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# 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'Alembert'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 Studios Press Ltd., Brüel & Kjær

K.F. Graff, Wave Motion in Elastic Solids, Dover, 1991.

R. Garziera, Introduzione alla diagnostica dei sistemi meccanici, 1998