

## Syllabus

### Subject

<b>Subject / Group</b>	11014 - Quantum and Nonlinear Optics / 1
<b>Degree</b>	Master's in Physics of Complex Systems
<b>Credits</b>	3
<b>Period</b>	2nd semester
<b>Language of instruction</b>	English

### Professors

Lecturers	Office hours for students					
	Starting time	Finishing time	Day	Start date	End date	Office / Building
Gian Luca Giorgi -	14:00	15:30	Tuesday	07/10/2019	29/05/2020	S03/Edifici Institut Universitari de Recerca
Roberta Zambrini -	16:00	17:00	Wednesday	01/10/2019	31/07/2020	Ed.inst.univ., despacho 206

### Context

Introductory course on interaction between light and matter including classical and quantum phenomena.

### Requirements

#### Recommended

Knowledge on the quantum physics basics

### Skills

#### Specific

- \* To be able to identify characteristic properties of quantum systems including nonlinear effects (E16)

#### Generic

- \* To be able to describe, both mathematically and physically, complex systems in different situations (TG1)
- \* To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions (TG2)

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- \* To write and describe rigorously the research process and present the conclusions to an expert audience (TG3)
- \* To acquire the ability to ask questions, read and listen critically and participate actively in seminars and discussions (TG4)

### Basic

- \* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: [http://estudis.uib.cat/master/comp\\_basiques/](http://estudis.uib.cat/master/comp_basiques/)

## Content

### Range of topics

1. Planck law and Einstein coefficients. Quantization of electromagnetic field.
2. Quantum theory of coherence. Light quantum states.
3. Light matter interaction. Photons and spins.
4. Nonlinear processes; generation of quantum states and entanglement

## Teaching methodology

### In-class work activities (0.76 credits, 19 hours)

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	lessons	Large group (G)	Exposition and discussion on the main course contents.	15
Practical classes	exercises	Large group (G)	Exercises	3
Assessment	oral presentation	Large group (G)	Student oral presentation deepening a subject of the course. List of options decided during the semester.	1

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 Aula Digital platform.

### Distance education tasks (2.24 credits, 56 hours)

Modality	Name	Description	Hours
Individual self-study	exercises	Exercises.	10

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Modality	Name	Description	Hours
Individual self-study	essay	Preparation of a short essay on a subject suggested during the lessons and of its oral exposition.	18
Individual self-study	individual study	Elaboration of the contents of the lessons, reading of related material, book chapters and papers.	28

### Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

### Student learning assessment

#### Frau en elements d'avaluació

In accordance with article 33 of Regulation of academic studies, "regardless of the disciplinary procedure that may be followed against the offending student, the demonstrably fraudulent performance of any of the evaluation elements included in the teaching guides of the subjects will lead, at the discretion of the teacher, a undervaluation in the qualification that may involve the qualification of "suspense 0" in the annual evaluation of the subject".

#### lessons

Modality Theory classes  
 Technique Short-answer tests (**recoverable**)  
 Description Exposition and discussion on the main course contents.  
 Assessment criteria  
 Final grade percentage: 20%

#### exercises

Modality Practical classes  
 Technique Short-answer tests (**recoverable**)  
 Description Exercises  
 Assessment criteria  
 Final grade percentage: 20%



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### oral presentation

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Modality	Assessment
Technique	Oral tests ( <b>non-recoverable</b> )
Description	Student oral presentation deepening a subject of the course. List of options decided during the semester.
Assessment criteria	
Final grade percentage:	60%

### Resources, bibliography and additional documentation

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#### 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).  
C.G. Gerry and P.L.Knight, Introductory Quantum Optics (Cambridge University Press, 2005).

#### Complementary bibliography

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Relevant papers provided during the lessons

