Universitat de les Illes Balears

Teaching guide

Academic year	2012-13
Subject	11006 - Quantum physics for complex systems
Group	Group 1, 2S
Teaching guide	A
Language	English

Subject identification

Subject	11006 - Quantum physics for complex systems
Credits	1.52 in-class (38 hours) 4.48 distance (112 hours) 6 totals (150 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
Llorenç Serra Crespí llorens.serra@uib.es	There are no defined sessions					
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

This is a compulsory subject of the basic module of the master in complex systems. It is taught in the second semester of the academic year. It provides the basics to understand complex quantum systems, both as closed and open systems.

Requirements

There are no specific requirements for the course. However, a basic knowledge of quantum physics at the undergraduate level is assumed.

Recommendable

A basic command of scientific English is highly recommended

Skills

Date of publication: 06/07/2012

Specific

1. E14 To understand the concept of symmetry breaking.
2. E16: To be able to identify characteristic properties of quantum systems including nonlinear effects.
3. E17: To be able to identify and model dissipation and decoherence effects in physical systems coupled to environments.

Generic

1. TG1: To be able to describe, both mathematically and physically, complex systems in different situations.
2. TG2: To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions..
3. TG4: To acquire the ability to ask questions, read and listen critically and participate actively in seminars and discussions..

Content

The course is divided into two parts, for closed and open quantum systems, respectively.

Theme content

Part I.. Closed quantum systems

I.1. Statistics and quantum mechanics: second quantization

Formalism of identical particles for states, operators and fields.

I.2. Non linearity in mean field

Static Hartree and Hartree-Fock models for bosons and fermions. Mean field symmetry breakings.

I.3. Symmetries and collective modes

Dynamical self-consistent fields. Appearance of collective modes.

I.4. Examples

Quantum dots. Bose-Einstein condensates. Numerical simulations.

Part II. Open quantum systems

II.1. Motivation and system-bath theories

Introduction and overview of different approaches to open systems

II.2. Master equation

Derivation of master equations in weak coupling limit

II.3. Damped oscillators

Description of decoherence with damped oscillators. Phase-space representations.

II.4. Brownian motion

II.5. Spin-boson model

Date of publication: 06/07/2012

Teaching methodology

In-class work activities

Modality	Name	Typ.Gr.	Description
Theory classes	Lectures	Large group (G)	Presentation of the course contents
Practical classes	Problem solving classes	Medium group (M)	Solving exercises
Practical classes	Work presentations	Medium group (M)	Presentation of the individual works to the class

Distance education work activities

Modality	Name	Description
Individual self-study	Problems	Solving problems
Individual self-study	Reading papers	Reading recommended papers
Individual self-study	Study	Assimilate new knowledge
Individual self-study	Work	Writing final work and preparing its presentation

Riscs especifics i mesures de protecció

Les activitats d'aprenentatge d'aquesta assignatura no comporten riscs 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		**38**	**1.52**	**25.33**
Theory classes	Lectures	24	0.96	16
Practical classes	Problem solving classes	10	0.4	6.67
Practical classes	Work presentations	4	0.16	2.67
	Total	**150**	**6**	**100**

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Modality	Name	Hours	ECTS	%
Distance education work activities		**112**	**4.48**	**74.67**
Individual self-study	Problems	20	0.8	13.33
Individual self-study	Reading papers	20	0.8	13.33
Individual self-study	Study	55	2.2	36.67
Individual self-study	Work	17	0.68	11.33
	Total	**150**	**6**	**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

Lectures

Modality	Theory classes
Technique	Short-answer tests **(Non-recoverable)**
Description	Presentation of the course contents
Assessment criteria	Relevance of questions posed by the students and clarity in answers.

Percentage of final qualification: 20% following path A

Problem solving classes

Modality	Practical classes
Technique	Observation techniques **(Non-recoverable)**
Description	Solving exercises
Assessment criteria	Correction and clarity in solving problems

Percentage of final qualification: 30% following path A

Work presentations

Modality	Practical classes
Technique	Observation techniques **(Non-recoverable)**
Description	Presentation of the individual works to the class
Assessment criteria	Quality of written work and clarity on its exposition

Percentage of final qualification: 50% following path A

Resources, bibliography and additional documentation

Basic bibliography

Date of publication: 06/07/2012

Modern Many Particle Physics, Enrico Lipparini, World Scientific
Quantum dissipative systems, Ullrich Weiss, World Scientific

Complementary bibliography

Recommended papers.

Other resources

Lecture presentations.

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