



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Radioactivity

2526-1-F1703Q047

---

#### Aims

Description of the basics of radioactive decay, of radioactive sources and methods for radioactivity measurements.

#### Contents

Introduction to nuclear models

Characterization of radioactive decays

Radioactive decay law

Natural radioactive sources: fossils and cosmogenics

Artificial radioactive sources

Activity measurements of radioactive sources

Concentration measurements of radioactive sources

Numerical simulation methods for radioactive source characterization

#### Detailed program

Introduction to nuclear models

- General characteristics of atomic nucleus
- Mass defect concept
- Binding energies of nucleons
- Description of table of nuclides
- Liquid drop model of nucleus and von Weizsäcker formula

#### Characterization of radioactive decays

- Alpha decay
- Beta decay
- Gamma decay

#### Radioactive decay law

- General formula of radioactive decay
- Variation in time of the concentration and activity of the parent and daughter nuclei
- Definition of activity and identification of physical units
- Multiple decays and radioactive chains
- Secular equilibrium conditions

#### Natural radioactive sources: fossils and cosmogenics

- Natural fossil radioactivity
- Natural radioactive chains: secular equilibrium and its breaking
- Primary and secondary cosmic rays
- Cosmogenic radioactive nuclei

#### Artificial radioactive sources

- Nuclear reactions for the production of anthropogenic radioactivity
- Basics of nuclear fission: bombs and nuclear reactors
- Dispersion of artificial radioactivity in the environment

#### Characterization of detector for radioactivity measurements

- Radiation interaction with matter
- Characteristics of detectors for radioactivity measurements
- Introduction of signal analysis for nuclear radiation detectors

#### Characterization of radioactive sources with activity measurements

- Alpha spectroscopy
- Gamma and X spectroscopy
- Beta spectroscopy
- Radon measurements

#### Numerical simulation methods for radioactive source characterization

- Numerical simulation applied to radiation matter interaction
- Methods to correctly determine the radioactivity measurement efficiencies

#### Characterization of radioactive sources with concentration measurements

- Mass spectroscopy analysis
- Neutron activation analysis

- X ray fluorescence

Application of radioactivity measurement techniques

- Cultural Heritage applications
- Studies on neutron sources from nuclear reactors and accelerators

## **Prerequisites**

Basic knowledge of the three-year degree in physics

## **Teaching form**

Lectures.

Some seminars on specific arguments will be organized as parts of the course program.

Some guided tours to radioactivity measurement laboratories will be organized.

Seminars will be in some cases organized remotely with the support of a videoconference connection.

## **Textbook and teaching resource**

Kenneth S. Krane - Introductory Nuclear Physics, ed. John Wiley & Sons Inc

Merril Eisenbud - Environmental Radioactivity, ed. Academic Press

Glenn Knoll - Radiation detection and measurement, ed. John Wiley & Sons Inc

<http://nucleardata.nuclear.lu.se/toi/>

<http://atom.kaeri.re.kr/>

## **Semester**

Second semester

## **Assessment method**

Oral examination - No intermediate evaluation will be organized

- Discussion on argument presented during the course
- Analysis on some radioactivity aspects

- Description of possible instrumental approaches to radioactivity measurements

## **Office hours**

Monday - Friday by appointment

## **Sustainable Development Goals**

GOOD HEALTH AND WELL-BEING | INDUSTRY, INNOVATION AND INFRASTRUCTURE

---