Diagnostics and dynamics of mechanical systems

Finalità
The course is an advanced course in dynamics of mechanical systems.
The students will develop skills for numerical and experimental modelling of mechanical systems.

Programma
Introduction and definitions
Examples of mechanical systems
Different approaches to the dynamical study of mechanical systems
Principles of dynamics: general considerations.
Principle of virtual work, D'Alambert's principle, Hamilton's principle
Lagrange equations for lumped and continuous systems
Rayleigh-Ritz method
Linearisation of the equations of motion
Linear systems: convolution integral and impulse response
Classifications of signals
Time domain analysis
Frequency domain analysis
Fourier transform and other transforms
Convolution
Auto-spectrum and cross-spectrum
Coherence
Modal analysis
Identification of the modal parameters
Frequency Response Function
Introduction to Matlab
Nonlinear problems
Introduction to wave motion in elastic solids
Basic concept of the finite element method

Attività d'esercitazione
Some exercises will be carried out in the lab, where the students will perform some modal analysis and use the software MATLAB.

Modalità d'esame
The exam consists in the presentation of a project and an oral exam at the end of the course.

Propedeuticità
Mathematical analysis, physics, geometry, rational mechanics and applied mechanics are recommended.

Testi consigliati
Ottorino Sesini , Meccanica applicata alle macchine, Milano : Casa editrice ambrosiana
L. Meirovitch, Elements of Vibration Analysis, 2nd edition, McGraw Hill, 1986.
D.J. Ewins, Modal Testing: Theory, Practice and Applications - second edition, Research Studioes Press ltd., Brüel & Kjær
K.F. Graff, Wave Motion in Elastic Solids, Dover, 1991.
R. Garziera, Introduzione alla diagnostica dei sistemi meccanici, 1998