



Academic year	2012-13
Subject	11014 - Quantum and nonlinear optics
Group	Group 1, 2S
Teaching guide	A
Language	English

Subject identification

Subject	11014 - Quantum and nonlinear optics
Credits	0.76 in-class (19 hours) 2.24 distance (56 hours) 3 totals (75 hours).
Group	Group 1, 2S
Teaching period	2nd semester
Teaching language	English

Lecturers

Lecturers	Timetable for student attention					
	Starting time	Finishing time	Day	Start date	Finish date	Office
ROBERTA ZAMBRINI	There are no defined sessions					

Degrees where the subject is taught

Degree	Character	Academic year	Studies
Master's Degree in Physics of Complex Systems	Optional		Postgraduate degree

Contextualisation

Introductory course to quantum optics, including nonlinear phenomena, light matter interaction and matter waves.

Requirements

Recommendable

Knowledge on the quantum physics basics

Skills

Specific

1. To be able to identify characteristic properties of quantum systems including nonlinear effects (E16).





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Generic

1. To be able to describe, both mathematically and physically, complex systems in different situations (TG1).
2. To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions (TG2).
3. To write and describe rigorously the research process and present the conclusions to an expert audience (TG3).
4. To acquire the ability to ask questions, read and listen critically and participate actively in seminars and discussions (TG4).

Content

Theme content

1. Planck law and Einstein coefficients. Quantization of electromagnetic field (review)
2. Quantum theory of coherence. Light quantum states: coherent, squeezed, Fock...
3. Nonlinear processes; generation of quantum states and entanglement
4. Multimode quantum optics. Optical angular momentum.
5. Light matter interaction.
6. Matter waves.

Teaching methodology

In-class work activities

Modality	Name	Typ.Gr.	Description
Theory classes	lessons	Large group (G)	Exposition and discussion on the main course contents.
Practical classes	exercises	Large group (G)	Exercises
Assessment	oral presentation	Large group (G)	Student oral presentation (during 15') of their own 2 pages paper..

Distance education work activities

Modality	Name	Description
Individual self-study	exercises	Exercises.
Individual self-study	individual study	Elaboration of the contents of the lessons, reading of related material, book chapters and papers.





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Modality	Name	Description
Individual self-study	paper	Preparation of a two pages paper on a subject suggested during the lessons and of its oral exposition.

Riscs específics i mesures de protecció

Les activitats d'aprenentatge d'aquesta assignatura no comporten riscos específics per a la seguretat i salut de l'alumnat i, per tant, no cal adoptar mesures de protecció especials.

Workload estimate

Modality	Name	Hours	ECTS	%
In-class work activities		19	0.76	25.33
Theory classes	lessons	15	0.6	20
Practical classes	exercises	3	0.12	4
Assessment	oral presentation	1	0.04	1.33
Distance education work activities		56	2.24	74.67
Individual self-study	exercises	10	0.4	13.33
Individual self-study	individual study	28	1.12	37.33
Individual self-study	paper	18	0.72	24
Total		75	3	100

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

Student learning assessment

lessons

Modality	Theory classes
Technique	Short-answer tests (Recoverable)
Description	Exposition and discussion on the main course contents.
Assessment criteria	
Percentage of final qualification: 20% following path A	





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exercises

Modality	Practical classes
Technique	Short-answer tests (Recoverable)
Description	Exercises
Assessment criteria	
Percentage of final qualification:	20% following path A

oral presentation

Modality	Assessment
Technique	Oral tests (Non-recoverable)
Description	Student oral presentation (during 15') of their own 2 pages paper..
Assessment criteria	
Percentage of final qualification:	60% following path A

Resources, bibliography and additional documentation

Basic bibliography

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- R. Loudon, The quantum theory of light, (Oxford University press, 2000).
 - S. Haroche and J.-M. Raimond, Exploring the Quantum(Oxford University Press, Oxford, 2005).
 - M. Orszag, Quantum Optics, (Springer Verlag, 2000).
 - L. P. Pitaevskii and S. Stringari, Bose–Einstein Condensation (Clarendon Press, Oxford, 2003).

Complementary bibliography

Relevant papers provided during the lessons

Other resources

