UNIVERSITÀ DEGLI STUDI DI TORINO

ID

VP128_DIP_MAT

Visiting Professor Program
Academic year 2022/2023

TEACHING COMMITMENT: 20 hours

COURSE TITLE

Dynamical Systems and Chaos Theory

TEACHING PERIOD

2nd term

SCIENTIFIC AREA

Mathematical Physics

LANGUAGE USED TO TEACH

Italian

COURSE SUMMARY

- Review of elementary notions on discrete and continuous dynamical systems. Stability of critical points and Lyapunov theorems;
- Bifurcations of iterated maps. Topological conjugacy of maps; Bernoulli shift and symbolic dynamics. Chaotic maps. Metric entropy and topological entropy of maps. Invariant sets of iterated maps;
- Review of planar autonomous ODEs: classification of phase portraits. Qualitative analysis of nonlinear autonomous systems. Stable and unstable manifold of a saddle point. Homoclines and eteroclines. Periodic orbits and their stability; Poincaré map. Poincaré-Bendixson theorem.
- Bifurcations of nonlinear ODEs. Structural stability. Concrete examples from physics, biology, social sciences.
- Hamiltonian integrable systems and perturbations: introduction to KAM and Nekhoroshev theorems, Chirikov regime.
- Frequency analysis for continuous chaotic systems. Lyapunov indicators.

LEARNING OBJECTIVES

Understanding and interpreting, from both the mathematical and the modeling viewpoint, equations and maps describing a (continuous or discrete) dynamical system.
Drawing phase portraits and performing qualitative analysis of the solution behavior in dependence of initial data and system parameters.
Comparing theoretical qualitative analysis with numerical simulation.
Understanding universality of qualitative behavior, structural stability and bifurcation types.
Understanding the notion of deterministic chaotic system and its applications.

TUTORSHIP ACTIVITIES

N/A

LAB ACTIVITIES

N/A

OTHER ACTIVITIES BESIDES THE COURSE

N/A

VISITING PROFESSOR PROFILE

Significant teaching experience on the subject. Expertise in application of dynamical systems to mathematical modelling in physics, astronomy, engineering, natural or social sciences, possibly including analysis of perturbations of Hamiltonian integrable systems and Fourier analysis.

CONTACT PERSON AT THE DEPARTMENT

Prof. Guido Magnano
guido.magnano@unito.it