

**PEF-5737 PROGRAMME**  
**NON-LINEAR DYNAMICS AND STABILITY**  
 Third Period 2018

Lectures 1 to 8: Wednesdays from 14:00 to 17:00  
 Lectures 9 and 11: Mondays from 14:00 to 17:00  
 Lectures 10 and 12: Wednesdays from 14:00 to 17:00

Lecture	Day	Subject	Lecturer
1	12/09	Revision of the Lagrangian and Hamiltonian formulation of equations of motion of discrete systems. Revision of stability theory: first Liapunov's method. Point attractor: one d.o.f. linear oscillator. Second Liapunov's method.	Carlos Mazzilli
2	19/09	Poincaré-Bendixson's theorem. Periodic attractor. Autonomous systems (van der Pol's oscillator). Non-autonomous systems (forced Duffing's oscillator): analytical solution by perturbation methods. Basins of attraction. Static and dynamic bifurcations. Poincaré's map.	Carlos Mazzilli
3	26/09	Chaotic attractor. Melnikov's method.	Carlos Mazzilli
4	03/10	Non-linear normal modes: invariant manifold and multiple-scale solutions.	Carlos Mazzilli
5	10/10	High-hierarchy systems. Matrix formulation of non-linear dynamics.	Carlos Mazzilli
6	17/10	Reduced-order models.	Carlos Mazzilli
7	24/10	Averaging methods.	Guilherme Franzini
8	31/10	Hilbert-Huang' method. POD method.	Guilherme Franzini
9	05/11	Fundamentals on global dynamics. Achieving load carrying capacity: theoretical and practical stability. Concepts and tools of dynamical integrity: basin erosion and solution/attractor robustness (in phase-space and control parameter space).	Giuseppe Rega
10	07/11	Dynamical integrity for analysing global dynamics and interpreting/predicting experimental behavior. Competing attractors. Escape as dynamical system representation of failure mechanisms in different physical systems. Control of chaos. Local and global control of nonlinear response.	Giuseppe Rega
11	12/11	Uncontrolled vs controlled response in applied mechanics and structural dynamics, with also system imperfections: smooth archetypal oscillators; discrete systems; piecewise smooth systems; slender structures liable to unstable interacting buckling; reduced order models in micro- and nano-mechanics.	Giuseppe Rega
12	14/11	Role of global dynamics in unveiling nonlinear response: a thermomechanical problem. Multidimensional basins of attraction. Effects of stochasticity. Exploiting global dynamics for engineering design.	Giuseppe Rega
	28/11	Workshop	

The course will be taught in English