Course guides
230861 - SM - Stochastic Methods for Optimization and Simulation

Last modified: 29/04/2020

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Optional subject).

Academic year: 2020 **ECTS Credits:** 4.0 **Languages:** English

LECTURER

Coordinating lecturer: Joaquim Casulleras

Others: Gregory Astrakharchik

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Basic:
CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.
CB8. (ENG) Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicio.

TEACHING METHODOLOGY

-Master classes
-Class exhibitions
-Team work
-Written work
-Problem resolution
-Practical exercises

LEARNING OBJECTIVES OF THE SUBJECT

- Ability to generate random numbers according to simple laws of
probability distribution
- Ability to perform a multidimensional integral through the Monte method
Carlo and correctly estimate its statistical variance
- Know how to perform a calculation program for the classical simulation of a system
multiparticular using the Metropolis method
- Know the methods of variance reduction and their optimal choice according to the type
of problem to solve
- Ability to perform multidimensional optimization using techniques
stochastic
- Know the main stochastic methods used in the study of
quantum systems

STUDY LOAD

Type	Hours	Percentage
Self study	64,0	64.00
Hours large group	36,0	36.00

Total learning time: 100 h

CONTENTS

Stochastic methods for optimization and simulation

Description:
1. Monte Carlo integration: distribution functions and their sampling, Monte Carlo crude, rejection, variance reduction techniques, multidimensional integration, Metropolis method.
2. Application of the Monte Carlo method to many particle systems: systems discrete (Ising), continuous systems in different statistical sets, finite-size scaling, advanced Monte Carlo methods.
3. Monte Carlo optimization: simulated annealing, genetic algorithms.
4. Dynamic Monte Carlo: random paths and diffusion equation, methods of Fokker-Planck and Langevin, Brownian dynamics.
5. Applications of the Monte Carlo method to quantum systems: wave functions for bosons and fermions, Monte Carlo variational, Monte Carlo diffusive, Monte Carlo of road integrals.

Full-or-part-time: 100h
Theory classes: 24h
Practical classes: 10h
Guided activities: 10h
Self study : 56h

GRADING SYSTEM

Oral tests 20% - 30%
Works carried out by the student 70% - 80%