

PHYS-454

**Quantum optics and quantum information**

Dupertuis Marc-André

Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Ing.-phys	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Photonics		Obl.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

Fully quantum theory of the light-matter interaction. Study of interacting quantum systems. Introduction to a few modern problems in quantum optics. Introduction to quantum information. Quantum cryptography and quantum computing.

**Content****5. Fully quantum theory of the light-matter interaction, and of the laser.**

Jaynes-Cummings model and spontaneous emission. Master equation for system-reservoir interaction within the Born-Markov approximation. Fully quantum theory of the laser: photon statistics and laser linewidth.

**6. Introduction to many-body effects in semiconductors. Microcavities.**

Semiconductor Bloch equations. Excitons. « Incoherent » relaxation terms. Correlation phenomena in atoms and quantum boxes. Microcavities, strong coupling and polaritons.

**7. Mechanical effects in the light-matter interaction.**

Radiation pressure. Casimir effect.

**8. Introduction to quantum theory of information.**

The quantum bit. Entangled states and Bell inequalities. Quantum cryptography, Quantum teleportation, Quantum simulation and quantum computers.

**Learning Outcomes**

By the end of the course, the student must be able to:

- Master the calculational techniques

**Assessment methods**

oral (75%), presentation in a team of two of a scientific article (25%)