Last update: 11-10-2019

230861 - SM - Stochastic Methods for Optimization and Simulation

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Teaching unit Optional)
ECTS credits: 4 Teaching languages: English

Teaching staff

Coordinator: 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

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Study load

Total learning time: 100h	Hours large group:	36h	36.00%
	Self study:	64h	64.00%

Content

Stochastic methods for optimization and simulation

Learning time: 100h

Theory classes: 24h
Practical classes: 10h
Guided activities: 10h
Self study : 56h

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.

Qualification system

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

Bibliography