UNIVERSITÀ DI PISA

COMPLEX SYSTEMS / SISTEMI COMPLESSI

RICCARDO MANNELLA

Academic year	2019/20
Course	FISICA
Code	230BB
Credits	9

Modules	Area	Type	Hours	Teacher(s)
SISTEMI COMPLESSI	FIS/03	LEZIONI	54	RICCARDO MANNELLA

Obiettivi di apprendimento

Conoscenze
Students are expected to acquire: some knowledge of stochastic calculus and probability, chaos dynamics and of the relevant tools and models; some knowledge to the appropriate tools to approach complex systems;

Modalità di verifica delle conoscenze
Students are expected to apply the learnt methods to a concrete case of interest. The emphasis will be on how the apply the learnt methodologies rather than on the results achieved in the application.
Methods:

- Final essay

Capacità
The student will be able to study and model some simple "complex system"

Modalità di verifica delle capacità
The student will be invited to apply to concrete cases some of the methodologies taught, throughout the lectures

Prerequisiti (conoscenze iniziali)
The student need to have the standard knowledge in maths and physics of a physics bachelor: calculus in many variables, knowledge of Fourier transform, classical physics (in particular, Hamiltonian mechanics), some background in classical thermodynamics.

Indicazioni metodologiche
Delivery: face to face

Learning activities:

- attending lectures
- individual study

Attendance: Advised
Teaching methods:

- Lectures

Programma (contenuti dell'insegnamento)
The course has a modular structure: 6 ECTS are devoted to general tools to study complex systems, like stochastic methods, chaotic dyamics etc.. The students then take an additional 3 ECTS modulus which applies the general tools to some complex systems. The modulus offered will depend on the specific academic year: this year it will mostly cover subjects on Econophysics

The general tools part of the course will cover topics like:
Brownian motion, Chapman Kolmogorov equation, Stable (Levy) distributions, Stochastic integration, Fokker Planck equation, Mean First Passage Time related problems, Path integral approach to stochastic processes; Chaotic dynamics both for conservative and dissipative flows, related tools (like Poincare maps and Lyapunov exponents), Fractals.

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Bibliografia e materiale didattico

Gardiner, Handbook of stochastic methods
Reichl, The transition to chaos
Tabor, Chaos and integrability in nonlinear dynamics

Modalità d'esame

The exam will be in oral form. The student is expected to work on a small project during which he/she will apply the tools and methodologies taught in the lectures, and to prepare a small talk/script, which will be the basis from which the oral exam will be carried out

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