

Direzione Innovazione e Internazionalizzazione

> ID VP078_MAT

Visiting Professor Program Academic Year 2023/2024

TEACHING COMMITMENT: 20 hours

COURSE TITLEDynamical Systems and Chaos Theory

TEACHING PERIOD 2nd term

SCIENTIFIC AREA Mathematical Physics

LANGUAGE USED TO TEACH Italian

COURSE SUMMARY

General aspects of the theory of continuous and discrete dynamical systems, expanding the topics already encountered at undergraduate level (ODE theory, Lyapunov stability theory) and introducing bifurcation theory and chaotic systems, with emphasis on general strategies for applications in physics (e.g. celestial mechanics), biology (e.g. population dynamics) and social sciences.

LEARNING OBJECTIVES

- 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.

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- 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.

TUTORSHIP ACTIVITIES

N/A

LAB ACTIVITIES

Computer analysis of planar dynamical systems (phase portrait, stability, bifurcations); computer visualization of KAM diffusion and resonance phenomena; computation of Lyapunov indicators.

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.

CONTACT REFERENT

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