



METODI DI MISURE E DATAZIONI ASSOLUTE

FIS/01 - 6 CFU - 1° Semester

Teaching Staff

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Office Hours: Lunedì e mercoledì dalle 09:00 alle 11:00. Si consiglia comunque di contattare il docente in anticipo per verificare che impegni istituzionali o personali non lo costringano a spostare il ricevimento di un giorno specifico.

LEARNING OBJECTIVES

The course aims at providing the basic knowledge and tools for the analysis of geophysical data, for the uncertainties estimation and for statistical analyses. It also gives an introduction to the main dating methods and their application in Geophysics.

The Learning Objectives, within the Dublin Descriptors scheme, are:

1. Knowledge and understanding: knowledge of the basic notions of statistics and data analysis techniques; knowledge of the main dating techniques and their field of application;
2. Applying knowledge and understanding: ability to analyze and understand experimental data;
3. Making judgements: ability to make numerical estimations of physical quantities;
4. Communication skills: ability to discuss (in an oral conversation or in writing) a scientific topic using an appropriate scientific language;
5. Learning skills: ability to study individually and to keep up-to-date with the new scientific discoveries in this field.

COURSE STRUCTURE

Classroom-taught lessons by the use of interactive power point presentations.

Practical sessions of data analysis and exercises.

Guided tours of nuclear physics and dating laboratories.

DETAILED COURSE CONTENT

First part

1) Measurement of a Physical quantity

The scientific method - Physical quantities - Units of measurement - Measurement uncertainty - Estimation of the uncertainty - Absolute and relative uncertainties - How to report uncertainties - Use of tables - Comparison of two measured numbers - Significant Figures - Graphical representation of the experimental data

2) Propagation of uncertainties

Direct and indirect measurements - Error propagation in sums, differences, products and quotients - Independent uncertainties in a measurement - General formula for error propagation

3) Statistical analysis of random uncertainties

Histograms and distributions - The mean and Standard Deviation - The weighted average - The Gaussian distribution and its properties - The Poisson distribution and its properties

4) Least-squares fitting

Introduction to the least-squares fit - The Linear best-fit - Calculation of the constants A and B - Uncertainties in the constants A and B - Least-squares fits to other curves - Examples and applications

5) The chi-squared test for a distribution

Comparison between theoretical and experimental data distributions - General definition of chi-squared - Degree of freedom and the reduced chi-squared - The chi-squared test - Examples

Second part

1) Basics of Nuclear Physics

The nucleus and its contents - Mass number and atomic number - Isotopes - Abundance of isotopes in nature

2) Basics of radioactivity

Nuclear stability - The radioactivity - The radioactivity decay law - Decay constant, lifetime and half-life - Types of Radioactive Decay - Alpha decay - Beta decay - Gamma decay

3) Dating methods

Introduction to the dating methods - Radiocarbon dating - AMS dating - Potassium-Argon dating - Argon-Argon dating - Uranium-Thorium dating - Fission track dating - Thermoluminescence phenomena and its application in archaeological dating - Electron spin resonance and its use in dating - archeomagnetic dating technique

TEXTBOOK INFORMATION

1) J.R. Taylor, "Introduzione all'analisi degli errori", Zanichelli

2) B.Povh, K.Rith, C.Scholtz, F.Zetsche, "Particelle e Nuclei", Bollati-Boringhieri

3) W.S.C. Williams, "Nuclear and Particle Physics", Oxford Science Publications

4) M.J.Aitken, "Science-based Dating in Archeology", Pearson Education

5) A.Castellano, M.Martini, E.Sibilia, "Elementi di archeometria", Egea
