Universitat de les Illes Balears

Teaching guide

Academic year	2015-16
Subject	11002 - Stochastic processes
Group	Group 1, 1S
Teaching guide	A
Language	English

Subject identification

Subject	11002 - Stochastic processes
Credits	0.75 de presencials (18.75 hours) 2.25 de no presencials (56.25 hours) 3 de totals (75 hours).
Group	Group 1, 1S (Campus Extens)
Teaching period	First semester
Teaching language	English

Professors

Lecturers	**Horari d'atenció als alumnes**					
	Starting time	**Finishing time**	**Day**	**Start date**	**Finish date**	**Office**
Pere Colet Rafecas	09:00	10:00	Friday	01/09/2015	31/07/2016	210
Raúl Toral Garcés rtg803@uib.es	You need to book a date with the professor in order to attend a tutorial.					

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.

Specific

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

Generic

* TG1: To be able to describe, both mathematically and physically, complex systems in different situations.

Date of publication: 21/07/2015

* TG2: To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions.
* TG3: To write and describe rigorously the research process and present the conclusions to an expert audience.
* TG6: To acquire high power computation skills and advanced numerical methods capabilities in applications to problems in the context of complex systems.

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/

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
   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

Date of publication: 21/07/2015

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Theoretical lectures	Large group (G)	Explanation of theoretical concepts and selected examples by the professor.	12
Practical classes	Practical sessions	Large group (G)	Resolution of assigned exercises and public presentation by the students.	5
Assessment	Exam	Large group (G)	This exam is intended to evaluate the knowledge adquired by the students. It will contain theoretical questions and problems.	1.75

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.

Distance education work activities

Modality	Name	Description	Hours
Individual self-study	Assignements	The student has to solve assigned exercises and present the solutions in written form.	30.5
Individual self-study	Study and understanding theoretical concepts	This activity aims at the understanding of the theoretical concepts and techniques explained in the lectures.	25.75

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

Practical sessions

Modality	Practical classes
Technique	Papers and projects **(non-retrievable)**
Description	Resolution of assigned exercises and public presentation by the students.
Assessment criteria	Accuracy of the results. Clarity and quality of the explanations and interpretation of the results. Quality of the oral presentation.

Final grade percentage: 25%

Date of publication: 21/07/2015

Exam

Modality	Assessment
Technique	Objective tests **(retrievable)**
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.

Final grade percentage: 50%

Assignements

Modality	Individual self-study
Technique	Papers and projects **(retrievable)**
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.

Final grade percentage: 25%

Resources, bibliography and additional documentation

Basic bibliography

R. Toral and P. Colet, "Stochastic Numerical Methods", Wiley (2014)
N.G. Van Kampen, “Stochastic Processes in Physics and Chemistry”, 3rd edition, Noth Holland, 2007.

Complementary bibliography

C.W. Gardiner, “Handbook of Stochastic Methods”, 3rd edition, Springer, 2004.
H. Risken, “The Fokker-Planck Equation”, 2nd edition 3rd printing, Springer 1996.

Date of publication: 21/07/2015