Subject identification

Subject	11002 - Stochastic processes
Credits	0.75 in-class (18.75 hours) 2.25 distance (56.25 hours) 3 totals (75 hours).
Group	Group 1, 1S
Teaching period	1st semester
Teaching language	English

Lecturers

Lecturers	Timetable for student attention					
	Starting time	Finishing time	Day	Start date	Finish date	Office
Pere Colet Rafecas			There are no defined sessions			
Raúl Toral Garcés rtg803@uib.es			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 one of the compulsory courses of the Structural Module of the master in Physics of Complex Systems. It provides a solid background on stochastic processes that will be used in other parts of the master, in particular in the course on Stochastic Simulation Methods.

Requirements

Recommendable

It is recommended that the student has a basic knowledge on probability theory and statistics,

Skills

This course develops both specific and generic skills.

Date of publication: 16/07/2012

Specific

1. E2: Development and optimal application of numerical algorithms for the simulation of complex systems.
2. E6: To understand and to model processes subject to fluctuations.

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. TG3: To write and describe rigorously the research process and present the conclusions to an expert audience.
4. TG6: To acquire high power computation skills and advanced numerical methods capabilities in applications to problems in the context of complex systems.

Content

Theme content

1. Introduction

   Basic Concepts. Brownian motion. Einstein Description. Langevin description.

2. Probability

   Random variables. Probability density function. Join and conditional probabilities. Moments. Correlations. Central limit theorem. Characteristic function. Cumulants. Novikov Theorem.

3. Markov processes

   Definition. Equation of Chapman-Kolmogorov. Random walk. Poisson process. Dichotomous noise. Lévy flights.

4. Stochastic differential equations.

   Wiener process. Continuous limit. Ito and Stratonovich interpretations. Orstein-Uhlenbeck process.

5. Fokker-Planck equations

   Derivation starting from the stochastic differential equation. Stationary solution. Potential case. Detailed balance.

6. Master equations

   Birth and death processes. Stationary solutions. Approximation of Master equations by Focker-Planck equations. Van Kampen's system size expansion.

7. Passage times and scape times

   Absorbing barriers. Adjoint Fokker-Planck equation. Decay from unstable states. Scape time from metastable states.

8. Constructive effects induced by fluctuations

Date of publication: 16/07/2012

This topic will be given as one or two seminars at the end of the course addressing phenomena such as: Stochatic resonance, coherence resonance and noisy precursors.

Teaching methodology

In-class work activities

Modality	Name	Typ.Gr.	Description
Theory classes	Theoretical lectures	Large group (G)	Explanation of theoretical concepts by the professor.
Practical classes	Practical sessions	Large group (G)	Resolution of problems and questions
Assessment	Exam	Large group (G)	This exam is intended to evaluate the knowledge adquired by the students. It will contain theoretical questions and problems.

Distance education work activities

Modality	Name	Description
Individual self-study	Assignements	The student has to solve assigned exercises and present the solutions in written form.
Individual self-study	Study and understanding theoretical concepts	This activity aims at the understanding of the theoretical concepts and techniques explained in the lectures.

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		**18.75**	**0.75**	**25**
Theory classes	Theoretical lectures	14.25	0.57	19
Practical classes	Practical sessions	3.5	0.14	4.67
Assessment	Exam	1	0.04	1.33
Distance education work activities		**56.25**	**2.25**	**75**
	Total	**75**	**3**	**100**

Date of publication: 16/07/2012

Modality	Name	Hours	ECTS	%
Individual self-study	Assignements	30.5	1.22	40.67
Individual self-study	Study and understanding theoretical concepts	25.75	1.03	34.33
	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

Exam

Modality	Assessment
Technique	Objective tests **(Non-recoverable)**
Description	This exam is intended to evaluate the knowledge adquired by the students. It will contain theoretical questions and problems.
Assessment criteria	Accuracy of the answers. Clarity and quality of the explanations.

Percentage of final qualification: 50% following path A

Assignements

Modality	Individual self-study
Technique	Papers and projects **(Non-recoverable)**
Description	The student has to solve assigned exercises and present the solutions in written form.
Assessment criteria	Accuracy of the results. Clarity and quality of the explanations and interpretation of the results. Quality of the written presentation.

Percentage of final qualification: 50% following path A

Resources, bibliography and additional documentation

Basic bibliography

C.W. Gardiner, “Handbook of Stochastic Methods”, 3rd edition, Springer, 2004.
H. Risken, “The Fokker-Planck Equation”, 2nd edition 3rd printing, Springer 1996.
N.G. Van Kampen, “Stochastic Processes in Physics and Chemistry”, 3rd edition, Noth Holland, 2007.

Complementary bibliography

Other resources

Date of publication: 16/07/2012

Academic year	2012-13
Subject	11002 - Stochastic processes
Group	Group 1, 1S
Teaching guide	A
Language	English

Date of publication: 16/07/2012