UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Electronics for Physicists

2526-113R028

Aims

The course is specifically aimed at physicists (experimental, analytical, and theoretical), providing the fundamental knowledge necessary for the design and analysis of hardware in complex scientific experiments. The main objective is focused on the practical implementation of an experiment, concentrating on high-precision acquisition electronics.

- Optimizing the Signal-to-Noise Ratio (SNR) of an experiment: understanding and optimizing critical electronic amplifiers. The emphasis is on maximizing the signal-to-noise ratio, which is fundamental to the effectiveness of any detector-based experiment.
- Management of Extreme Environments: Cutting-edge experiments (such as those studying neutrinos and high-energy physics) operate in extreme environments that require dedicated technological and design requirements, including performance under very low operating temperatures and high particle fluence (radiation resistance).
- Design of Stable Systems: Basic information will be provided to ensure the stability and low drift of amplification systems, which are essential for the reliability and accuracy of data collected over the long term.

In summary, the course provides the basis for critically understanding experimental requirements in terms of concrete hardware specifications concerning electronic instrumentation (in particular low-noise amplification) necessary for advanced physics experiments and critical scientific instrumentation.

Contents

Subjects of the 16 hours of lecturers:

1. A physical/mathematical approach to the fed-backed amplifiers and their strategic importance;
2. The fed-backed amplifiers characteristics from the physical/mathematical method;

3. Frequency behavior of fed-backed amplifiers and the importance of stability;
4. Amplifiers and noise;
5. A heuristic introduction to transistors in view of their employment with low noise amplifiers;
6. Amplification of detector signals and optimization of their signal to noise ratio with emphasis on low frequency noise and low drift, jitter and radiation hardness.

Detailed program

Prerequisites

The course is for physicists. No prior knowledge of the subject is required. The prerequisites for attending the seminars are knowledge of the basic properties of the electromagnetic field and the Fourier transform.

Teaching form

2 CFU, 16 hours.

Textbook and teaching resource

Bibliographic references are indicated in the slides, which are available in advance.
A list will be published in this section well in advance.

Semester

Second semester.
The period under consideration for the seminars will be late spring/early summer.
The exact period will depend on your needs and will be decided based on the information you provide.

Assessment method

A brief qualitative interview on one of the topics covered that you will select.

Office hours

Always by appointment requested by email.

Sustainable Development Goals

QUALITY EDUCATION