed.

Textbooks

Course Textbook:

R. A. Serway and J. W. Jewett, **Physics for Scientists and Engineers with Modern Physics, Part 6**, 9th edition (2013), Cengage Learning

Supplementary Materials:

A. Beiser, **Concepts of modern physics**, McGraw-Hill

QuVis: Web site with quantum mechanics visualizations and simulations for educational purposes

Applet(s) by Paul Falstad for 1D quantum systems (many other science related educational applets can be found on www.falstad.com/)

Course website and announcements

You will find all announcements relevant to the course (homework, grades, etc.) on MS-Teams. Some course materials will also be made available via Michaël Barbier's webpage. Syllabus and course schedule may be subject to change during the semester.

Class structure

Course material will be presented on the whiteboard and on the screen. All lecture notes and class materials can be reached from Teams.

Course schedule (tentative)

Week 1	Relativity
Week 2	Waves and Particles
Week 3	Wave packets and Uncertainty

Week 4	The Schrödinger equation and Probability
Week 5	Midterm exam 1
Week 6	Quantum particles in a potential
Week 7	Harmonic oscillator
Week 8	Tunneling through a potential barrier
Week 9	The hydrogen atom, absorption/emission spectra
Week 10	Midterm exam 2
Week 11	Many-electron atoms
Week 12	Pauli-exclusion principle
Week 13	Atomic bonds and molecules
Week 14	Crystalline materials and energy band structure
Week 15	Final exam
Week 16	Final exam

Course Policies

Attendance and class behavior

Students who attend the lecture are expected to actively participate (in listening, taking notes, understanding, problem solving sessions, etc.).

Homework assignments

Non-graded homework exercises can be assigned during the term. The sole purpose of them is to guide students in what type of exercises are important within the course. These are neither obligatory nor graded.

Quizzes

Non-graded quizzes can be given during some lectures, these do not influence your grades and scores will only be given to the individual students for him/her to understand what type of questions he/she might expect on the exam.

Examinations and Grading

There will be two midterm exams and a final exam. The exams are closed book and exist out of open questions and problems which can be answered using pen and paper. If you miss one of the exams without a valid excuse, a zero will be averaged into your grade. If you have a valid excuse (i.e., an official certified medical report), a make-up exam will be organized during the semester.

Your final grade is the weighted average of the midterm and final exam grades, according to following weights (tentative):

- Midterm exam 1: 20 %
- Midterm exam 2: 20 %
- Final exam: 60 %

Examination Dates (tentative)

Midterm exam 1: Wednesday, March 19 at 10:45

Midterm exam 2: Friday, April 25 at 8:45

Final exam: TBA

Disabilities

Students with certified disabilities requiring special accommodation are urged to contact the instructor at the beginning of the semester so that suitable arrangements may be made.

Academic Integrity

Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or suspension from the University. Forms of academic dishonesty include copying the reports of homework assignments (from a fellow student or internet), cheating on exams, use of unauthorized materials for exams, and changing solutions to returned assignments and exams.