

230558 - EXPQO - Advanced Quantum Optics with Applications

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	893 - ICFO - Institute of Photonic Sciences
Academic year:	2014
Degree:	ERASMUS MUNDUS MASTER IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional) MASTER IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	3
Teaching languages:	English

Teaching staff

Coordinator: Morgan W. Mitchell (ICFO)(Coord)

Others: Hugues de Riedmatten (ICFO)

Opening hours

Timetable: morgan.mitchell@icfo.es
hugues.deriedmatten@icfo.es

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. 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.
3. 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.
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

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Learning objectives of the subject

A BRIEF DESCRIPTION

This course presents the modern understanding of light as a quantum phenomenon, and explores how quantum applications such as quantum communications and quantum sensing are developed using quantum light. We describe optics at the individual-photon level, entangled and squeezed states of light, quantum non-locality, quantum memories and related advanced topics. The course gives necessary background for understanding contemporary experiments. Special attention is given to applications with atomic ensembles including quantum-enhanced sensing, and quantum memory.

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Quantization of the electromagnetic field

Quantum states of light: single photons, coherent states, squeezed states, entangled states.

Detection of quantum light: photon counting, coincidence counting, phase-sensitive detection.

Generation of quantum light by non-linear optical processes.

Experimental signatures of quantum behaviour.

Interaction of light with atomic ensembles.

Spin squeezing and quantum-enhanced measurements.

Quantum memories based on Electro-magnetically Induced Transparency, Photon echoes, DLCZ.

Experimental quantum communications : Quantum teleportation, entanglement swapping, quantum repeaters

BIBLIOGRAPHY

<http://mitchellgroup.icfo.es/MEQO/>

Study load

Total learning time: 75h	Hours large group:	22h 30m	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

Qualification system

- Homework assignments (45%)
- Oral Exam (45%)
- Participation and presentation (10%).

Bibliography