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: Tuesdays from 14:00 to 17:00

Lectures 10 and 12: Thursdays from 14:00 to 17:00

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| **Lecture** | **Day** | **Subject** | **Lecturer** |
| 1 | 13/09 | 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 | 20/09 | 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 | 27/09 | Chaotic attractor. Melnikov’s method. | Carlos Mazzilli |
| 4 | 04/10 | Non-linear normal modes: invariant manifold and multiple-scale solutions. | Carlos Mazzilli |
| 5 | 11/10 | High-hierarchy systems. Matrix formulation of non-linear dynamics. | Carlos Mazzilli |
| 6 | 18/10 | Reduced-order models. | Carlos Mazzilli |
| 7 | 25/10 | Averaging methods. | Guilherme Franzini |
| 8 | 01/11 | Hilbert-Huang’ method. POD method. | Guilherme Franzini |
| 9 | 07/11 | 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 | 09/11 | 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 | 14/11 | 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 | 16/11 | 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 |
|  | 29/11 | Workshop |  |

The course will be taught in English