UNIVERSITÀ DEGLI STUDI DI TORINO

ID

VP17_DIP_MAT

Visiting Professor Program
Academic year 2019/2020

DEPARTMENT OF MATHEMATICS "GIUSEPPE PEANO"

TEACHING COMMITMENT: 24 hours

COURSE TITLE

Dynamical Systems and Chaos Theory

TEACHING PERIOD

2nd term

SCIENTIFIC AREA

Mathematical Physics

LANGUAGE USED TO TEACH

Italian/English

COURSE SUMMARY

Review of elementary notions on discrete and continuous dynamical systems. Stability of critical points and Liapunov 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. Fractals and fractal dimensions.
- 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. Poincaré-Bendixson theorem.
- Bifurcations of ODEs. Structural stability. Concrete examples from physics, biology, social sciences.
- Global behavior of ODEs: relation with differential geometry and topological geometry. Dynamical systems on differentiable manifolds, vector fields as sections of the tangent bundle. Introduction to transversality and intersection theory. Degree of a map, Lefschetz number and index of a vector field.
- Introduction to evolution equations for space-dependent quantities: ecology, traffic, reaction-diffusion models.

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.

VISITING PROFESSOR PROFILE

The visiting professor must have high scientific skills in the field of dynamical systems and chaos theory from both the theoretical and the application point of view, with reference to the calculation of the Liapunov exponents in the examination of predictability and long-term stability in some application context (for example astronomical)

CONTACT PERSON AT THE DEPARTMENT

Lorenzo Fatibene
lorenzo.fatibene@unito.it