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## D Physics

### Finalità

Useful material (including lecture presentations, technical descriptions, links to free software) is available from my [teaching](http://www.fis.univr.it/~derenzi/didattica) home page. <br>

The aim of the course is to introduce the student to measurement instruments and methods of interest for mechanical engineers. Coupling between the instrument and the physical system under investigation, data acquisition, error estimate and statistical data analysis are described and illustrated by examples.

Direct implementation of the statistical techniques on PC, by means either of Matlab or of Octave (Open Source), will be given as home assignments.

The second half of the course takes place in the laboratory, where students shall plan, perform and analyse a series of experiments.

### Programma

#### **Numerical data analysis (lectures and assignments):**

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<LI>Significant figures.</LI>

<LI>Statistical and systematic uncertainties (errors).</LI>

<LI>Plots.</LI>

<LI>Error distributions.</LI>

<LI>Propagation of errors.</LI>

<LI>Linear regression.</LI>

<LI>Least squares and chi square. Maximum likelihood.</LI>

<LI>Linear and polynomial minimization.</LI>

<LI>Non linear minimization (MINUIT).</LI>

<LI>Numerical simulations with statistical errors.</LI>

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#### **Laboratory:**

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<LI> Measurements: electrical, optical, force, pressure, temperature, deformation, ...</LI>

<LI> Instruments: voltmeters, bridge configuration, lock-in amplifiers, ADC, multifunction cards, oscilloscopes, computer controlled data acquisition.</LI>

<LI> Sensors and transducers. stepper motor drives.</LI>

<LI> How to interface an instrument: calibration, input and output impedance, coupling of impedances, dynamical response, stationary response, response to periodic and to pulsed excitations.</LI>

<LI> Experiment, design, data taking and data analysis.</LI>

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### Modalità d'esame

Home assignments, written report on the laboratory sessions, discussion of the assignments

### Testi consigliati

R. Taylor INTRODUZIONE ALL'ANALISI DEGLI ERRORI Lo studio delle incertezze nelle misure fisiche. Seconda edizione. Zanichelli editore. (29 Euro)

Philip R. Bevington, D. Keith Robinson DATA REDUCTION AND ERROR ANALYSIS for the Physical Sciences - McGraw Hill Higher Ed. Boston and Milan Third Edition (20 sterline)

Manuals for card NI-6025E and for laboratory instruments.

Matlab documentation.