UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Elements of Experimental Methods

2526-1-ESM02Q023-ESM02Q02301

Aims

General Objectives.
The main goal of the course is to learn methodologies for performing physics experiments, evaluating the precision and accuracy of measurements, and processing the obtained data.

Knowledge and Understanding.
By the end of the course, the student is expected to know the fundamentals of statistical analysis of experimental data.

Applying Knowledge and Understanding.
Upon completing the course, the student will be able to:
(i) use basic statistical tools for processing experimental data;
(ii) conduct simple physics lab experiments and identify the sources of precision and accuracy in data collection, as well as the best experimental strategies to improve these parameters;
(iii) develop a better understanding of the concept of statistical distribution.

Independent Judgment.
The student should be able to choose the appropriate method for data analysis based on the type of raw experimental data.

Learning Skills.
The student should be capable of systematically handling experimental data, correctly using significant figures, and graphically representing the data. These tools will serve as a foundation for all experimental data analysis in subsequent experimental courses.

Communication Skills.
At the end of the course, the student should be able to present the covered topics using appropriate and precise language.

Contents

The first part of the course is based on lectures on statistics: Analysis of experimental data, random and systematic errors, Distributions, Probability and confidence. The second part of the course is carried out in laboratory, by making basic Physics experiments.

Detailed program

The first part of the course is based on lectures on statistics: Analysis of experimental data, random and systematic errors, Distributions, Probability and confidence.

The second part of the course is carried out in laboratory, by making the following basic physics experiments

1 DENSITY
2 BINOMIAL AND GAUSSIAN DISTRIBUTIONS
3 MOMENT OFDI INERTIA
4 STANDING WAVES
5 ELASTICITY
6 RADIOACTIVE DECAY
7 PENDULUM
8 PROJECTILE MOTION
9 FORCED AND DAMPED HARMONIC OSCILLATOR
10 POISSON DISTRIBUTION

Prerequisites

Basic knowledge of calculus, algebra, geometry, and analytical geometry and of classical physics are required, as commonly taught in high school.

Teaching form

Lessons and activity in laboratory, in groups of three/four students each, managing experimental activities varying every day of presence. Lessons will be held in Italian.

32 hours of in-person lectures
40 hours of in-person laboratory (10 sessions of 4 hours)

Textbook and teaching resource

J.R. Taylor, *Introduzione all'analisi degli errori*, ed. Zanichelli

Laboratory notes (e-learning page of the course)

Semester

Lessons: September - December 2024

Laboratory activities: February - April 2025

Assessment method

The student will acquire credits by 1) attending the Physics Laboratory I,2) writing laboratory reports and 3) passing an oral exam. The oral exam will focus on the content of the lectures and the experiences carried out in the laboratory.

Office hours

On request contacting the teacher: roberto.lorenzi@unimib.it

Sustainable Development Goals