Program of "**Elaborazione dei dati e delle informazioni di misura"**

(Processing of Measurement Data and Information)

- Code: I0025.
- Compulsory.
- 2nd cycle in Electronic Engineering, 2nd year, 2nd semester.

Number of ECTS credits: 9 (Lecture activity is around 90 hours, workload 225 hours; 1 credit = 25 hours).
Course Structure Lecture: 8 hour per week, including laboratory activities.

Teacher: Giovanni BUCCI

1	**Course objectives**	Digital approach is widely applied in modern instrumentation for processing measurement signals to extract some specific piece of information. Software-based instruments are currently being customized for different specific applications. The goal of this course is to provide the measurement and working principles adopted in modern instrumentation to process measurement signals. Upon successful completion of this module, the student should be able to understand the fundamental concepts of signal processing techniques applied in the measurement field and should be aware of potential applications of software-based electronic instrumentation in a large spectrum of applications in different engineering fields. The activities are both theoretical and practical.
2	**Course content and Learning outcomes**	Topics of the module include: Instruments and techniques for digital signal measurement in both time and frequency domains. Use of the DFT/FFT algorithms using windowing and interpolation techniques for leakage reduction and accuracy improvement. Interpolations in both time domain and frequency domain. Digital filter design. Architecture of oversampling and sigma-delta A/D converters. Architecture of digital signal generators (DDS and arbitrary). Metrological characterization of data acquisition systems and A/Ds. Introduction to the use of PC, microcontroller and DSP in advanced instrumentation and process monitoring. On successful completion of this module, the student should: • be able to choose measurement methods and signal treatment relevant for many parts of science and technology; • develop methods to estimate parameters from signal sequences and frequency spectra; • demonstrate capacity for defining and selecting appropriate strategies to solve problems using digital signal processing applied to a measured signal as the subject; • have profound knowledge in signal processing suitable for different measurement applications such as sensor technology, industrial process monitoring; • have knowledge and understanding of working principle of advanced digital instrumentation, such as virtual instruments, FFT analyzers, DDS and arbitrary signal generators, measurement system with embedded processing; • be able to read instrument specifications with a critical attitude, and hopefully become a sophisticated user of modern measurement systems; • simulate measurement methods and algorithms in Matlab; • demonstrate capacity to communicate the results of technical works in a clear and coherent way, with the generation of systematic and meaningful documentation for any designed and assembled measurement system; The course will be supplemented with a series of dedicated practical activities, to underpin the theoretical aspects. Some data processing tools (e.g. Matlab, LabView) are applied to implement and test measurement algorithms. Dedicated PC-based commercial data acquisitions systems will allow students acquire real data for experimental applications. Some projects devoted to the design and development of software for data acquisition systems and real time processing of measurement signals will be carried out in the lab.

3	**Prerequisites and learning activities**	The student needs to know the basic notions of electronics, signal processing, electronic measurements, data acquisition systems, A/D converters and informatics.
4	**Teaching methods and language**	Lectures and experimental activities. Language: Italian. Ref. Text books: Lesson notes in Italian or English will be published on the course homepage. Books recommended for better improvements: V. Oppenheim, Ronald W. Schafer, Discrete-time Signal Processing, Prentice Hall. R.A.Witte, Spectrum and Network Measurements, Prentice Hall. S.Qian, D.Chen, Joint Time-Frequency Analysis: Method and Application, PTR Prentice Hall.
5	**Assessment methods and criteria**	A lab project is assigned to enforce the students to achieve the intended learning outcomes. The exam will consist in a discussion on any three topics from the course, proposed by the teacher during the examination, including discussion on the experimental activities.