



230555 – QO – Quantum Optics

Coordinating unit: 230 - ETSETB Barcelona School of Telecommunications Engineering
Teaching unit: 1022 - UAB - Universitat Autònoma de Barcelona
Academic year: 2015 - 2016
Degree: Master's Degree in Photonics
 Erasmus Mundus Master's Degree in Photonics Engineering, Nanophotonics and Biophotonics
ECTS credits: 3 **Teaching languages:** English

Academic staff

Coordinator: [Jordi Mompart](#) (UAB) jordi.mompart@uab.cat
Other professors: [Verònica Ahufinger](#) (UAB) veronica.ahufinger@uab.cat

Degree competences to which the subject contributes

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
3. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
4. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

Lectures

Activities:

- Discussion sessions and/or seminars

Objectives and short description of the course

This course will provide a wide-ranging introduction to the field of quantum optics, developing in detail the semiclassical and quantum approaches to light-matter interaction.

Study load

Total learning time: 75h	Hours large group:	22.5h	30%
	Hours medium group:	0h	0%
	Hours small group:	0h	0%
	Guided activity:	2.25h	3%
	Self study:	50.25h	67%



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Course index

1. Semiclassical theory of atom-field interaction

Rate equations. Schrödinger equation. Two-level atom under the RWA.AC-Stark splitting. Dressed atom. Rabi oscillations. Mollow triplet. Autler-Townes doublet.Dipole force. Density matrix formalism. Two and three-level atoms. Coherent population trapping. Electromagnetically Induced Transparency. Stimulated Raman Adiabatic Passage.

2. Quantum theory of atom-field interaction

Classical Electrodynamics. Quantization of the e.m. field. Quantum states of the free e.m. field. Vacuum states. Coherent States. Squeezed states. Jaynes-Cummings model. Weisskopf-Wigner treatment for spontaneous emission. Quantum Rabi Oscillations. Collapses and revivals. Cavity quantum electrodynamics.

Qualification system

Attendance to be evaluated: >80% of the lecture time

Oral exam (70%)

Homework assessments (30%)

Bibliography

• Online

- Daniel A. Steck, Quantum and Atom Optics (2007)
- Oregon Center for Optics and Department of Physics. Oregon University
- <http://atomoptics.uoregon.edu/~dsteck/teaching/quantum-optics/quantum-optics-notes.pdf>

• Basic

- P. Meystre and M. Sargent, Elements of Quantum Optics, Springer, 1990.
- M.O. Scully, M.S. Zubairy, Quantum Optics, Cambridge U. P., 1997.
- Walls, G.J. Milburn, Quantum Optics, Springer-Verlag, 1994.
- C. Gerry and P. Knight, Introductory Quantum Optics, Cambridge University Press, 2005.

• Advanced

- C. Cohen-Tannoudji, J. Dupont-Roc, G. Grynberg, Atom-Photon Interactions. John Wiley & Sons, 1992.
- C. Cohen-Tannoudji, J. Dupont-Roc, G. Grynberg, Photons and Atoms. Introduction to Quantum.